COSEWIC
Assessment and Status Report

on the

White Prairie Gentian
Gentiana alba

in Canada

ENDANGERED
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC
Assessment Summary

Assessment Summary – November 2010

Common name
White Prairie Gentian

Scientific name
Gentiana alba

Status
Endangered

Reason for designation
This showy perennial exists in Canada as a single small population within a remnant oak savannah habitat in southwestern Ontario. The small population size and impacts from potential threats such as increased shading, trampling, and genetic contamination through hybridization with a common native species of gentian, places the species at ongoing risk.

Occurrence
Ontario

Status history
Designated Endangered in April 1991. Status re-examined and confirmed in May 2001 and November 2010.

COSEWIC
Executive Summary

White Prairie Gentian
Gentiana alba

Wildlife species description and significance

White Prairie Gentian (*Gentiana alba*) is a perennial plant that grows up to 1 m tall, with a long, thick taproot and a stout, smooth unbranched stem. Its growth form tends to be somewhat sprawling. Leaves are pale yellowish or olive green, broadly lance-shaped to egg-shaped with a somewhat heart-shaped base, opposite except just beneath the flowers, where they are whorled. Flowers appear in the axils of the leaves, but are clustered towards the apex of the stem. The flowers are white, greenish-white or pale creamy-white, tube-shaped or spindle-shaped with closed mouths. The fruits are oval to egg-shaped capsules.

The genus *Gentiana* is named after Gentius, King of Illyria (ancient name for Greece) who, around 500 B.C., found the roots of the European Yellow Gentian (*Gentiana lutea*) to have a healing effect on his malaria-stricken troops. The root of White Prairie Gentian has been used by North American natives as a medicinal tea. The species is also sold widely as a garden plant but is not known to spread from cultivation in Ontario.

Distribution

The species is native to eastern North America. Its range extends from Pennsylvania, Ohio, southern Ontario, southern Michigan, Wisconsin and Minnesota in the north through Iowa, eastern Nebraska, Kansas and Oklahoma in the west to Arkansas, Kentucky, and West Virginia in the south. In Canada, White Prairie Gentian occurs only at Walpole Island First Nation (WIFN). Historically it was known from collections from Amherstburg, Essex County and from Healey Falls, Northumberland County.

Habitat

White Prairie Gentian is usually a prairie species, but it also grows in a variety of other habitats including open woodlands, savannahs, glades and even roadsides. It can tolerate a fairly wide range of moisture regimes, but seems to prefer drier sites with an abundance of light. On WIFN, it grows in partially shaded oak savannah. Periodic fire is essential to maintaining open savannah conditions.

Biology

The species is a perennial herb that reproduces by seed. Plants may produce one to several stems in a growing season, although it is possible for a plant not to produce any stems in a given year. Most plants flower only when they are taller than about 20 cm. Flowering begins in mid-August and continues through September. Capsules ripen in October. Seeds germinate readily after cold stratification for about three months.

The flowers are almost always pollinated by bumble bees. Few other insect species are strong enough to push open the closed mouth and enter the flower. White Prairie Gentian hybridizes readily with both Fringed-top Bottle Gentian (*G. andrewsii*) and Downy Gentian (*G. puberulenta*).

Population sizes and trends

There is one population of White Prairie Gentian at WIFN, with the plants distributed in three distinct stands or subpopulations. One stand consists of a single individual that produced two stems in 2008, but that has not flowered since 2003. A second stand contains 3-5 individual plants that do not all appear above ground every year. The largest stand consists of 95 flowering stems on an estimated 38 plants. There were 30 plants counted in 1986 when the stand was first discovered, 41 plants and 97 flowering stems in 2000 and 141, 125 and 95 flowering stems counted in 2003, 2006 and 2008 respectively. The appearance and vigour of the stems likely depend on such factors as moisture and the occurrence and timing of fire, but this has not been assessed.

Threats and limiting factors

The greatest limiting factor for White Prairie Gentian in Canada is probably the extremely small population size, which could be reduced or eliminated by stochastic events. Destruction of the habitat for dam building and quarrying probably destroyed the historic populations at Healey Falls and Amherstburg respectively.

At WIFN, the amount of natural habitat has been reduced by conversion to agriculture, housing and other land uses. One stand is adjacent to a cemetery. Direct trampling, especially from ATV traffic may also be a threat. Periodic fire is necessary to maintain the savannah habitat in which White Prairie Gentian grows at WIFN. Fire frequency is decreasing as more houses are built on prairie and savannah habitat. Late spring fires or fall fires would likely be detrimental to the plants themselves.

Hybridization with Fringed-top Bottle Gentian has been noted at WIFN. The extent of hybridization and introgression is not known, but is likely a threat to White Prairie Gentian. Seed herbivory occurs, but the extent of its effects on the population is not known.

