

Recovery Strategy for the toothcup (*Rotala ramosior*) in British Columbia and Ontario



Prepared by the National Toothcup Recovery Team



Ministry of
Environment

June 2008

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the Province of British Columbia on the general strategic approach required to recover species at risk. The Province prepares recovery strategies to meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more information

To learn more about species at risk recovery in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

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Disclaimer

The British Columbia Ministry of Environment and the Ontario Ministry of Natural Resources led the development of this recovery strategy for toothcup, under the *Accord for the Protection of Species at Risk in Canada*.

This recovery strategy has been prepared as advice to the responsible jurisdictions and the many different constituencies that may be involved in recovering the species. The recovery strategy does not necessarily represent the views of all individuals on the recovery team or the official positions of the organizations with which the individual recovery team members are associated.

The goals, objectives, and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment and the Ontario Ministry of Natural Resources are responsible for producing a recovery strategy for toothcup under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the preparation of this recovery strategy.

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EXECUTIVE SUMMARY

Toothcup (also known as toothcup meadow-foam in British Columbia) (*Rotala ramosior*) was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered in April 1999 based on a status report by Douglas and Oldham (1998). This status was confirmed in 2000. Toothcup is listed as Endangered under Schedule 1 of the federal *Species at Risk Act*. The plant is also listed as Endangered under Ontario's *Endangered Species Act, 2007*.

The designation of this species as Endangered by COSEWIC is primarily based on the low number of populations and low abundance of plants at most sites. There are three extant populations and one likely extirpated population in British Columbia, and four extant populations and one extirpated population in Ontario. The current Canadian population is estimated at 18,258 plants of which 67% occur in south-central British Columbia. The largest viable population occurs in British Columbia on private land that, in 2004, contained approximately 98.5% of plants found in the province. Plants on First Nations land made up an additional 1.5% of the British Columbia population. In Ontario, there is an approximately equal split between plants on public (Crown and provincial park land) versus private lands.

Toothcup is currently Red-listed and ranked S1 (critically imperiled) in British Columbia (B.C. Conservation Data Centre 2007) and is ranked S1 in Ontario (Natural Heritage Information Centre; OMNR 2007). The species is listed as Endangered (Not Regulated) on the Species at Risk in Ontario list, and is a candidate for regulation under the provincial *Endangered Species Act (1971)*.

Toothcup is an annual, obligate wetland plant (an emergent hydrophyte) that is subject to wide fluctuations in numbers based on rainfall and water levels. Biologically limiting factors include restricted habitat availability and specific germination requirements, both resulting from toothcup's affinity for strongly fluctuating water levels.

Threats to toothcup in B.C. include: habitat loss or degradation; changes in ecological dynamics or natural processes (flood regime); invasive species; and cattle browsing, trampling and recreational activities (ATV use) which are potential minor threats. Threats in Ontario include: habitat loss and degradation (conversion to cropland and pastures, development, recreational activities, and shoreline development); changes in ecological dynamics or natural processes (water level fluctuations); and competition with invasive (particularly woody) species.

No critical habitat can be identified for toothcup in Canada at this time, but it may be identified at a later date in a federal addition by Environment Canada, or in a future action plan. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

Recovery actions could potentially affect the following socio-economic sectors: land development along foreshore areas, recreational use of provincial parks, agriculture (irrigation),

and domestic animal grazing. The expected magnitude of these effects is unknown and will be further addressed in the recovery action plan.

The recovery goal for Toothcup is to protect and maintain the four extant populations in Ontario and the three extant populations in B.C., and to restore the species at historic sites if deemed necessary.

This recovery strategy identifies management actions required to protect and maintain toothcup populations and habitat, and requirements for implementation. The objectives of the recovery strategy are to:

1. Ensure the persistence of the species at all known extant sites, with no loss or degradation of currently occupied habitat, for the next five years.
2. Assess the extent of the three main threats to the seven populations (habitat loss or degradation, flood regime, and invasive species, flood regime) by 2012.
3. Confirm the distribution of Toothcup in Ontario and British Columbia (historic and new locations), and update population and distribution objectives as needed by 2012.
4. Investigate the feasibility of restoring populations at extirpated sites or in suitable habitat near historical areas by 2012.

The general approaches that will be taken to address identified threats are:

- habitat protection
- public outreach and stewardship
- inventory and monitoring
- habitat management
- habitat restoration/rehabilitation
- scientific research

In British Columbia, a multi-species action plan will be completed by 2012 for four sand spit species (and others), including toothcup, small-flowered lipocarpha (*Lipocarpha micrantha*), short-rayed alkali aster (*Symphyotrichum frondosum*), and scarlet ammannia (*Ammannia robusta*). An action plan for Ontario sites will also be completed by 2013.

TABLE OF CONTENTS

RECOVERY TEAM MEMBERS.....	iii
AUTHORS.....	iii
RESPONSIBLE JURISDICTIONS	iii
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	v
BACKGROUND	1
Species Assessment Information from COSEWIC.....	1
Description of the Species.....	1
Population Distribution and Abundance	1
Population distribution.....	1
Population abundance.....	7
Needs of the toothcup.....	9
Habitat and biological needs	9
Limiting factors	10
Threats.....	10
British Columbia	11
Ontario.....	11
Actions Already Completed or Underway.....	12
Knowledge Gaps	12
Inventory and Monitoring Requirements	12
Biological / Ecological Research Requirements.....	12
Threat Clarification Research Requirements	13
RECOVERY	13
Recovery Feasibility.....	13
Recovery Goal	14
Population and Distribution Objectives.....	14
Recovery Objectives.....	14
Approaches Recommended to Meet Recovery Objectives.....	14
Recovery planning table.....	15
Performance Measures	17
Critical Habitat.....	17
Identification of the species' critical habitat	17
Recommended schedule of studies to identify critical habitat	17
Existing and Recommended Approaches to Habitat Protection.....	18
Effects on Other Species	19
Socioeconomic Considerations	20
Recommended Approach for Recovery Implementation.....	20
Statement on Action Plans	20
REFERENCES.....	21

LIST OF TABLES

Table 1. Conservation status of Toothcup at the subnational level.....	2
Table 2. Population sizes at sites surveyed for toothcup, <i>Rotala ramosior</i> , in British Columbia.....	7
Table 3. Population sizes of toothcup, <i>Rotala ramosior</i> , in Ontario.....	8
Table 4. Biological and technical recovery feasibility.....	13
Table 5. Recovery planning table.	15

LIST OF FIGURES

Figure 1. Distribution of toothcup, <i>Rotala ramosior</i> , in North America	4
Figure 2. British Columbia distribution of toothcup, <i>Rotala ramosior</i>	5
Figure 3. Ontario distribution of toothcup, <i>Rotala ramosior</i>	6

BACKGROUND

Species Assessment Information from COSEWIC

Common Name: toothcup

Scientific Name: *Rotala ramosior*

Status: Endangered

Last Examination and Change: May 2000 (No change)

Canadian Occurrence: British Columbia, Ontario

Reason for designation: An annual plant present at very few remaining sites. It has limited occurrence across habitat and shows population fluctuations. It is subject to continued threats from habitat development and elevated water levels.

