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Ontario Species at Risk Evaluation Report for
Purple Wartback
Mulette verruqueuse
(*Cyclonaias tuberculata*)

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

Assessed by COSSARO as Threatened

September 2021

Mulette verruqueuse (*Cyclonaias tuberculisa*)

La moule verruqueuse (*Cyclonaias tuberculisa*) est classée dans la catégorie des espèces menacées en Ontario par le CDSEPO.

La moule verruqueuse est un mollusque d'eau douce longévif, de taille moyenne et à la coquille lourde, dont la présence est limitée au sud-ouest de l'Ontario. Cette espèce vit dans des cours d'eau, petits à grands, aux conditions d'écoulement diverses, et préfère un substrat composé de galets, de gravier et de sable. Elle aurait disparu des sites de la rivière Détroit et du lac Érié où elle se trouvait autrefois, mais est encore présente dans les rivières Ausable, Sydenham et Thames.

On prévoit la poursuite du déclin de la qualité de l'habitat de l'espèce à cause de menaces comme la pollution (ruissellement agricole et urbain), les changements climatiques (sécheresses), les espèces envahissantes (dreissénidés et gobie à taches noires) et le dragage.

Compte tenu du petit nombre de sous-populations, de la réduction des habitats qui lui conviennent et des menaces qui pèsent sur ceux-ci, le CDSEPO désigne la moule verruqueuse comme espèce menacée dans la province de l'Ontario.

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Executive summary

The Purple Wartyback is a long-lived, medium-sized, heavy-shelled fresh water mussel that is restricted to southwestern Ontario. The species occupies small to large rivers with a range of flow conditions and favours a substrate comprised of cobble, gravel, and sand. It is believed to be extirpated from its historical distribution in the Detroit River and Lake Erie, but still persists in the Ausable, Sydenham, and Thames rivers.

The habitat in which this species occurs is projected to continue to decline in quality, as a result of threats that include pollution (agricultural and urban run-off), climate change (droughts), invasive species (dreissenids and Round Goby), and dredging.

Based on the limited number of sub populations and decrease and threats to suitable habitats, COSSARO designates the Purple Wartyback as Threatened within the province of Ontario.

1. Eligibility for Ontario status assessment

1.1. Eligibility conditions

1.1.1. Taxonomic distinctness

The following description of Purple Wartyback was adapted from Clarke (1981), Parmalee and Bogan (1998), Metcalfe-Smith *et al.* (2005) and Watters *et al.* (2009) *Cyclonaias tuberculata* (Purple Wartyback) is laterally compressed to moderately inflated with a circular to sub-quadrangle shape. The periostracum is yellow or yellow-green in juveniles and may possess fine green rays. In adults the colour is often yellow-green progressing to reddish-brown and the rays are usually lost. The anterior of the shell remains smooth while the rest of the shell surface is covered in prominent pustules that follow the growth lines. The pustules extend onto the beak (umbonal) region and may form ridges along the dorsal wing. Beaks are low and wide and beak sculpture consists of numerous fine ridges that form a chevron pattern. In Canada adults reach a maximum length of 200 mm.

Teeth are massive, heavy and complete. Pseudocardinal teeth are wide and serrated; the lateral teeth are short and slightly curved. Adductor muscle scars are obvious and the pallial line is complete and well-removed from the ventral margin. Nacre is usually purple but may be centrally white with purple outside the pallial line.

Purple Wartyback is one of the most easily identifiable mussels in Canada.

1.1.2. Designatable units

The Purple Wartyback is designated by COSEWIC as a single designatable unit, which includes populations that occur in Ontario.

1.1.3. Native status

The Purple Wartyback is native to Ontario, with a known distribution in southwestern Ontario.

1.1.4. Occurrence

There is no information specific to the population genetic structure of Purple Wartyback within the Great Lakes or 3 extant subpopulations of Purple Wartyback in Ontario corresponding to the 3 watersheds within which it can still be found (Ausable River, Sydenham River, Thames River) in Southwestern Ontario.

Surveys detected striking declines of unionid populations after the invasion of Zebra

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Mussel (*Dreissena polymorpha*) and Quagga Mussel (*D. rostriformis*) in the Detroit River, noting extirpations of numerous species (Schloesser *et al.* 1998). More recent surveys re-examined sites in the Detroit River and determined unionid densities were too low to support viable reproducing populations, concluding that all unionid species (including the Purple Wartyback) have been extirpated from the Detroit River (Schloesser *et al.* 2006).

1.2. Eligibility results

Purple Wartyback (*Cyclonaias tuberculata*) is eligible for status assessment in Ontario.