Protection, status, and ranks

White Prairie Gentian has a NatureServe Global Rank of G4 (apparently secure) and a U.S. Rank of NNR (not ranked). In Canada, it has a national rank of N1 (critically imperilled) and it is listed as Endangered under Schedule 1 of the federal *Species at Risk Act*. In Ontario, it is ranked S1 (critically imperilled) and listed as Endangered under the provincial *Endangered Species Act, 2007*.

TECHNICAL SUMMARY

Gentiana alba
White Prairie Gentian Gentiane blanche
Range of occurrence in Canada (province/territory/ocean) : Ontario

Demographic Information

Generation time Plants can survive at least 15 years under cultivation.	Unknown Estimated about 5 yrs
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations	Stable
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations].	Stable
Projected or suspected percent reduction 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 years or 3 generations period, over a time period including both the past and the future.	Stable
Are the causes of the decline clearly reversible and understood and ceased?	N/A
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence Actual value based on a convex polygon drawn around the extant populations is 0.35 km² but EO is set equal to IAO as per COSEWIC convention when EO is < IAO.	Maximum of 8 km²
Index of area of occupancy (IAO) Actual area of habitat is 4100 m^2.	8 km² using 2x2 grid
Is the total population severely fragmented? There is only a single population with three subpopulations at WIFN.	N/A
Number of “locations”. Potentially each of the three subpopulations may be considered to represent separate locations, based on threats; however, succession resulting in shading represents a general and perhaps overriding threat impacting the entire population.	1
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	No
Is there an observed, inferred, or projected continuing decline in index of area of occupancy? One stand with one individual is severely threatened by shading and is likely not sustainable.	Yes
Is there an observed, inferred, or projected continuing decline in number of populations?	No
Is there an observed, inferred, or projected continuing decline in number of locations?	No
Is there an observed, inferred or projected continuing decline in extent and/or quality of habitat? Savannah habitat continues to decline through conversion to other land uses. Habitat quality is declining as a result of lack of fire.	Yes in quality and extent
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations (as per definition, in terms of threat)?	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
WIFN population had 99 stems on an estimated 42 individuals in 2008.	42
Total	42

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not done

Threats (actual or imminent, to populations or habitats)

The overall greatest threats are successional changes causing shading of plants due to the lack of adequate fire frequency, stochastic events impacting the small population, and hybridization with another native gentian.

Rescue Effect (immigration from an outside source)

Status of outside population(s)? U.S.: **Adjacent states - Michigan S1, Ohio S2, Pennsylvania SH)**	
Is immigration known or possible?	Unknown
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Very unlikely

Current Status

COSEWIC: Endangered (November 2010)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	B1ab(iii)+2ab(iii), D1

Reasons for Designation:

This showy perennial exists in Canada as a single small population within a remnant oak savannah habitat in southwestern Ontario. The small population size and impacts from potential threats such as increased shading, trampling, and genetic contamination through hybridization with a common native species of gentian, places the species at ongoing risk.

Applicability of Criteria

Criterion A (Declining Total Population): Not applicable. Population is small but appears to be stable.
Criterion B (Small Distribution, and Decline or Fluctuation): Meets Endangered B1ab(iii)+2ab(iii) with EO and IAO within criterion limits and with a single location (or possibly a maximum of three) where habitat quality continues to decline.
Criterion C (Small Total Population Size and Decline): Not applicable. Small population size but population appears to be stable.
Criterion D (Very Small Population or Restricted Distribution): Meets Endangered D1 with a population size < 250 mature individuals.
Criterion E (Quantitative Analysis): None available.

PREFACE

The single population consisting of three small subpopulations on Walpole Island First Nation lands has remained roughly stable in terms of number of plants. Area and quality of habitat, however, continue to decline.

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.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune
Canada

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

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Gentiana alba

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TABLE OF CONTENTS

List of Figures

List of Tables

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

Scientific Name:	*Gentiana alba* Muhl. ex Nuttall
Synonyms:	
	Gentiana flavida A. Gray, A. Jour. Sci. II.1: 80 1846.
	Dasystephana flavida (A. Gray) in Britton & Brown, Ill. Fl. ed. 2. 3:12. 1913.
	Gentiana ochroleuca sensu auctt., non Froel. Gent. 35. 1796.
	Pneumonanthe flavida (A.Gray) Greene, Leaflet. Obs. & Crit. 1: 71. 1904.
Common Names:	White Prairie Gentian, Gentiane blanche (French), Cream Gentian, Plain Gentian, Yellow Gentian, Pale Gentian, White Gentian, bemîte'obagûk [greasy weed] (Potawatomi).
Family Name:	Gentianaceae (Gentian Family)
Major Plant Group:	Eudicot flowering plant

There has been considerable confusion over the scientific name of *Gentiana alba*. Asa Gray named the species *G. flavida* without realizing that *G. alba* was the same species (Pringle 1967). Although Wilbur (1989) suggested that the correct name was *Gentiana flavida* and this has been used by some Canadian authorities (e.g., Morton and Venn, 1990, Newmaster *et al*. 1998) as well as by Fernald (1950) and Gleason and Cronquist (1991), *Gentiana alba* Muhl. ex Nutt. is now the accepted name (ITIS 2008).