Status history: Designated Endangered in April 1999. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report.

Description of the Species

Toothcup (also known as toothcup meadow-foam in British Columbia) is an annual plant that grows up to 40 cm tall. Generally green, most Ontario and British Columbia populations have a reddish tinge in the late summer. Leaves are 1–5 cm long, oblong in shape, and positioned in opposite pairs. Small flowers occur individually along the stem, at the junction of a leaf. Petals are pinkish-white, and the fruits develop into 3 mm long, roundish seed capsules that become green (or cranberry red). Hundreds of seeds are typically produced by an individual plant.

Population Distribution and Abundance

Population distribution

Each known toothcup population is referred to as a “site,” and each site may contain several separate groups, or sub-populations. A distinct site (or population) is one that is separated by 1 km or more from the next nearest site (NatureServe 2008).

Global range

Globally, toothcup ranges from south-central British Columbia and southeastern Ontario, south throughout most of the United States (where it is documented in reports from 42 states, the exception being some Midwestern states; NatureServe 2008; see Table 1 for an overview of toothcup’s conservation status in North America). Figure 1 shows the North American range for toothcup (from Oldham and Sutherland 1987). Toothcup’s range also extends from the southern United States into Mexico and to South America. It has also naturalized in the Philippines and in northern Italy.

Toothcup is considered a disjunct species in the Great Lakes region. The populations in British Columbia and Ontario likely represent post-glacial remnants of this rare vegetation type.

Table 1. Conservation status of Toothcup at the subnational level (from NatureServe 2008).

Country	Province or State	NatureServe rank code	NatureServe rank
Canada	British Columbia	S1	Critically Imperiled
	Ontario	S1	Critically Imperiled
US	Alabama	SNR	Unranked
	Arizona	S1	Critically Imperiled
	California	SNR	Unranked
	Colorado	S1	Critically Imperiled
	Connecticut	S1S2	Critically Imperiled/Imperiled
	Delaware	S3	Vulnerable
	District of Columbia	SNR	Unranked
	Florida	SNR	Unranked
	Georgia	SNR	Unranked
	Idaho	SNR	Unranked
	Illinois	SNR	Unranked
	Iowa	S3	Vulnerable
	Kansas	SNR	Unranked
	Kentucky	S4	Apparently Secure
	Louisiana	SNR	Unranked
	Maryland	S4S5	Apparently Secure/Secure
	Massachusetts	S1	Critically Imperiled
	Michigan	S3	Vulnerable
	Minnesota	S2	Imperiled
	Mississippi	S5	Secure
	Missouri	SNR	Unranked
	Montana	S1	Critically Imperiled
	Nevada	SNR	Unranked
	Nebraska	S3?	Vulnerable(?)
	New Hampshire	SH	Possibly Extirpated (Historical)
	New Jersey	S3	Vulnerable
	New York	S2	Imperiled
	North Carolina	S5	Secure
	Ohio	SNR	Unranked
	Oklahoma	SNR	Unranked
	Oregon	S2	Imperiled
	Pennsylvania	S3	Vulnerable
	Rhode Island	S1	Critically Imperiled
	South Carolina	SNR	Unranked
	South Dakota	SNR	Unranked
	Tennessee	SNR	Unranked
	Texas	SNR	Unranked
	Virginia	S5	Secure
	Washington	S1	Critically Imperiled
	West Virginia	S3	Vulnerable
	Wisconsin	SNR	Unranked

Canadian range

In British Columbia, toothcup has been reported at four sites, one of which is likely extirpated (Figure 2 and Table 2). The Mica Spit site, on Osoyoos Lake, contains one extant sub-population; habitat of two other sub-populations has been destroyed. A second extant site exists at Osoyoos, on private land. Toothcup was discovered in 1981 at McArthur Island, on Kamloops Lake, and was reconfirmed at this site for the first time in 2004. Toothcup was recorded at the Haynes Point Provincial Park site, on Osoyoos Lake in 1953 but has not been seen since, despite regular surveys from 1991 to the present.

In Ontario, toothcup has been reported at five sites in southern Ontario (Figure 3 and Table 3). This species was first discovered in Ontario in 1984 near St. Williams, but has not been seen at that site since 1987; that population is considered extirpated (Douglas and Oldham 1998). Four populations, three of which were discovered in 1994 by V. Brownell (see Brownell *et al.* 1996; Brownell 1997) and one discovered in 2004 by the Ontario Ministry of Natural Resources (OMNR), are considered extant (Figure 3). The two Sheffield Long Lake populations are separated by approximately 930 m, and the Puzzle Lake West population is separated from the Puzzle Lake East population by 910 m. These are regarded as separate sites using the 1 km rule because the distances measured above are straight line distances. True distances upon the lake are close to 1 km. The closest Sheffield Long Lake population is 1.87 km from the closest Puzzle Lake population to the east. All extant populations are found within a distance of 5.2 km from each other.

