

**Ontario Species at Risk Evaluation Report for
Mapleleaf (*Quadrula quadrula*)**

Committee on the Status of Species at Risk in Ontario
(COSSARO)

Assessed by COSSARO as Special Concern

May 2017

Final

Mulette feuille-d'érable (*Quadrula quadrula*)

La moule feuille-d'érable est un mollusque d'eau douce distinctif qui vit uniquement dans le Sud-Ouest de l'Ontario, majoritairement dans les bassins versants des rivières Sydenham, Thames et Grand, mais aussi dans des ruisseaux et rivières et dans des enfoncements des lacs Érié et Ontario. Elle est probablement disparue du lac Sainte-Claire et des rivières Detroit et Niagara. Ses préférences en matière d'habitat sont assez étendues, et elle s'accommode de divers substrats : gravier, sable, boue, etc. Ses glochidies profitent de la bonne présence dans son habitat de la barbe de rivière, leur hôte de prédilection, et probablement de celle d'autres poissons qui lui serviraient aussi d'hôtes.

Ces 20 dernières années, de nombreuses enquêtes ont permis de dénombrer une population estimative de plus de six millions d'individus matures répartis dans environ 15 bassins versants. Malgré les indices de stabilité de la population, il y a de nombreuses menaces susceptibles de provoquer un déclin : pollution agricole et industrielle, altération de l'habitat, compétition directe d'espèces envahissantes (particulièrement la moule zébrée), dragage, etc.

La moule feuille-d'érable est classée dans la catégorie des espèces préoccupantes en Ontario. Ce changement de statut n'est pas attribuable à une augmentation réelle de la population, mais plutôt à l'accroissement des efforts d'échantillonnage ayant mené à la découverte de nouvelles populations et à la hausse des estimations du nombre d'individus. Par ailleurs, les études témoignent d'un flux génétique élevé et d'une forte probabilité d'immigration de source externe des populations nombreuses et stables de l'Ouest du lac Érié.

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Executive summary

The Mapleleaf is a distinctive freshwater mussel that occurs only in southwestern Ontario. The majority of the Mapleleaf population in Ontario is found in the Sydenham, Thames, and Grand River drainages, and it is also found in other creeks and rivers as well as in embayments of Lakes Erie and Ontario. It is probably extirpated from Lake St. Clair and the Detroit and Niagara Rivers. The Mapleleaf has broad habitat preferences and is found in many different substrates including gravel, sand, and mud. Its known glochidial host, the Channel Catfish, is common within its range, and other common fish hosts are suspected.

Substantial survey effort over the past two decades has resulted in a population estimate of over 6 million mature individuals distributed in approximately 15 drainages. Although there are indications that this population is stable, there are several threats to this species that are predicted to cause future declines. These include agricultural and industrial pollution, habitat modification, direct competition by invasive species especially dreissenid (zebra) mussels, and dredging.

The Mapleleaf is assessed as Special Concern in Ontario. The change in status is a result of increased sampling effort that has led to newly discovered populations and larger population estimates, rather than a genuine increase in population size. Research has also indicated that gene flow is high among populations, and that there is a reasonable likelihood of rescue from large and stable populations in western Lake Erie.

1. Eligibility for Ontario status assessment

1.1. Eligibility conditions

1.1.1. Taxonomic distinctness

Yes. The Mapleleaf is a distinct species recognized by the current authority for scientific classification of freshwater mussels in North America (Turgeon et al. 1998).

1.1.2. Designatable units

Not applicable. All Mapleleaf mussels in Ontario are part of the Great Lakes – Upper St. Lawrence population discussed in the 2016 COSEWIC status report. The Mapleleaf is therefore being assessed in Ontario at the species level.

1.1.3. Native status

Yes. The Mapleleaf was first described in 1820 and is considered native to North America and to Ontario (Turgeon et al. 1998, COSEWIC 2016).

1.1.4. Occurrence

Yes. The Mapleleaf is known to be extant in Ontario (COSEWIC 2016).

1.2. Eligibility results

The Mapleleaf (*Quadrula quadrula*) is eligible for status assessment in Ontario.