Morphological description

Gentiana alba is a perennial plant growing up to 1 m tall, with a long, thick taproot and a stout, smooth unbranched stem. The growth form tends to be somewhat sprawling, with the plants often leaning on adjacent vegetation. Leaves are rather pale yellowish or olive green, broadly lance-shaped to egg-shaped with a somewhat heart-shaped base, about 5-8 cm broad, opposite in arrangement except just beneath the flowers, where they are whorled. There is a prominent central vein and two side veins parallel to the smooth margins.

Flowers appear in the axils of the leaves, but are clustered towards the apex of the stem. The flowers are white, greenish-white or pale creamy-white, tube-shaped or spindle-shaped with closed mouths, and about 4 cm long with 5 petal lobes (Figure 1). Flowering starts in mid- to late August and continues through September. The seed capsules are oval to egg-shaped and split into 2 sections, releasing numerous tiny seeds.

Figure 1. *Gentiana alba* at WIFN showing the growth form and details of the inflorescence (photo by Jane M. Bowles).

Gentiana alba is the only whitish-flowered gentian in southern Ontario except for rare albino forms of other species. Albino forms of *Gentiana andrewsii* (Bottle Gentian) have rough to slightly serrated leaf edges and the lobes of the sepals are ciliate along the edges. In *G. andrewsii*, fringed lobes (called plicae) between the petal lobes are longer than the petal lobes. In *G. alba*, the petal lobes are longer than the plicae. *Gentian rubicaulis* (Great Lakes Gentian) has creamy-white flowers suffused with blue near the tips and edges of the petals. The calyx lobes (sepals) in *G. alba* have a strong mid-rib keel, which is absent in *G. rubricaulus*. *Gentiana rubricaulis* is generally a more northern species; the ranges of *G. alba* and *G. rubricaulis* do not overlap in Ontario.

Population spatial structure and variability

Yuan *et al.* (1996) report that the ancestral chromosome number for the Section *Pneumonanthe* of *Gentiana,* to which *G. alba* belongs, is 2n=26, but *G. alba* was not included in their study of *Gentiana* DNA sequences. There are no chromosome counts for *G. alba* .

Hybrids between *G. andrewsii* and *G. alba*, designated *G.* x *pallidocyanea* Pringle, were described by Pringle (1965a). Hybrids between *G. alba* and the morphologically dissimilar G*. puberula* are named *G.* x *curtisii* Pringle (Pringle 1965a). In some areas, hybrid swarms exhibiting a range of variation between the two parents have been found (Pringle 1967, 1971). In Canada, a few plants with pale blue flowers occur amongst the population of creamy-white-flowered plants of *G. alba* and are presumed to be hybrids with *G. andrewsii*, which also occurs in the area. Although leaf samples for genetic analysis have been collected from both parents and the hybrids, no analysis has yet been done on this material.

Designatable units

Designatable units do not apply because no infraspecific taxa are recognized, only a single population is known, and the species occurs within a very restricted geographical area in the Great Lakes Plains Ecological Area recognized by COSEWIC.

Special significance

The genus *Gentiana* is named after Gentius, King of Illyria (ancient name for Greece), who, around 500 B.C., found the roots of Yellow Gentian (*Gentiana lutea*) to have a healing effect on his malaria-stricken troops. Gentianae Radix is a bitter extract of the dried root of this European gentian (Gentian Research Network 2009). It has been used as an appetite stimulant and to flavour many alcoholic beverages. Other members of the genus have been widely used as medicinal herbs, as well as for horticulture, art, decoration, perfume, and inspiration. Gentians are also popular on postage stamps worldwide.

Gentiana alba plants and seed are widely available in the horticultural trade, but the sprawling habit does not make it ideal as an ornamental species.

According to Smith (1933), the root of *Gentiana alba* is used as a medicinal tea by the Potawatomi.

DISTRIBUTION

Global range

Gentiana alba is native to eastern North America. Its range extends from Pennsylvania, Ohio, southern Ontario, southern Michigan, Wisconsin and Minnesota in the north through Iowa, eastern Nebraska, Kansas and Oklahoma in the west to Arkansas, Kentucky, and West Virginia in the south (Figure 2).