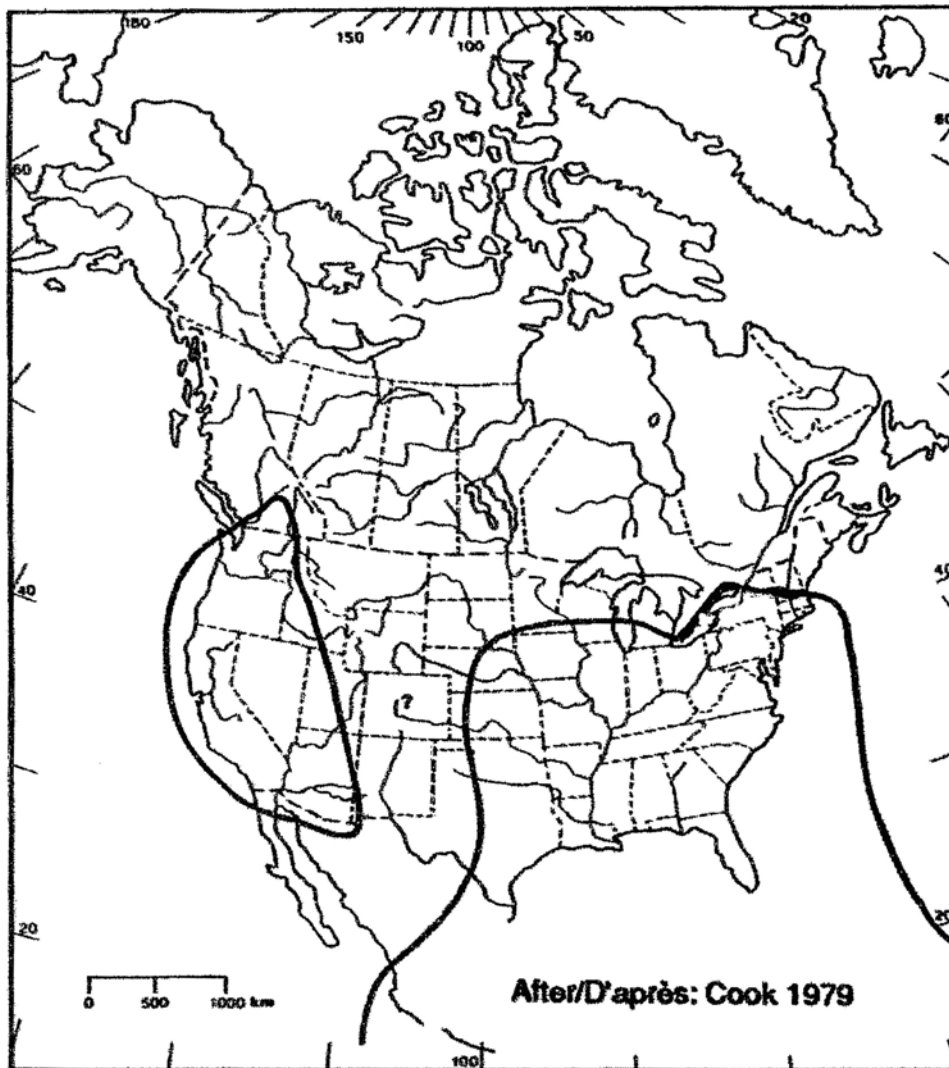


Figure 1. Generalized distribution of toothcup, *Rotala ramosior*, in North America (adapted from Oldham and Sutherland 1987).

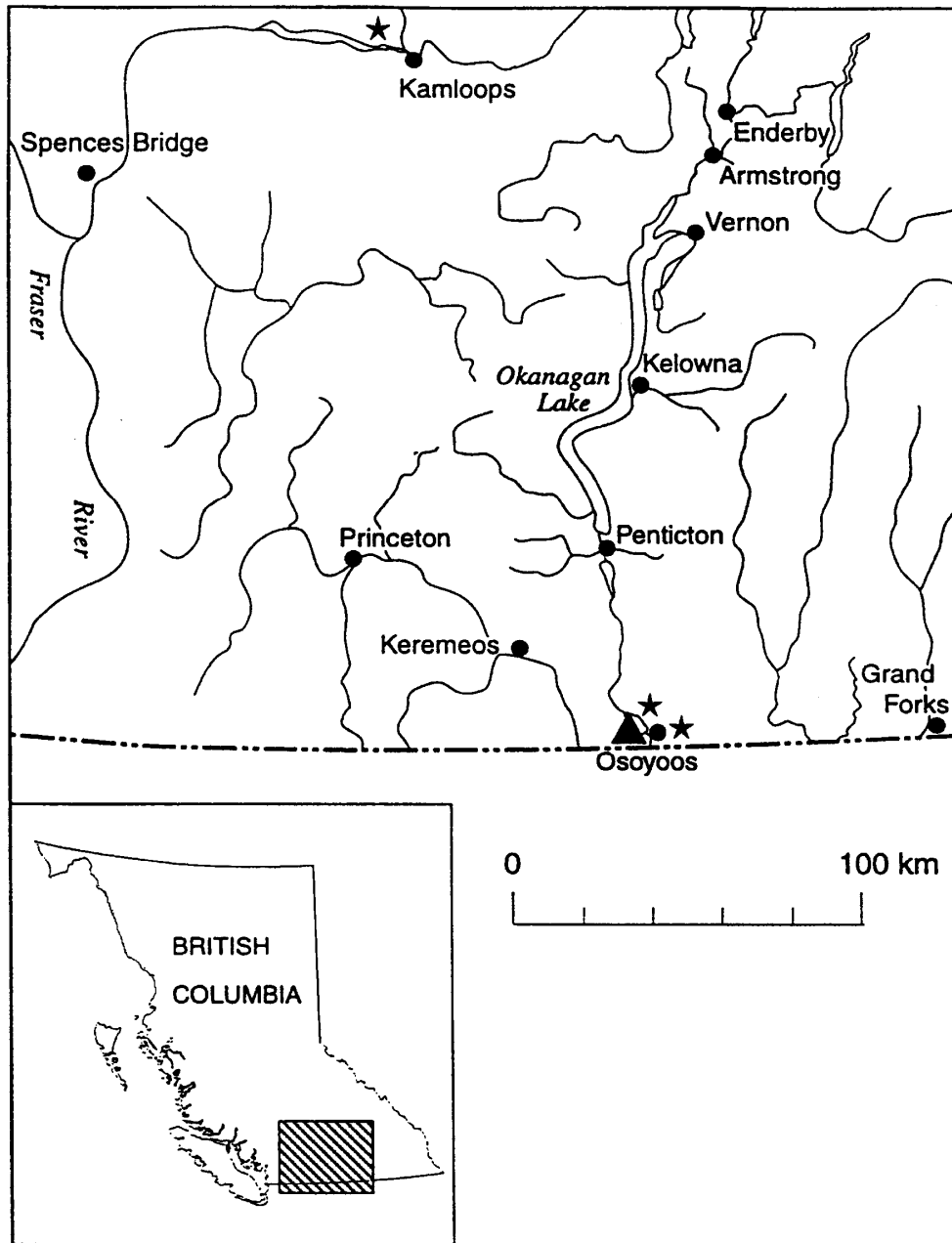


Figure 2. British Columbia distribution of toothcup, *Rotala ramosior* (Circles are urban centres, stars represent extant populations, and triangles represent extirpated populations).