2. Background information

2.1. Current designations

- GRANK: G5T2 (NatureServe 2017)
- NRANK Canada: N2 (NatureServe 2017)
- COSEWIC: Special Concern (November 2016)
- SARA: Threatened (Schedule 1, based on 2006 Assessment)
- ESA 2007: Threatened (June 2008)
- SRANK: S2

2.2. Distribution in Ontario

The Mapleleaf occurs only in southwestern Ontario, mainly in rivers and creeks that drain into Lakes Erie, Huron and Ontario. The vast majority of the Mapleleaf population in Ontario (>75%) is found in the Sydenham, Thames, and Grand River drainages, and there is a sizeable subpopulation in the Ausable River. There are several small

subpopulations in other creeks and rivers, in the St. Clair delta, and in some embayments of Lakes Ontario and Erie.

Although it formerly occurred infrequently in deep offshore waters of the Canadian Great Lakes, the Mapleleaf is no longer found in these habitats. It appears to be functionally extirpated from Lake St. Clair, and the Detroit and Niagara Rivers.

Within this range, the Mapleleaf generally inhabits medium to large rivers with slow to moderate current, river and coastal embayments, and Great Lakes wetlands. It has a fairly wide habitat preference, having been found in mud, sand, and gravel substrates.

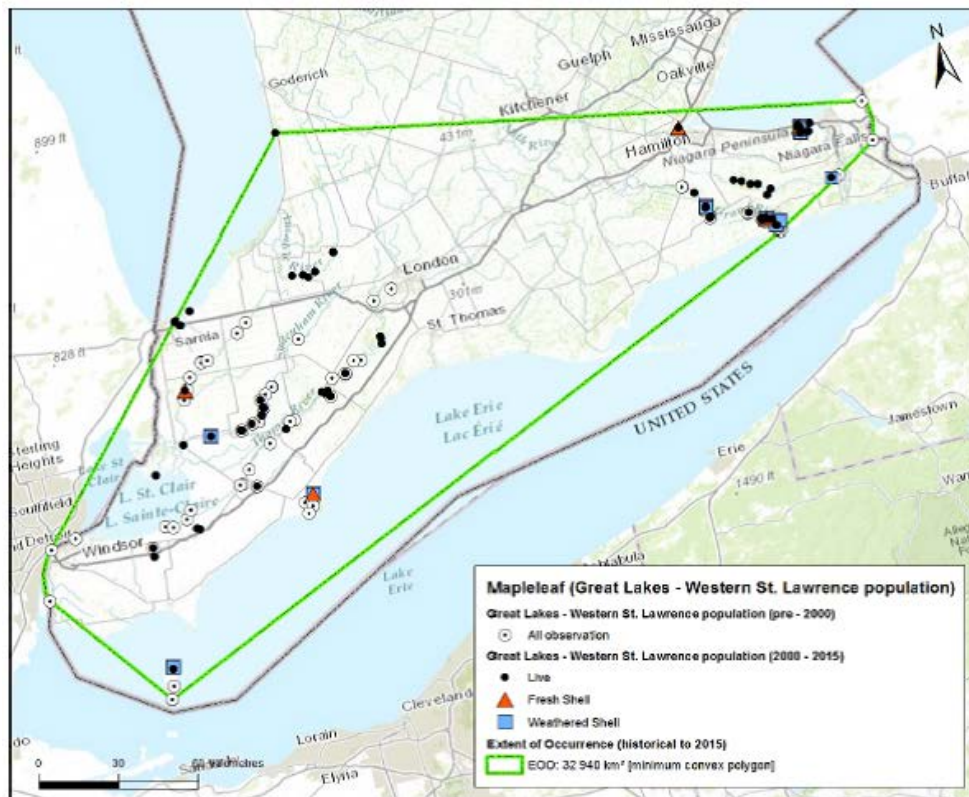


Figure 1. Total distribution of Mapleleaf in Ontario, based on records and surveys prior to and after 2000 (COSEWIC 2016 used with permission).

2.3. Distribution and status outside Ontario

The species *Quadrula quadrula* occurs broadly across eastern-central North America (see COSEWIC 2016, Figure 3). Within Canada, it occurs in Manitoba, where it is found in the Red and Assiniboine Rivers and associated tributaries, and in Lake Winnipeg. Within the drainages of the Ohio and Mississippi Rivers, it extends from Minnesota and Wisconsin south to Louisiana and Texas, and east to New York and Pennsylvania. It has been reported from 23 American States (NatureServe 2017).