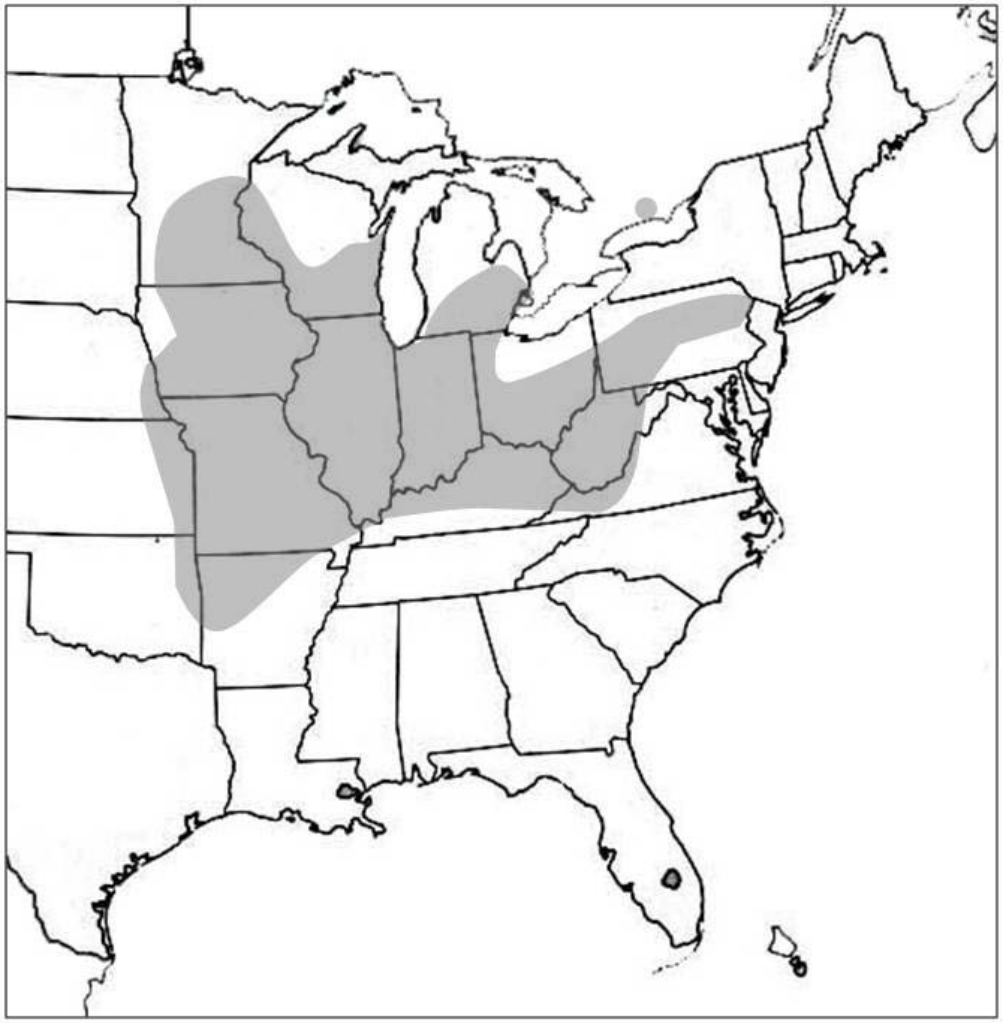

Figure 2. Global historic range of *Gentiana alba* based on Pringle (1967).

Pringle (1963) suggested that *G. alba* originally had a centre of distribution west of the Mississippi River, and that it spread east with the expansion of prairie vegetation during the post-Wisconsin xerothermic period. He proposed that the eastern populations are relicts of this expansion in range.

Canadian range

Gentiana alba presently occurs in Canada (Figure 3) only at Walpole Island First Nation (WIFN). Before it was discovered there in 1984, it was only known in Canada from a collection by P.W. Maclagan in 1840 from Amherstburg and from a collection by John Macoun made in 1891 at Healey Falls (Rupert, *et al*. 1987). It is thought to be extirpated from both of these locations, although P. Catling, in a personal communication to G. Waldron (COSEWIC 2001), suggested that it might still occur at Healey Falls where suitable habitat still exists.