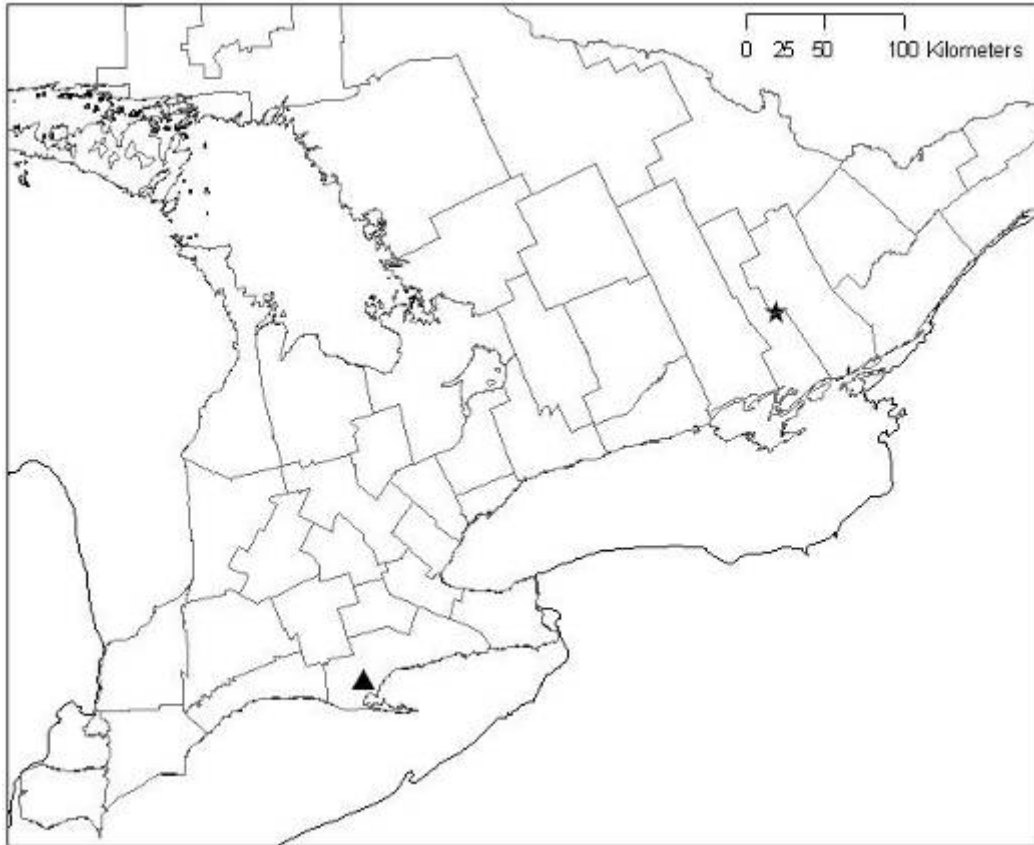


Figure 3. Ontario distribution of toothcup, *Rotala ramosior* (based on map in Oldham and Sutherland 1987); triangle represents extirpated population in Haldimand-Norfolk Regional Municipality; star represents four extant sites in Lennox and Addington County.

Percent of global distribution in Canada

Canada contains less than 1% of the global distribution of this species.

Distribution trend

Of the nine known Canadian sites, habitat has been destroyed at one entire site in Ontario, at one entire site in B.C., and at two of three subpopulations at another site in B.C. Habitat quality at one site on Mica Spit (Osoyoos Lake, BC) has been degraded through invasion of woody vegetation, although this site is being restored through shrub removal. Habitat quality and quantity at the remaining sites is unknown and requires investigation.

Toothcup is considered extirpated from two out of nine sites in Canada: one in B.C., and one in Ontario. The species is confirmed extirpated from one site in southwestern Ontario; plants were not found during surveys in 1989 and 1997 and the primary habitat has since been destroyed through conversion to pasture and cropland (Douglas and Oldham 1998). Toothcup is also considered extirpated from Haynes Point Provincial Park in British Columbia, where the natural substrate was removed and replaced with coarse sand for beach management purposes.

Population abundance

Global abundance

Toothcup is ranked as G5 (globally secure), although the global population size is unknown. In the United States, toothcup is considered nationally secure and is ranked N5 (secure) (NatureServe 2008). Toothcup occurs in 42 states, with sub-national rankings between S5 (secure) and S1 (critically imperiled) (Table 1; NatureServe 2008). Toothcup is legally listed as endangered in Connecticut, Rhode Island and Massachusetts, and threatened in Minnesota and New York (USDA Natural Resource Conservation Service 2003).

Canadian abundance

Based on 2004 data (last survey of the populations), the Canadian population is estimated at 18,258 plants, of which approximately 67% occur in southwestern British Columbia. As this species is an annual, it is expected that there are fluctuations in population numbers year-to-year. The species is ranked as critically imperiled in Canada (N1), British Columbia (S1), and Ontario (S1) (NatureServe 2008). It is assessed as Endangered by COSEWIC. Characteristics of British Columbia's four populations and their sub-populations (Douglas and Oldham 1998; Douglas 1999; G. Douglas, pers. comm., 2004) are shown in Table 2. Table 3 describes characteristics of Ontario's five populations and their sub-populations (Brownell 1997; Veit 2000; Bonta 2004).

Table 2. Population sizes at sites surveyed for toothcup, *Rotala ramosior*, in British Columbia.

Site/Sub-population	Survey date(s)	Extent	Number	Ownership
1a. Osoyoos Lake, Mica Spit	27 July 1994	6 m ²	200	Osoyoos Indian Reserve
	15 August 1995	6 m ²	250	
	1999	Extirpated	0	
1b. Osoyoos Lake, Mica Spit	26 July 1994	50 m ²	50	Osoyoos Indian Reserve
	15 August 1995	50 m ²	2000	
	15 July 1997	-	0	
	20 August 1999	150–200 m ² (50 m × 4 m)	5000+	
	29 August 2001	-	0	
	11 August 2002	-	0	
	5 August 2003	-	0	
	29 August 2004 August 2006	2 m ² ~100m ²	180 ~ 5000	
1c. Osoyoos Lake, Mica Spit	5 August 2003	1 m ²	4	Osoyoos Indian Reserve
	29 August 2004	Extirpated	0	
2. Private site, Osoyoos	31 August 2004	1000 m ²	12 000	Private
3. Kamloops Lake, McArthur Island	1981	100 m ²	1000	Public – Municipal Park
	1994	-	0	
	18 August 1996	-	0	
	28 July 1997	-	0	
	13 August 2002	-	0	
	5 Sept. 2004	1 m ²	3	

Site/Sub-population	Survey date(s)	Extent	Number	Ownership
4. Osoyoos Lake, Haynes Point	1953	Unknown	Unknown	Public – Haynes Point Prov. Park
	1991	0	0	
	1994	0	0	
	1995	0	0	
	1997	0	0	
	1999	0	0	
	2002	Extirpated	0	
Total in British Columbia	1994	56 m ²	750	
	1995	56 m ²	2250	
	1999	200 m ²	5000+	
	2002	-	0	
	2003	1 m ²	4	
	2004	1003 m ²	12 183	
	2006	~100m ²	~ 5000	