2.4. Ontario conservation responsibility

The percentage of the global and/or population range of the Mapleleaf that occurs in Ontario has not been calculated but is certainly less than 25%, based on the range map in Figure 3 of COSEWIC 2016.

2.5. Direct threats

Primary threats to the Mapleleaf are thought to be pollution, habitat modification, direct competition by invasive species, and transportation corridors.

Agricultural effluents resulting in nutrients, sediments and toxins are a major threat to unionid mussels, and the largest populations (Thames, Sydenham, Grand Rivers) occur in highly agricultural landscapes. Industrial spills from the area, while of low likelihood, could result in brief but potentially damaging toxic exposure. Levels of new types of contaminants, including chloride and ammonia are largely unmonitored.

Invasive dreissenid mussels (e.g. the Zebra Mussel, *Dreissena polymorpha*) compete directly with unionid mussels for food, and could impact up to 30% of Mapleleaf mussel habitat in Ontario. Zebra mussels also physically attach to native adult mussels, smothering them, and resulting in rapid population decline. Zebra Mussel infestation is thought to have been the cause of extirpation of the Mapleleaf from Lake Erie, Lake St. Clair, and the Detroit and Niagara Rivers.

The Round Goby (*Neogobius melanostomus*) is another Great Lakes invasive species that threatens unionid mussels by preying on them.

Dredging benthos for shipping and boating is thought to affect up to 10% of Mapleleaf habitat.

2.6. Specialized life history or habitat use characteristics

Like other freshwater mussels, the Mapleleaf is dependent on a fish host during its larval (glochidial) stage. The Channel Catfish (*Ictalurus punctatus*), a common Ontario fish, is a known host for this species. It is also suspected that Brown Bullhead (*Ameiurus nebulosus*) is a suitable host, although this has not been demonstrated (COSEWIC 2016).

Adults are sessile and typically disperse no more than 100 m (Schwalb and Pusch 2007). However, long-distance dispersal can occur while the glochidial larvae are hosted on adult catfish (Stewart and Watkinson 2004). Gene flow among some distant American populations is high (Berg et al. 1998).

The Mapleleaf is a relatively long-lived species, and generation time is estimated to be about 20 years.

3. Ontario status assessment

3.1. Application of endangered/threatened status in Ontario

3.1.1. Criterion A – Decline in total number of mature individuals

Does not apply. Thresholds for Endangered and Threatened are not met. There are no quantitative trend data for mature individuals available, but estimates indicate that the Ontario population is relatively stable. The previous (2006) status report estimated the Ontario population at 5.5 million, and with substantial recent sampling effort, the number of mature individuals is now estimated at over 6 million. However, this likely does not represent a genuine increase in population size since the last assessment. A past rate of decline of 12.5% in the Extent of Occurrence (EOO) was estimated over the last 3 generations (60 years), although this reduction probably does not relate directly to number of mature individuals. This is because the Mapleleaf was likely always rare at the Detroit and Niagara River sites that have been lost. A 3-30% population decline has been predicted by the Threats Calculator, based on cumulative threats, although there is considerable uncertainty in this estimate.

3.1.2. Criterion B – Small distribution range and decline or fluctuation

Does not apply. The EOO (26826 km²) exceeds thresholds for Threatened under B1. Although the IAO (228 km² or 660 km², see COSEWIC 2016) meets the threshold for Threatened under B2, the population is not severely fragmented, occurs at >21 locations, and does not demonstrate extreme fluctuations.

3.1.3. Criterion C – Small and declining number of mature individuals

Does not apply. The number of mature individuals in Ontario is not known, but it is estimated that there are more than 6 million mature adult Mapleleaf mussels, greatly exceeding thresholds for this category.

3.1.4. Criterion D – Very small or restricted total population

Does not apply. All thresholds are exceeded. It is estimated that there are >6 million mature adult Mapleleaf mussels in Ontario, exceeding thresholds for this category. The number of locations (at least 21) and IAO also exceed applicable thresholds for endangered/threatened status.