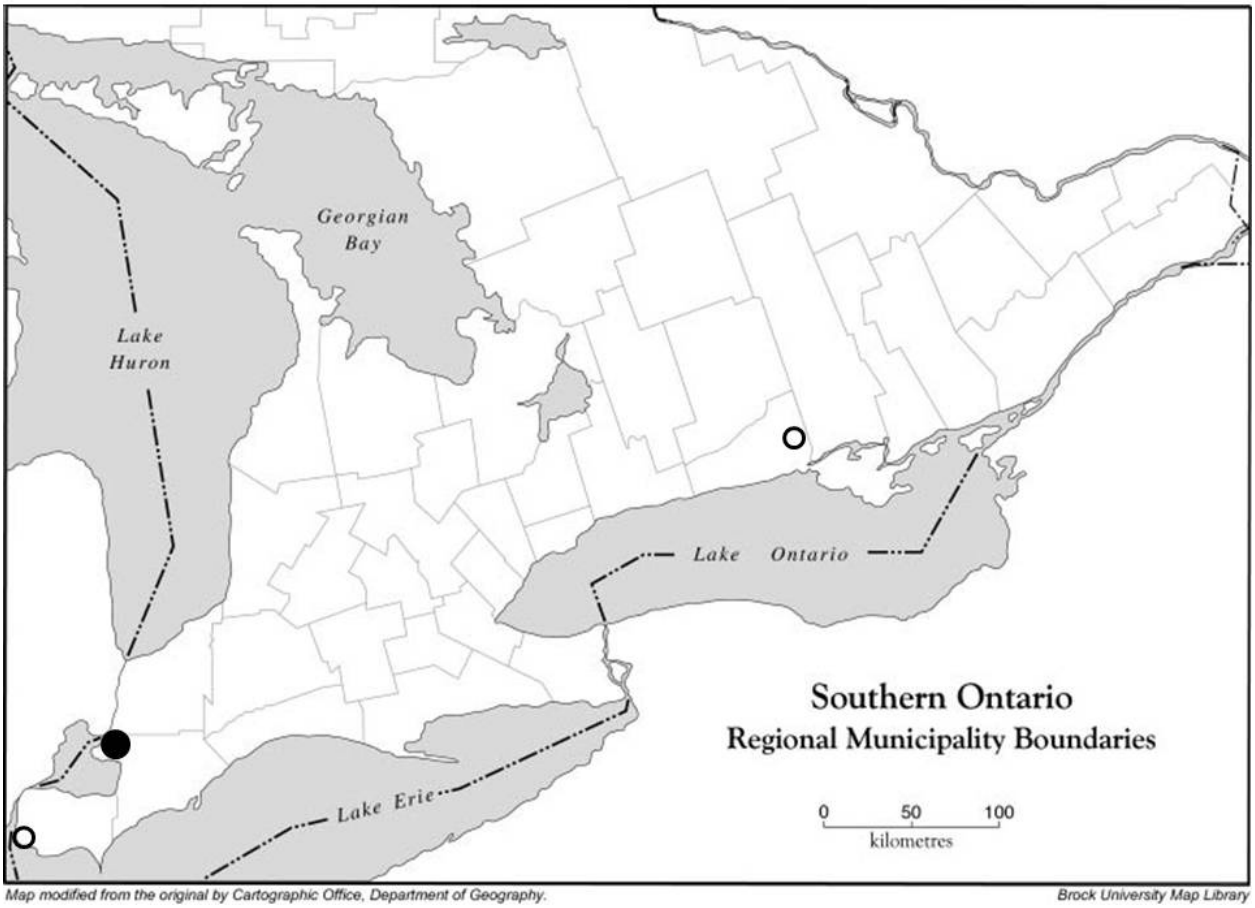

Figure 3. Current and historic range of *Gentiana alba* in Ontario.[● = extant occurrence, ○ = historic occurrences].

The extent of occurrence (EO) based on the area of a convex polygon drawn around all known occurrences is approximately 35.3 ha (0.35 km^2). Based on COSEWIC convention when the EO is actually less than the index of area of occupancy (IAO), the EO is made equivalent to the IAO. The IAO for the Canadian population is 3 km^2 based on the number of 1 x 1 km UTM grid squares occupied and 8 km^2 based on 2 x 2 km^2 squares. The actual patches of habitat occupied total about 4,100 m^2.

Search effort

The prairies of Walpole Island have been well surveyed (Woodliffe and Allen, 1996) and all populations of *Gentiana alba* are probably known. On the other hand, the plant is easily overlooked when not in flower and growing amongst taller vegetation. It is possible, albeit highly unlikely, that some populations have been missed, both at WIFN and at other sites, although suitable habitat is extremely rare in Ontario.

The WIFN population has been monitored by the Walpole Island Heritage Centre since 2003. Censuses were carried out in 2003, 2006 and 2008 and consisted of walking back and forth across the site and recording the GPS waypoints of plants and the number of individuals at each GPS waypoint. Most of these censuses have been carried out by J.M. Bowles and C.R. Jacobs with the assistance of summer staff of the Walpole Island Heritage Centre (WIHC). In 2008, Bowles and Jacobs spent about 3 hours (total about 6 person hours) on census and mapping of the populations.

The site at Healey Falls in Northumberland County has been searched by several botanists including Paul Catling, Wasyl Bakowsky and Michael Oldham (Oldham, pers. comm. 2008).

HABITAT

Habitat requirements

Gentiana alba is usually a prairie species (Pringle 1965; Wood and Weaver 1982), but it also grows in a variety of other habitats including open woodlands, savannahs, glades and even roadsides (Gleason and Cronquist 1991; Heikens,2002). It can tolerate a fairly wide range of moisture regimes, but seems to prefer drier sites with an abundance of light.