2. Background information

2.1. Current designations

- GRANK: G5 (NatureServe 2021)
- IUCN: Near Threatened (June 10, 2015)
- NRANK Canada: N2 (NatureServe 2021)
- COSEWIC: Threatened (May, 2021)
- SARA: Not Currently Listed
- ESA 2007: Not Currently Listed
- SRANK: S2 (2020)

2.2. Distribution in Ontario

Canadian subpopulations for the Purple Wartyback are located in Ontario, within the Great Lakes – Upper St Lawrence National Freshwater Biogeographic Zone. There is no evidence to suggest the presence of local adaptations (e.g., morphological differences) or significant genetic structure within any Ontario subpopulations (COSEWIC 2021).

2.3. Distribution, status and the broader biologically relevant geographic range outside Ontario

Purple Wartyback was historically widespread throughout eastern North America having been recorded in 20 American states and one Canadian province. The historical distribution ranged from southwestern Ontario south to Mississippi, east to North Carolina, and west to Oklahoma. In the United States it has been recorded in Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Virginia, West Virginia, and Wisconsin (NatureServe 2021). Purple Wartyback is now thought to be extirpated from Pennsylvania and South Dakota (NatureServe 2021).

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Table 1. Condition of Purple Wartyback in Adjacent Jurisdictions and Broader Biologically Relevant Geographic Range

Adjacent Jurisdictions	Biologically Relevant to Ontario (n/a, yes, no)	Condition	Notes & Sources
Quebec	n/a		
Manitoba	n/a		
Michigan	Yes	S2	Nature Serve 2021
Minnesota	No	S1	Nature Serve 2021
Nunavut	n/a		
New York	n/a		
Ohio	Yes	S3	Nature Serve 2021
Pennsylvania	No	SH	Nature Serve 2021
Wisconsin	No	S2	Nature Serve 2021
Alabama	No	S5	Nature Serve 2021
Arkansas	No	S3?	Nature Serve 2021
Illinois	No	S2?	Nature Serve 2021
Indiana	No	S4	Nature Serve 2021
Iowa	No	S2	Nature Serve 2021
Kansas	No	S1	Nature Serve 2021
Kentucky	No	S4S5	Nature Serve 2021
Mississippi	No	S1	Nature Serve 2021
Missouri	No	S1	Nature Serve 2021
North Carolina	No	S1	Nature Serve 2021
Oklahoma	No	SNR	Nature Serve 2021
South Dakota	No	SH	Nature Serve 2021
Tennessee	No	S4	Nature Serve 2021
Virginia	No	S2	Nature Serve 2021

2.4. Ontario conservation responsibility

Less than 5% of the global range of the species occurs in Ontario.

2.5. Direct threats

Based on the COSEWIC Threats Calculator completed October 17, 2019, Pollution and Climate Change & Severe Weather represent the two most significant threats to Purple Wartyback in Ontario. The three southern Ontario watersheds where the species is still found are predominantly agricultural with high inputs of agricultural run-off, largely through tile drainage systems. Freshwater mussels are sensitive to elevated levels of phosphorous and nitrogen and agricultural waste products. Elevated total suspended solids associated with agricultural watersheds can impair reproduction and lead to

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decreased feeding in mussels. Freshwater mussels have been identified as a group likely to be highly impacted by climate change in Ontario in part because of their sessile nature and dependence on another animal to complete their life cycle. Data suggest that the Ausable, Sydenham and Thames Rivers are highly to extremely vulnerable to the effects of climate change.

2.6. Specialized life history or habitat use characteristics

Purple Wartyback are a member of the Family Unionidae and are obligate parasites and cannot complete their life cycle without a period of encystment on a vertebrate host. Purple Wartyback hosts are believed to be Channel Catfish, Black Bullhead, and Yellow Bullhead.

Purple Wartyback in Ontario are generally found in areas with cobble, gravel, and sand as these made up at least 80% of the substrate in quadrats where the species was observed in both the Sydenham and Thames Rivers. Typically, these areas will have moderate to swift currents (Metcalf-Smith *et al.* 2005) and mean water velocities in the Sydenham and Thames Rivers were 0.66 and 0.43 m/s, respectively (Morris unpub. data). According to Parmalee and Bogan (1998), Purple Wartyback can be found at depths of 0.6 m up to 6 m; however during surveys in Ontario in the summer months, mean water depths were 0.32 m in the Sydenham River and 0.34 m in the Thames River.

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

Not applicable. Population trends are unknown

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

Meets **Threatened** B1ab(iii)+2ab(iii).

The EOO (5015 km²) and IAO (664 km²) are both below thresholds for Threatened (20,000 km² and 5,000 km² respectively). There are 5 or fewer locations (a), and there is an observed and projected decline in habitat quality (iii) based on threats from pollution, invasive species, dredging, and climate change.

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

Not applicable. Estimated number of mature individuals exceeds thresholds.

3.1.4. Criterion D – Very small or restricted total population

Not applicable. Estimated number of mature individuals exceeds thresholds.

3.1.5. Criterion E – Quantitative analysis

Not applicable. Analysis not conducted.

3.2. Application of Special Concern in Ontario

Not applicable.

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

The species is not globally at risk (G5) and less than 5% of the global range is found within Ontario. Ontario's conservation responsibility is considered low.