Table 3. Population sizes of toothcup, *Rotala ramosior*, in Ontario

Site/Sub-population	Survey date(s)	Extent	Number	Ownership
1. St. Williams	1984	Unknown	Present	Private
	1987	Unknown	Present	
	1989	-	0	
	1997	Extirpated	0	
2a. Clare River (Sheffield Long Lake)	1994	Unknown	Unknown	Public – Crown land
	2000	7-m spread	Unknown	
	2003	-	0	
	2004	4 m ²	~1000– 3000	
2b. Clare River (Sheffield Long Lake)	1994	Unknown	Unknown	Private
	2000	2 m ²	250–2700	
	2003	-	“A couple thousand”	
	2004	40-m spread	(~2000)	
3. Sheffield Long Lake	8 October 2004	5 m ²	215	Public – Municipal
4a. Puzzle Lake – W	2000	1.6 m ²	200	Private
	2003	-	0	
	2004	Extirpated?	0	
4b. Puzzle Lake – W	1994	Unknown	Unknown	Public – Puzzle Lake Provincial Park
	2000	20 m ²	5	
	2003	-	0	
	2004	8-m spread	400	
4c. Puzzle Lake – W	August 25 2004	8-m spread	700	Private
4d. Puzzle Lake – W	August 25 2004	6 m ²	40	Public – Puzzle Lake Prov. Park
	August 25 2004	1 m ²	“Several hundred” (~400)	
4e. Puzzle Lake – W	August 25 2004	1 m ²	“Several hundred” (~400)	Private
4f. Puzzle Lake – W	August 25 2004	Unknown	50–70	Public – Crown land

Site/Sub-population	Survey date(s)	Extent	Number	Ownership
5a. Puzzle Lake – E	1994	Unknown	Unknown	Public – Puzzle Lake
	2000	60 X 10 cm	50	Prov. Park
	2003	-	0	
	2004	Unknown	150–200	
5b. Puzzle Lake – E	25 August 2004	4 m ²	70–100	Public – Puzzle Lake Prov. Park
Total in Ontario (extant populations only)	1994		83*	46.5–66% of plants in Ontario are on private lands, as of 2004
	2000		505–525	
	2003		0	
	2004		~6025	

* 1994 discovery found a total of 33 plants along the Clare River (Sheffield Long Lake) shoreline and over 50 plants along Puzzle Lake's shore (Brownell 1997).

Percent of global population in Canada

Probably less than 1% of the global population of toothcup is in Canada.

Population trend

Because this species is an annual plant, and therefore subject to fluctuating numbers, data are insufficient to determine population trends at any of the sites. Toothcup populations in southeastern Ontario were surveyed by the Ontario Ministry of Natural Resources in 2000 (Veit 2000), 2003 (no plants were seen), and 2004 (Bonta 2004). Since toothcup's discovery in Ontario in 1994, seven additional sub-populations and one new population have been found, and the number of plants has seemingly increased from less than 100 to over 6000, although this may be attributable to variation in climatic variables and/or search efforts. Surveys in British Columbia indicate the number of plants found was 750 in 1994, and 12,183 plants in 2004. Two smaller sub-populations have become extirpated since 1995 (Douglas 1999).

Needs of the toothcup

Habitat and biological needs

Toothcup has been found on sandy, muddy, or rocky freshwater shorelines, which are not necessarily uncommon in southern Ontario and in British Columbia. However, toothcup has some relatively specific requirements that prevent it from being more common. This species requires open, strongly fluctuating, low nutrient shorelines in both Ontario and British Columbia. Habitats that the plant occupies in British Columbia and Ontario are described below.

Habitat characteristics, including plant associates, are described in detail in Douglas and Oldham (1998) for British Columbia, and in Bonta (2004) and Veit (2000) for Ontario.

British Columbia: Toothcup depends on water-level fluctuations for the creation and maintenance of suitable habitat. In British Columbia, toothcup inhabits moist to wet, often alkaline, muddy shorelines of lagoons or ponds, or sandy shorelines. These sites are submerged early in the year, with plants emerging when lake levels go down in late July to early September. At the lagoon on the east side of Osoyoos Lake, *Eleocharis acicularis* (needle spike-rush) is a constant companion along with various small herbaceous species, including *Gnaphalium* spp.

(cudweed). Both at the Osoyoos Lake Mica Spit site and at the privately owned site near Osoyoos, many other rare species occur with toothcup. These include *Chamaesyce serpyllifolia* ssp. *serpyllifolia* (thyme-leaved spurge), *Cyperus squarrosus* (awned cyperus), *Eleocharis rostellata* (beaked spike-rush), and *Ammannia robusta* (scarlet ammannia).

Ontario: Habitat for toothcup in Ontario includes flattish sandy, muddy, and/or sandy gravel depressions situated on pre-Cambrian bedrock shorelines at four extant sites along Sheffield Long Lake (Clare River) and Puzzle Lake. At some of these sites, toothcup is found growing out of cracks in the bedrock but again, only very near shore. Soils are thin (0–5 cm depth) and droughty. Both lakes are in Lennox and Addington County. The biophysical attributes of the surrounding rock barren landscape are described in detail in Brownell (1997). While remains of a dam exist at the southern end of Puzzle Lake, stop logs are no longer present to allow for effective damming of the lake's water levels (B. Edwards, pers. comm., 2006). Beaver dams are frequently built on the old dam structure and these can raise water levels significantly, with the lake level varying by as much as 1.3 m throughout the year. Occasionally, as reported by Edwards, the beaver dams are removed if water levels become high enough to flood low-lying shorelands for long enough periods to cause trees to die. The habitat is submerged for several weeks in the spring and early summer (Brownell *et al.* 1996), but water levels recede and most plants are located approximately 1 m above the waterline during seed production in September (Veit 2000; Bonta 2004). Sites are present on both private and public (Crown and provincial park) land. The former habitat of the extirpated site near St. Williams was unique because it was not associated with a lakeshore, but instead consisted of a wet meadow (Douglas and Oldham 1998).

Limiting factors

Water-level fluctuations: Toothcup requires strongly fluctuating water levels to complete its life cycle. As an obligate annual plant, its population numbers undergo wide fluctuations from year to year, dependent on the water-level regime at the site. Germination takes place under flooded conditions, and flowering and seed production occur as the water level recedes and the habitat dries (Cook 1979). The changing nature of the habitat reduces competition from other species by flooding terrestrial vegetation and keeping the habitat free of woody plants that would shade the diminutive toothcup, thereby reducing its vigour.

Threats

The COSEWIC status report by Douglas and Oldham (1998) identifies shoreline development and controlled water-level regimes as the primary threats to extant sites. Large-scale hydrological changes producing either a permanent lowering or raising of water levels, or abnormal fluctuations, would result in a significant decline or extirpation of some populations.