On WIFN, *Gentiana alba* grows in partially shaded oak savannah, with widely spaced trees that include Black Oak (*Quercus velutina*), Pin Oak (*Q. palustris*), White Oak (*Q. alba*), Swamp White Oak (*Q. bicolor*) and Bitternut and Shagbark Hickories (*Carya cordiformis, C. ovata*). Shrubs include Staghorn Sumac (*Rhus typhina*), Black Raspberry (*Rubus occidentalis*), Riverbank Grape (*Vitis riparia*) and New Jersey Tea (*Ceanothus americanus*). Common ground layer associates include Big Bluestem (*Andropogon gerardii*), Switch Grass (*Panicum virgatum*) Little Bluestem (*Schizachyrium scoparium*), Cordgrass (*Spartina pectinata*), Indian Grass (*Sorghastrum nutans*), Giant Sunflower (*Helianthus giganteus*), Pale-leaved Sunflower (*H. strumosus*), Golden Alexanders (*Zizia aurea*) and Culver's Root (*Veronicastrum virginicum*). Periodic fire is probably an essential factor for maintaining open savannah.

Habitat trends

Tallgrass prairie and oak savannah habitats are critically imperilled in Ontario (Bakowsky, 1995). Most savannahs at Walpole Island First Nation are in excellent condition, with many areas never having been ploughed and regular burns occur (Bowles, 2005); however, they are declining in both quality and extent. Without fire to suppress tree growth, savannahs can quickly become woodland. This is particularly true on WIFN where the water table is relatively high (Woodliffe and Allen 1996; Woodliffe 2002). In the 25-year period between 1972 and 1998, air photos suggest that prairies at Walpole Island First Nation were reduced from about 730 ha to about 470 ha, a loss of 36% (Crow *et al.* 2003). Some of this was a result of conversion to agriculture and housing, but most was due to encroachment by forest and woodland in the absence of regular fires, and after the grazing influence from herds of wild ponies was removed. Savannahs have been similarly affected, and canopy closure of existing savannahs is generally increasing.

BIOLOGY

Life cycle and reproduction

Gentiana alba is a perennial herb that reproduces by seed. Flowering begins in mid-August and continues through September. Capsules ripen in October. Usually, plants under about 20 cm tall do not flower (Waldron 1991). The rootstock increases in size with older plants, and plants with larger rootstocks may produce several stems. Some plants at WIFN are not seen every year, and it is possible that not every plant produces a shoot every year.

Species of gentian, such as *G. alba* and *G. andrewsii*, which have flowers with closed mouths, are almost always pollinated by bumble bees. Few other insect species are strong enough to push open the closed mouth and enter the flower. Like *G. andrewsii*, although the flower structure of *G. alba* is adapted to cross-pollination, the flowers likely also self-pollinate (Costellloe 1988). *Gentiana alba* is known to hybridize readily with both *G. andrewsii* and *G. puberulenta* (Pringle 1965a). Hybrid swarms may

be produced where the first-generation hybrids are fertile and may cross with another hybrid or backcross to either parent species (Pringle 1965). Plants at WIFN with pale blue flowers are found amongst white-flowered plants. These are presumably hybrids with *G. andrewsii*, a fairly common species at WIFN. *Gentiana andrewsii* is known from the immediate vicinity of *G. alba* at Stand C (Oldham, pers. comm. 2009). Bumble bees are effective pollinators that can fly long distances, and both species flower at the same time. At WIFN, plants with pale blue flowers made up about 20% of the *Gentiana* population in 2006 and 10% in 2008.

Gentiana alba plants and seeds are grown commercially and are available from a wide selection of nurseries and seed outlets. According to Waldron (1991, 2001) and references therein, *Gentiana alba* seeds may be readily germinated after cold stratification for about 3 months. Seedlings may be transplanted a year after germination. In 1989, Waldron (2001) grew plants from WIFN seeds that were out-planted in 1991. One of these plants, growing at the Ojibway Prairie Nature Centre in Windsor, Ontario, survived and had 5 flowering stems in 2000, but it died in about 2006 (Paul Pratt, pers. comm. to J.M. Bowles 2008), suggesting that plants can survive at least 15 years under cultivation. Seeds collected from WIFN in the fall of 2007, planted straight away on the soil surface in pots and left in plastic bags in a cold frame germinated in October 2008. The germination rate was high. The seedlings were kept in a greenhouse at the University of Western Ontario during the winter of 2008-2009 and grew very slowly, the largest rosettes reaching 15 mm diameter by late summer of 2009 (J.M. Bowles, personal observation).

The average age for mature individuals (generation time) is estimated at 5 years.

Herbivory

The effects of herbivory on *Gentiana alba* are unknown. The leaves of gentians are quite bitter and no herbivory of the plants has been observed at WIFN. Waldron (1991) noted insect larvae eating seeds inside ripening capsules.

Dispersal

The tiny winged seeds are released when the capsule splits in two, and are presumably wind-dispersed.