3.1.5. Criterion E – Quantitative analysis

Does not apply. Quantitative analysis has not been completed.

3.2. Application of Special Concern in Ontario

The Mapleleaf is found in an area of southwestern Ontario with an IAO that meets the threshold for Threatened under B2. Continuing declines in the extent and quality of habitat have been observed due to the establishment of dreissenid mussels. Subpopulations in Lake Erie, Lake St. Clair, and the Detroit and Niagara Rivers have been extirpated, probably due to dreissenid establishment. Declines are predicted to continue based on a threat assessment range from 3-30% in the next 3 generations (60 years). The range of the Mapleleaf is within an area where both agriculture and urban

development continue to intensify. In particular, levels of nitrate and chloride are rising in some areas; other potential new contaminants and their effects may be unmonitored.

Despite estimates of a large number of mature adults, the Mapleleaf population in Ontario continues to face ongoing range decline and persistent, low-impact threats that warrant their status to be assessed as Special Concern.

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

Does not apply. Less than 25% of the Mapleleaf's global range is found in Ontario, and the species is not globally at risk.

3.3.2. Rescue effect

Probable. There are several large US populations in western Lake Erie, and demonstrated high levels of gene flow between these populations. The Mapleleaf is apparently secure (S5) in adjacent Ohio and most US states, including American Great Lakes populations. It is likely that immigrants would be adapted to this very similar habitat, and that there is sufficient habitat available for immigrants to establish.

3.4. Other status categories

3.4.1. Data deficient

Not applicable. There is sufficient data to assess this species.

3.4.2. Extinct or extirpated

Not applicable.

3.4.3. Not at risk

Not applicable.

4. Summary of Ontario status

The Mapleleaf (*Quadrula quadrula*) is classified as Special Concern in Ontario. A change in status from Threatened in 2008 to Special Concern is warranted as increased sampling and research have resulted in newly discovered locations, higher estimates of adult individuals, reduced evidence of declines, and the potential for rescue. The change in status represents a "non-genuine" change based on increased knowledge and effort, rather than a genuine increase in population size since the last assessment.

5. Information sources

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COSEWIC. 2016. [COSEWIC assessment and status report on the Mapleleaf *Quadrula quadrula* in Canada.](#) Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 86 pp..

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Stewart, K.W., and D.A. Watkinson. 2004. *The Freshwater Fishes of Manitoba*. University of Manitoba Press, Winnipeg, Manitoba, Canada. 276 pp.

Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd edition. American Fisheries Society, Special Publication 26, Bethesda, Maryland, U.S.A. ix + 526 pp.

Appendix 1: Technical summary for Ontario

Species: Mapleleaf (*Quadrula quadrula*)

Demographic information

Demographic attribute	Value
Generation time. Based on average age of breeding adult: age at first breeding = X year; average life span = Y years.	20 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	The Ontario population is believed to be stable but a 3-30% projected (future) decline is estimated by the Threats Calculator.
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Projected 3-30% decline in 3 generations based on Threats Calculator; presumed smaller over 2 generations
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	Probably stable number of mature individuals. 12.5% decline in EOO in 3 generations, but largest populations appear stable.
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Projected 3-30% decline in 3 generations based on cumulative threats in Threats Calculator
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	Suspected 3-30% future decline based on cumulative threats in Threats Calculator
Are the causes of the decline (a) clearly reversible, and (b) understood, and (c) ceased?	a. No b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
Estimated extent of occurrence (EOO).	26826 km ²
Index of area of occupancy (IAO).	228 km ² discrete based on one grid over each