Threat categories are arranged in order of descending priority.

British Columbia

Habitat loss or degradation: Shoreline development presents the most significant known threat to toothcup in British Columbia. Cottage and housing development affect existing and potential toothcup habitat on private and First Nations land via the creation of docks, boat ramps, boathouses, and sheds along the shoreline. Significant development adjacent to or in the area of the lagoon at Osoyoos Lake (location of the First Nations Mica Spit site) may irreversibly alter lagoon hydrology, and affect toothcup populations. The removal of native substrate and subsequent replacement with coarse sand have contributed to population extirpation at the Haynes Point Provincial Park site (Douglas and Oldham 1998). Threats to the McArthur Island site (Kamloops Lake) are unknown.

Changes in ecological dynamics or natural processes: flood regime: Water levels are artificially controlled at Osoyoos Lake sites in B.C. In the case of the Mica Spit site on Osoyoos Lake, water levels are maintained by water control structures in the United States. The Mica Spit site for toothcup occurs on and around a lagoon, whose water level is directly related to lake levels. If lake water levels were maintained higher, then the seed bank of toothcup (at the Mica Spit site and other sites on the lake) would not be exposed and would not be able to germinate. Conversely, if lake water levels were maintained at a lower level, the plant would not flower, or seeds would not be able to germinate (T. McIntosh, pers. comm., 2006).

Invasive species: Invasive non-native plants (e.g., Russian olive, willows) pose a potential threat to toothcup by reducing available habitat and competing for resources. Efforts to control invasive plants through mechanical or chemical means may inadvertently harm extant and currently unknown populations or individuals of toothcup.

Other potential threats: Cattle browsing, trampling and recreational activities such as all-terrain vehicle use could threaten toothcup populations.

Ontario

Habitat loss and degradation: Conversion of the habitat to cropland and pasture caused extirpation of the species at the St. Williams, Ontario site (Brownell *et al.* 1996). Increased development on Puzzle and Sheffield Long lakes may dramatically increase threats to toothcup. Potential campsites have been identified on Puzzle Lake within the park. However, all development in the park will be carried out in ways that will ensure the protection of any species at risk (OMNR 2001). Cottage development is also a potential threat to toothcup in Ontario. Both campsite and cottage development encourage recreational activities, such as swimming and boating, that could dramatically affect toothcup populations through trampling or dislodging plants. Shoreline development, such as cottages, boat ramps, and public beaches, is another serious threat.

Changes in ecological dynamics or natural processes: One of the greatest threats to habitat occurs from extended flooding or drying due to altered water levels. This can result from water level stabilization and/or abnormal fluctuations.

Other potential threats: Inter-specific competition with invasive species is also a less significant threat.

Actions Already Completed or Underway

At Osoyoos Lake, efforts have been made to reduce threats at the Mica Spit site through fencing and removal of invasive plant species. Removal of invasive species by the Osoyoos Indian Band was funded by the Habitat Stewardship Program from 2004 to 2007. As well, there have been discussions with the International Joint Commission (IJC) for Osoyoos Water Levels and the recovery team regarding potential research projects to determine the water-level requirements of the species during all life phases.

OMNR has sent letters to private landowners in Ontario informing them of the occurrence of this species on their property and inviting them to participate in recovery efforts. Some of the landowners expressed interest in the protection of the species. Provincial park management reflects consideration of this species within its jurisdiction.

In both provinces, local botanists continue to monitor known sites and surveys for new populations.

Knowledge Gaps

Inventory and monitoring requirements

Annual monitoring over a relatively long period of time is required, for all extant populations, to accurately assess population trends. Inventory and assessment of potential habitats are required in south-central British Columbia and southern Ontario to identify new populations. Because seed banks can persist in an area without obvious evidence of plants, surveys should be conducted over multiple years. Potential restoration sites need to be identified and restoration projects must be monitored annually.

Biological/ecological research requirements

There is a need to know whether soil characteristics play major roles in determining success of toothcup growth and maintenance. For example, is soil texture critical? Since toothcup has been described in some parts of its range as growing in mud, sand, burnt marsh soil, rice fields, and so on, soil texture may not be that limiting. Additionally, there is a need to discern the effects of soil pH, calcium content, potassium, nitrogen, and phosphorus. Water chemistry may also play a role, and research on total conductivity, clarity, colour, pH, calcium, and other nutrients could prove useful. Understanding these attributes will lead to a better assessment of potential habitat.

Research into light characteristics (wavelengths and duration) and ambient temperature for germination, as well as germination rates, are needed. The potential for establishing new populations through the introduction of seeds or seedlings into suitable habitats should be assessed. Conditions for seed germination, seed dispersal, and seed bank viability must be determined to facilitate restoration and re-introductions. Additional scientific research on seed

production in toothcup is required to determine whether seed supply or habitat limit the Canadian populations.

The effects of hydrology and water regime on germination and growth must be quantified to assist with identifying suitable habitat for re-introduction. More detailed understanding of within- and between-year water-level fluctuations at all sites and the apparent effects on toothcup growth and numbers must be sought. This will require the establishment of standard measuring protocols.

Further research into the seasonal growth changes of toothcup at all Canadian sites is required. For example, in any given year when do new plants first appear? How quickly do they grow? How many remain submerged and for how long? When do flowers first appear and does this vary much across the range? When do seeds first develop and when do capsules begin to open?

What pollinators are at work on toothcup plants? Other factors such as competition and predation will also affect population sustainability and establishment, which can contribute to our development of population targets to guide recovery. There is also a need to discern genetic differences and similarities between the British Columbia and Ontario population. As well, a comparison of abiotic and biotic habitat attributes between sites alongside with demographic studies of stable populations vs. potentially declining populations.

Threat Clarification Research Requirements

Potential threats related to land development, habitat disturbances, water-level fluctuations, non-native invasive plants, and all-terrain vehicle activity must be investigated.

RECOVERY

Recovery Feasibility

Recovery of Toothcup is considered by the recovery team to be biologically and technically feasible (Table 3).

If the habitat and suitable conditions can be maintained, toothcup is expected to remain at known sites. The level of effort required to recover this population is moderate and includes habitat preservation, stewardship and public education, restoration, and management (including involvement of IJC if appropriate), as well as population introduction, monitoring, and inventory. Significant challenges to recovery include development pressure, recreational use, and private landowner cooperation. Also, additional populations may be discovered if thorough surveys are conducted of potential habitat and historical sites.

Table 4. Biological and technical recovery feasibility. Criteria from Environment Canada *et al.* (2005).

Criteria	Toothcup
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	YES - there are seven extant populations in Canada, each with reproductively capable individuals.