Interspecific interactions

Although bumble bees are the primary pollinators of the flowers, some beetles, such as Blister Beetles (*Epicauta* sp.), and other bees have been known to gnaw on the base of the flowers (Hilty 2008). By doing this, they bypass the closed mouth to reach the nectar, and probably do not pollinate the flowers.

POPULATION SIZES AND TRENDS

Abundance

There is one population of *Gentiana alba* at WIFN, with the plants distributed in three distinct stands (subpopulations). Stands A and B are about 500 m apart and Stand C is about 900 m to the south. Stand A consists of a single individual that produced 2 stems in 2008, but that has not flowered since monitoring began in 2003. Stand B contains 1-3 individual plants that do not all appear every year, with three seen in 2008.

In Stand C, there were ~30 plants in 1986 when the stand was first discovered, 41 plants and 97 flowering stems in 2000 (Waldron, 2001) and 141, 125 and 95 flowering stems counted in 2003, 2006 and 2008 respectively (Table 1). The number of plants was not counted between 2003 and 2008 because of the difficulty in distinguishing one individual from another. Estimates in 2008 based on the number of groups or clumps of stems in a subsample of the largest stand suggest that the average number of stems per plant was about 2.5 that year. This provides an estimate of approximately 38 plants in 2008 for the largest stand and a total of 42 plants at WIFN.

Table 1. Table showing population estimates for White Prairie Gentian in the three Walpole Island First Nation (WIFN) populations from 1989 to 2008.

Site	1986	1989	1997	2000	2003	2006	2008
WIFN: Stand A		0	p = 1	p = 1	p = 1	p = 1	p = 1 s = 2
WIFN: Stand B		p = 1	0	p = 3	p = 1	p = 2 fs = 4	p = 3 fs = 2
WIFN: Stand C	p = 30	p = 18	fs = 41	p = 41 fs = 97	fs = 141	fs = 125	p = 38 fs = 95
ESTIMATED TOTAL	30 plants	19 plants	42 plants	101 stems	143 stems	130 stems	42 plants 99 stems

p = plants, fs = flowering stems, s = non-flowering stems

Fluctuations and trends

Monitoring *Gentiana alba* plants in the two smallest stands (Stands A and B) has demonstrated that not all plants produce shoots every year (C.R. Jacobs pers. obs. 2003-2008). The number of plants in both of these subpopulations is very low, and in some years the plant at Stand A has not been detected.

At the largest stand (Stand C), the number of plants appears to have increased from ~30 plants at the time of discovery in 1986 to 45 plants consisting of 97 flowering stems in 2000 to a high of 141 flowering stems in 2003. Only stems and not number of plants were counted between 2003 and 2008. In 2008, the number of plants was estimated at 38, based on 95 flowering stems. The apparent increase in the number of plants between 1989 and 2000 was likely due to search effort. The appearance

and vigour of the stems may depend on such factors as moisture and the occurrence and timing of fire, but this has not been assessed. The population appears to have been reasonably stable for the last 20 years.

Rescue effect

Natural recolonization of *Gentiana alba* from U.S. populations is extremely unlikely. The nearest population at Teeple Lake, Michigan, is 50 km due west of the WIFN population in a protected natural area (Reznicek, pers. comm. 2010). This population is well beyond the dispersal distance possible even over a period of several generations. The species is also listed as imperilled (S2) in Ohio and critically imperilled (S1) in Michigan, the two states closest to the existing population. Suitable habitat is rare and the intervening habitat (land and water) is unsuitable.

Based on limited experiments on out-planting seedlings and the fact that *Gentiana alba* is widely used as a garden plant, it is possible, or even likely, that introduced plants could survive in Canada, if suitable habitat exists. No escapes from cultivation are known in Ontario.

THREATS AND LIMITING FACTORS

The greatest limiting factor for *Gentiana alba* in Canada is probably the extremely small population, which could be reduced or eliminated by stochastic events.

The two historic populations of *Gentiana alba* not at WIFN have almost certainly been destroyed by anthropogenic disturbance: dam building at Healey Falls and quarrying at Amherstburg (Waldron 1991).

Anthropogenic factors are also important at WIFN. The amount of natural prairie and savannah habitat has been reduced by conversion to agriculture, housing and other land uses. Stand A is adjacent to a cemetery and earthworks from cemetery expansion in 2003 came within about 3 m of the single plant. The rate of conversion of prairie to agriculture has been reduced on WIFN because of an active campaign by the Walpole Island Heritage Centre to lease the land for conservation, but the threat remains, especially on private land.

There is a critical housing shortage at WIFN and houses are continuously built in tallgrass prairie and savannah habitat. Lack of planning was identified as a threat to species at risk in the Draft Walpole Island Ecosystem Recovery Strategy (Bowles, 2005).