Extent and occupancy attributes	Value
	<p>observation record (57 2x2 km grids).</p> <p>660 km² continuous. Based on continuous stretch of river between all observation records (165 2x2 km grids).</p>
<p>Is the total population severely fragmented? i.e., is >50% of its total area of occupancy in habitat patches that are:</p> <p>(a) smaller than would be required to support a viable population, and</p> <p>(b) separated from other habitat patches by a distance larger than the species can be expected to disperse?</p>	<p>a. No</p> <p>b. No</p>
<p>Number of locations</p>	<p>At least 21</p>
<p>Number of NHIC Element Occurrences</p>	<p>Unknown, N/A</p> <p>See locations</p>
<p>Is there an observed, inferred, or projected continuing decline in extent of occurrence?</p>	<p>Projected continuing decline of 3-30% based on threats calculator</p>
<p>Is there an observed, inferred, or projected continuing decline in index of area of occupancy?</p>	<p>Projected continuing decline of 3-30% based on threats calculator</p>
<p>Is there an observed, inferred, or projected continuing decline in number of populations?</p>	<p>Projected continuing decline of 3-30% based on threats calculator</p>
<p>Is there an observed, inferred, or projected continuing decline in number of locations?</p>	<p>Yes – projected continuing decline of 3-30%. Some subpopulations are small.</p>
<p>Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?</p>	<p>Yes. Habitat quality is probably declining in some areas due to pollution resulting from agricultural runoff, as well as dreissenid mussels.</p>
<p>Are there extreme fluctuations in number of populations?</p>	<p>No</p>
<p>Are there extreme fluctuations in number of locations?</p>	<p>No</p>
<p>Are there extreme fluctuations in extent of occurrence?</p>	<p>No</p>

Extent and occupancy attributes	Value
Are there extreme fluctuations in index of area of occupancy?	No

Number of mature individuals in each sub-population or total population (if known)

Sub-population (or total population)	Number of mature individuals
Total (for subpopulation details, see COSEWIC 2016 (p. vi))	Estimated > 6,000,000

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild has not been calculated via PVA.

Threats

Pollution: Habitat degradation from agriculture (siltation, loss of riparian vegetation, streambank erosion, and nutrient loading), municipal and industrial pollution (including oil spills).

Natural system modifications and invasive, non-native alien species: Invasive dreissenid mussel infestation may still be causing declines in some subpopulations. However, several river systems where Mapleleaf is found have little chance of becoming infested due to a lack of upstream impoundments that could act as seed populations for dreissenids.

Rescue effect

Rescue effect attribute	Value
Status of outside population(s) most likely to provide immigrants to Ontario	Secure. Status apparently secure within areas of US distribution, including those in the Great Lakes drainage.
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Possible. There is evidence of gene flow between Canadian and American populations in Lake Erie.
Would immigrants be adapted to survive in Ontario?	Probably
Is there sufficient suitable habitat for immigrants in Ontario?	Yes
Are conditions deteriorating in Ontario?	Possibly, in some areas
Is the species of conservation concern in bordering jurisdictions?	Yes in some bordering jurisdictions (NY, PA, WI), but is mostly secure

Rescue effect attribute	Value
	on American side of Great Lakes drainage.
Is the Ontario population considered to be a sink?	No
Is rescue from outside populations likely?	Probably, given high measured levels of gene flow between populations in the US and Canada.

Sensitive species

The Mapleleaf is not considered a data sensitive species.

Appendix 2: Adjoining jurisdiction status rank and decline

Information regarding rank and decline for the Mapleleaf (*Quadrula quadrula*)

Note: ranks and decline information are based on the species rather than population level

Jurisdiction	Subnational rank	Population trend	Sources
Ontario	S2	Stable	COSEWIC 2016
Quebec	N/A	N/A	N/A
Manitoba	S2 (Western population)	Inferred decline of 10-70% based on threats calculator, declines in both IAO and EOO	COSEWIC 2016
Michigan	SNR	Unknown	NatureServe 2017
Minnesota	SNR	Unknown	NatureServe 2017
Nunavut	N/A	N/A	N/A
New York	SH	Unknown	NatureServe 2017
Ohio	S5	Unknown	NatureServe 2017
Pennsylvania	S1S2	Unknown	NatureServe 2017
Wisconsin	S3	Unknown	NatureServe 2017

Acronyms

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

EOO: extent of occurrence

ESA: Endangered Species Act

GRANK: global conservation status assessments

IAO: index of area of occupancy

MNRF: Ministry of Natural Resources and Forestry

NHIC: Natural Heritage Information Centre

NNR: Unranked

NRANK: National conservation status assessment

SARA: Species at Risk Act

SNR: unranked

SRANK: subnational conservation status assessment

S1: Critically imperiled

S3: Vulnerable

S5: Secure

IUCN: International Union for Conservation of Nature and Natural Resources

CDSEPO: Le Comité de détermination du statut des espèces en péril en Ontario