2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management and/or restoration?	YES - the habitat at the currently occupied sites is suitable, and habitat at some of the previously occupied sites could be restored. Additional suitable habitat may also be available.
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	YES - recovery actions such as stewardship and cooperation with landowners and land managers can prevent major threats.
4. Do the necessary recovery techniques exist and are they known to be effective?	YES - standard propagation techniques exist for raising new stock for translocation; also, general restoration methods/techniques are known.

Recovery Goal

The recovery goal for toothcup is to protect and maintain the four extant populations in Ontario and the three extant populations in B.C., and to restore the species at historic sites if deemed necessary.

Population and Distribution Objectives

Specific targets for population numbers are not possible at this time due to the species being an annual (therefore population sizes are highly variable) and also the lack of survey data for determining long-term population trends.

Recovery Objectives

The main objectives of the recovery strategy for toothcup are to:

1. Ensure the persistence of the species at all known extant sites, with no loss or degradation of currently occupied habitat, for the next five years.
2. Assess the extent of the three main threats to the seven populations (habitat loss or degradation, flood regime, and invasive species, flood regime) by 2012.
3. Confirm the distribution of Toothcup in Ontario and British Columbia (historic and new locations), and update population and distribution objectives as needed by 2012.
4. Investigate the feasibility of restoring populations at extirpated sites or in suitable habitat near historical areas by 2012.

Specific steps to be taken to meet the recovery objectives are listed in Table 4.

Approaches Recommended to Meet Recovery Objectives

The general approaches that will be taken to address identified threats are:

- habitat protection
- public outreach and stewardship
- inventory and monitoring
- habitat management

- habitat restoration/rehabilitation
- scientific research

Associated specific steps and expected outcomes are summarized in Table 5.

Recovery planning table

Table 5. Recovery planning table.

Priority	Obj. no.	Broad approach / strategy	Threat addressed	Specific steps	Outcomes or deliverables
Urgent	1	Habitat protection	Habitat loss or degradation	<ul style="list-style-type: none"> • Explore conservation options with the landowners and land managers at extant and historic sites 	<ul style="list-style-type: none"> • Habitat for toothcup conserved • Reduce mortality due to land & water development • Stimulate support for recovery
Necessary	1	Habitat protection	Changes in ecological dynamics or natural processes	<ul style="list-style-type: none"> • In B.C. work in cooperation with the state of Washington and private landowners regarding water levels 	<ul style="list-style-type: none"> • Develop options for water-level manipulation at Osoyoos Lake, and Osoyoos private land site, B.C. • Appropriate water levels to maintain species at risk on Osoyoos Lake
Urgent	1	Public outreach – stewardship with private landowners and First Nations; habitat management	Habitat loss or degradation; Recreational use of shorelines (other threats)	<ul style="list-style-type: none"> • Encourage landowners and land managers to steward and manage lands for persistence of the species • Control trampling by humans and vehicle impacts, including boats 	<ul style="list-style-type: none"> • Maintain populations • Reduce mortality due to development and recreation • Increase understanding and stewardship of species at risk and their habitats among landowners • Stimulate community support for recovery • Reduce mortality and maintain quality of habitat
Necessary	1, 3	Inventory and monitoring – survey current, historical and potential habitat	All	<ul style="list-style-type: none"> • Obtain permission to inventory and monitor • Establish a monitoring protocol • Identify sites for potential habitat • Integrate survey of current habitats with surveys of historic and potential habitats • In B.C., integrate with surveys of scarlet ammannia, small-flowered lipocarpa, and other Red-listed species. In Ontario, integrate with surveys of 	<ul style="list-style-type: none"> • Ongoing assessment of population status and trends and description of critical habitat • Critical habitat characteristics better understood and identified

Priority	Obj. no.	Broad approach / strategy	Threat addressed	Specific steps	Outcomes or deliverables
Necessary	1, 2	Habitat management	Exotic species (inter-specific competition)	<ul style="list-style-type: none"> other rare plant species Investigate relationship between water levels and abundance at all sites Develop large-scale maps of critical habitat Remove invasive non-native plants at British Columbia sites 	<ul style="list-style-type: none"> Increased habitat quality Increased potential/available habitat
Beneficial	4	Habitat and population restoration	Habitat loss and degradation	<ul style="list-style-type: none"> Restore habitat and population(s) at Haynes Point, if feasible Investigate additional / alternate locations in the Okanagan Valley in B.C.; and Ontario If seed supply is found to be limiting, develop a seed propagation program to increase populations that are exhibiting low abundance under low to moderate water-level conditions 	<ul style="list-style-type: none"> Habitat restored if feasible Alternate locations identified in Okanagan Valley Seed propagation program complete Increased population size
Beneficial	1	Habitat protection – legal protection	Habitat loss and degradation	<ul style="list-style-type: none"> Provincial Park zoning and rare species management planning in Ontario Develop and apply provincial habitat mapping guidelines for identification of significant habitat for toothcup under Ontario's Provincial Policy Statement B.C. and Ontario to encourage municipal land use planning offices to ensure protective zoning by-laws 	<ul style="list-style-type: none"> Legal and policy protection for populations on Crown and private land Reduce mortality and loss of habitats / populations due to development and associated recreational activities Maintain populations on public land
Beneficial	2, 4	Scientific research	All	<ul style="list-style-type: none"> Determine seed viability, dispersal mechanisms, and success Research specific habitat requirements and other ecological factors Assess potential for determining population viability Determine feasibility of restoration Determine whether seed supply is limiting 	<ul style="list-style-type: none"> Increased understanding of toothcup ecology Determination of the size for a self-sustaining population

Performance Measures

Criteria for evaluation of the progress towards the goals and objectives of this strategy include:

1. Population monitoring indicates that the numbers of plants at the sites are stable or increasing, by 2012 (Objective 1);
2. Impact of the three main threats to the populations has been investigated as well as a reduction of threats by 2012 (Objective 2);
3. Agreements with appropriate resource managers are developed to mitigate the impacts of fluctuating water levels and support toothcup and other rare plant populations from this threat by 2012 (Objective 2).
4. Surveys of suitable habitat for new populations has been conducted and documented by 2012 (Objective 3);
5. Historic sites are investigated as potential habitat for re-introduction and restoration, where appropriate, in B.C. and in Ontario by 2012 (Objective 4).

Critical Habitat

Identification of the species' critical habitat

No critical habitat can be identified for toothcup in Canada at this time, but it may be identified at a later date in a federal addition by Environment Canada, or in a future action plan. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species and monitoring of the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

Because so little is known about toothcup's persistence in the seed bank, it is possible that seeds are still present in the substrate. Historic sites may be considered for inclusion as critical habitat if they are needed for re-introduction purposes.