Periodic fire is necessary to maintain the savannah habitat in which *Gentiana alba* grows at WIFN. Regular fires still occur at WIFN, but the frequency of fires is decreasing as more houses are built in prairies and savannah habitat. Stand A is becoming increasingly more shaded by large saplings and small trees in the absence of a fire for several years. Late spring fires or fall fires would likely be detrimental to *Gentiana alba* plants themselves.

Direct trampling, especially from ATV traffic may also be a factor. Stand C spans a regularly used trail and some plants were found right on the trail, between tire tracks, in 2003 and 2008.

Hybridization with *G. andrewsii* has been noted at Stand C (Waldron 1991, 2001, Walpole Island Heritage Centre unpublished data). The extent of hybridization and introgression is not known, but is likely a threat to *Gentiana alba*. Leaves from apparently pure forms of both parents and from known hybrids have been collected and dried in silica gel for future genetic analysis. Waldron (1991) suggested that seed herbivory is a threat, but the extent of its effects on the population is not known.

Locations based on threats

The three subpopulations could be considered to represent from 1 to 3 locations based on threats. However, successional changes causing shading may perhaps be considered to be an overriding threat that impacts all three. Stand A, with a single plant, is impacted the most by this factor. Both Stand A and Stand B are highly prone to stochastic events based on their small sizes (1 and 3 plants respectively). Trampling and ATV traffic are also a threat at Stand C.

PROTECTION, STATUS, AND RANKS

Legal protection and status

In Canada, the species is listed as Endangered under Schedule 1 of the federal *Species at Risk Act*, which was passed in 2002 and applies to populations on Federal Land, including Walpole Island First Nation. In Ontario, it is listed as Endangered under the provincial *Endangered Species Act, 2007*. This Act has provided protection for the species since June 2008, but the habitat will not be legally protected until June 2013.

Non-legal status and ranks

Gentiana alba has a Global rank of G4 (apparently secure) and a U.S. rank of NNR (not ranked) (NatureServe 2009). In Canada, it has a national rank of N1 (critically imperilled) and in Ontario, it is ranked S1 (critically imperilled) and is listed as SH (historic) in Pennsylvania and North Carolina, and S1 (critically imperilled) in Michigan, Nebraska, Oklahoma and West Virginia. Other sub-national rankings are listed in Table 2.

Table 2. S-ranks for *Gentiana alba* in the United States (NatureServe, 2009).

S-rank	State
SH	North Carolina, Pennsylvania
S1	Michigan, Nebraska, Oklahoma, West Virginia, Kentucky (S1S2)
S2	Indiana, Kansas, Ohio
S3	Iowa, Wisconsin
SNR	Arkansas, Illinois, Maryland, Minnesota, Missouri,

Habitat protection and ownership

Site C with most plants of *Gentiana alba* on WIFN is on private land held under a Certificate of Possession (under the *Indian Act*). The habitat for Stand B, with 3-5 plants is on private land leased by the Walpole Island Heritage Centre for conservation purposes. Stand A, with a single plant, is also on private land held under a Certificate of Possession. All sites for *Gentiana alba* on WIFN are in or adjacent to areas that have been recognized by the Band Council as Significant Natural Heritage Sites. This status provides recognition, but no formal protection. The Draft Walpole Island Ecosystem Recovery Strategy (Bowles 2005) identifies general threats and actions to protect habitat on WIFN.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Jane M. Bowles received her PhD from the University of Western Ontario in 1980. She has over 25 years of experience as a freelance ecologist in southern Ontario, doing life science inventories, pursuing research in conservation ecology and working with species at risk. She has worked with the Walpole Island Heritage Centre on their species at risk and habitat stewardship programs since 2003. She has been a member of the Vascular Plant Specialist Sub-Committee of COSEWIC since 2002 and a member of COSSARO since 2006. She sits on the recovery teams for Wood-poppy, Lake Huron Dune Grasslands/Pitcher's Thistle, Tallgrass, Carolinian Woodlands and Walpole Island First Nation. She is an Adjunct Professor at the University of Western Ontario where she has also been Curator of the Herbarium and Director of the Sherwood Fox Arboretum since 2005.

Clinton R. Jacobs is Anishnaabe from Walpole Island First Nation – Bkejwanong Territory and has been Natural Heritage Coordinator for Walpole Island Heritage Centre (WIHC) since 1998. He is part of the team of the WIHC's Natural Heritage Program, which includes species at risk and habitat stewardship program. He manages species at risk monitoring, management, outreach and education programs on Walpole Island First Nation (WIFN) as well as the land securement program. He advises and supervises research activities on WIFN in collaboration with various universities. He is familiar with all populations of plant species at risk on Walpole Island and supervises field crews who conduct monitoring and census. He is well recognized in the community and has ongoing regular contact and communication with landholders. He has reviewed and commented on numerous single species recovery strategies. He sits on the Walpole Island Ecosystem Recovery Team.

COLLECTIONS EXAMINED

No herbarium specimens were examined during the preparation of this report.