Recommended schedule of studies to identify critical habitat

The following three studies will be done in both British Columbia and Ontario, and will allow for the identification of critical habitat for extant populations:

1. Identify habitat attributes at extant sites (e.g., moisture regime, length of inundation and exposure, soil and water chemical properties, plant cover, water clarity) by 2012.
2. Using established survey and mapping techniques (applied during phenologically appropriate periods), delineate the boundaries of all occupied habitats by 2012.

3. For each occupied habitat, delineate the boundaries and condition of the associated shoreline with respect to fluctuations in water levels (temporal and spatial) and any large-scale hydrological changes by 2012.

The following three studies will be done in British Columbia only, and will facilitate the identification of additional critical habitat:

1. Identify, map, and describe all suitable sites in the north and south Okanagan valley that are currently unoccupied by species at risk. Rate these habitats for their potential to support scarlet ammannia, as well as other species at risk by 2012.
2. Identify, map, and rate any significant shorelines in the north and south Okanagan valley for restoration potential where the habitat attributes indicate that suitable habitat may exist but the structure and/or function has been lost or compromised as a result of alien plant invasion, urbanization, or water-level changes by 2012.
3. Through experimental trials, test the suitability of high-ranking sites for plant translocations/reintroductions by 2012.

A comprehensive survey of suitable habitat in southwestern Ontario may reveal additional populations of toothcup. The extent of occurrence of populations and associated vegetation communities may be mapped in years where the populations are evident, to contribute to critical habitat identification.

Existing and Recommended Approaches to Habitat Protection

Toothcup is listed as Endangered on the Species at Risk Ontario List regulation under the *Endangered Species Act, 2007* which provides the plant with species protection. The habitat of this species receives protection through the provisions of the Provincial Policy Statement (PPS) of the *Ontario Planning Act*, which requires that planning agencies must “be consistent with” the PPS in land use planning (Ontario Ministry of Municipal Affairs 2005). The PPS states that “development and site alteration are not permitted in significant habitat of endangered and threatened species.”

In British Columbia, protection of the species will be achieved in cooperation with First Nations, private landholders, and the City of Kamloops. Stewardship will be the main emphasis, but other mechanisms may also be involved in maintenance of the species.

Stewardship Approach

For successful implementation of species at risk protection, there will be a strong need to engage in stewardship on various land tenures, and in particular on private land. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on.

The Preamble to the federal *Species at Risk Act* (SARA) states that “stewardship activities contributing to the conservation of wildlife species and their habitat should be supported” and

that “all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct.” The *Canada – British Columbia Agreement on Species at Risk* also recognizes that “stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk” and that “cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk.”

In addition, Ontario’s Biodiversity Strategy identifies stewardship as a key strategic direction for conserving biodiversity in Ontario (OMNR 2005).

Stewardship Approach for Private Lands

Since many species at risk occur only or predominantly on private lands, stewardship efforts will be the key to their conservation and recovery. To successfully protect many species at risk, there will have to be voluntary initiatives by landowners to help maintain areas of natural ecosystems that support these species of risk. Examples of this stewardship approach include following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat on private property; establishing conservation covenants on property titles; eco-gifting part or all of their property to protect certain ecosystems or species at risk; or selling their property for conservation. For example, both government and non-governmental organizations have had good success in partnering with private landowners to conserve private lands in B.C. and Ontario. This could be aided by stewardship programs and local land trusts.

Effects on Other Species

In both Ontario and British Columbia, it is believed that any actions taken for toothcup will benefit other species and ecosystems.

In British Columbia, toothcup is found with small-flowered lipocarpha (*Lipocarpha micrantha*; S1) and scarlet ammannia (*Ammannia robusta*; S1), which are two COSEWIC-designated endangered species, and sometimes short-rayed alkali aster (*Symphyotrichum frondosum*). Three of these species have similar, but not identical, habitat requirements and face similar threats. In addition, awned cyperus (*Cyperus squarrosus*; S2) always occurs with small-flowered lipocarpha and is Red-listed by the British Columbia Conservation Data Centre. A total of 18 Red-listed plant species now occur with toothcup at the Mica Spit site on Osoyoos Lake, including red-rooted cyperus (*Cyperus erythrorhizos*; S1), hairy water-clover (*Marsilea vestita*; S1), bushy cinquefoil (*Potentilla paradoxa*; S1), and capitate spike-rush (*Eleocharis geniculata*; S1 in Ontario). This last species has only recently been identified at this location in British Columbia and will be assessed by COSEWIC sometime in 2009. Because the entire Okanagan-Similkameen area contains many endangered and threatened species, several of which are found in riparian/wetland areas, recovery efforts should focus on an ecosystem- or landscape-level plan.

At three Ontario sub-populations on Puzzle Lake, toothcup is found growing with two extant S1 species: Engelmann’s spike-rush (*Eleocharis engelmannii*) and false pimpernel (*Lindernia dubia* var. *anagallidea*). These two associates are known from several locations in Ontario and western Canada and are considered rare in Canada (both are ranked N1 in Canada) by Argus and Pryer

(1990). These species have not yet been considered for assessment by COSEWIC, but would likely be evaluated as threatened. Several other provincially rare species are found associated with toothcup sub-populations that also depend on fluctuating lakeshores or lakeshore microclimate. These include shiners three-awn grass (*Aristida dichotoma*; S1); bear oak (*Quercus ilicifolia*; S1); and panic grass (*Panicum rigidulum*; S2S3). Both shiners three-awn grass and bear oak are restricted in their occurrence in Canada to the Puzzle Lake area and to Sheffield Long Lake. These species have not yet been considered for assessment by COSEWIC, but would likely be evaluated as endangered. Recovery efforts in Ontario could therefore benefit several species if a multi-species approach was taken.

Socio-economic Considerations

Recovery actions could potentially affect the following socio-economic sectors: land development along foreshore areas; recreational users of provincial parks; agriculture (irrigation); and domestic animal grazing. The expected magnitude of these effects is unknown and will be further addressed in the recovery action plan.

Recommended Approach for Recovery Implementation

A multi-species recovery approach is recommended for toothcup, small-flowered lipocarpha, scarlet ammannia, and other provincially listed species in British Columbia. These species all share similar threats and have similar property ownership in the southern Okanagan valley; any activities for recovery will be done in conjunction with the Southern Okanagan-Similkameen Conservation Program.

Although all three of these species occur in Ontario, toothcup does not share sites or property ownership with the others. A species-specific approach is the most appropriate for the recovery of the species in that province.

Statement on Action Plans

In British Columbia, a multi-species action plan will be completed by 2012 for four sand spit species (and others), including toothcup, small-flowered lipocarpha, short-rayed alkali aster, and scarlet ammannia.

An action plan for Ontario sites will also be completed by 2013.

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