3.3.2. Status modification based on rescue effect or level of risk in broader biologically relevant geographic range

Due to the biological reproduction of this species, rescue effect from other established populations is highly unlikely and no status modifications were made to the assessment.

Although some hosts of Purple Wartyback are capable of largescale movement on the order of tens to hundreds of kilometers, it is unlikely that the Canadian subpopulations of Purple Wartyback will be subject to rescue from U.S subpopulations as the status of U.S. subpopulations within the Lake Huron and Erie drainages ranges from Vulnerable to Possibly Extirpated (Table 6). In addition, Zanatta *et al.* (2015) surveyed 25 sites in U.S. waters within the Detroit River and the western basin of Lake Erie and found no Purple Wartyback indicating that rescue of Canadian subpopulations in these waterbodies from U.S. waters is not likely (COSEWIC 2021).

Status modification does/does not apply based on level of risk in broader biologically relevant geographic range, as the State of Ohio has an S3 rank for this species and considers this species to be of Special Concern. All other states that border Ontario and the Great Lake of rankings equal or higher than Ontario, except Ohio. The Purple Wartyback is more of a conservation concern in the northern parts of its range but is stable in the southern reaches (Williams et al., 2008).

Commented [TH1]: Missing a discussion of BBRR and condition of the species. Needs to be added – distinct from rescue effect

Commented [n2R1]:

3.4. Other status categories

3.4.1. Data deficient

Not applicable.

3.4.2. Extinct or extirpated

Not applicable.

3.4.3. Not at risk

Not applicable.

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4. Summary of Ontario status

Purple Wartyback (*Cyclonaias tuberculata*) is classified as Threatened in Ontario based on meeting criterion B1ab(iii)+2ab(iii) as both the EOO and IAO are below criteria, and only 5 known sub populations that are risk to impacts on habitat quality.

The status of Threatened for this species is consistent with the definition of status under the Endangered Species Act, 2007.

5. Information sources

Clarke, A.H. 1981. The Freshwater Molluscs of Canada. National Museum of Natural Sciences/National Museums of Canada. Ottawa, Ontario. 446 pp.

COSEWIC. 2021. IN PRESS. COSEWIC assessment and status report on the Purple Wartyback *Cyclonaias tuberculata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 64 pp. (<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>).

Metcalfe-Smith, J.L., A. MacKenzie, I. Carmichael, and D. McGoldrick. 2005. Photo field guide to the freshwater mussels of Ontario. St. Thomas Field Naturalist Club Inc., St. Thomas, Ontario. 61 pp.

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Zanatta, D.T., J.M. Bossenbroek, L.E. Burlakova, T.D. Crail, F. de Szalay, T.A. Griffith, D. Kapusinski, A.Y. Karateyev, R.A. Krebs, E.S. Meyer, W.L. Paterson, T.J. Prescott, M.T. Rowe, D.W. Schloesser, and M.C. Walsh. 2015. Distribution of native mussel (Unionidae) assemblages in coastal Lake Erie, Lake St. Clair, and connecting channels, twenty-five years after the dreissenid invasion. Northeastern Naturalist 22: 223–235

Appendix 1: Technical summary for Ontario

Species: Purple Wartyback (*Cyclonaias tuberculata*)

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.	10-20 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Unknown. Suspected decline based on continuing declines in habitat, but there are insufficient data to determine. _____.
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	Unknown
Are the causes of the decline (a) clearly reversible, and (b) understood, and (c) ceased?	a. Unknown b. No 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). <i>If value in COSEWIC status report is not applicable, then use geocat.keew.org. State source of estimate.</i>	5015 km ²
Index of area of occupancy (IAO). <i>If value in COSEWIC status report is not applicable, then use geocat.keew.org. State source of estimate.</i>	664 km ²
Is the total population severely fragmented?	a. No

Extent and occupancy attributes	Value
<p>i.e., is >50% of its total area of occupancy is in habitat patches that are: (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?</p>	<p>b. No</p>
<p>Number of locations. See <i>Definitions and Abbreviations on COSEWIC and IUCN websites for more information on the term "location"</i>. Use plausible range to reflect uncertainty if appropriate.</p>	<p>4 (1-5) 1. Ausable River 2. Sydenham River 3. Thames River (including the South Thames and Thames River) 4. North Thames River (above Fanshawe Reservoir) 5. Black Creek (may not be viable population)</p>
<p>Number of NHIC Element Occurrences Request data from MNR.</p>	<p>228</p>
<p>Is there an observed, inferred, or projected continuing decline in extent of occurrence?</p>	<p>Unknown. There has been a decline from historical values prior to Dreissenid mussel invasion of the Great Lakes. There may be a continued decline based on continuing declines in habitat, but there are insufficient data to determine.</p>
<p>Is there an observed, inferred, or projected continuing decline in index of area of occupancy?</p>	<p>Unknown. There has been a decline from historical values prior to Dreissenid mussel invasion of the Great Lakes. There may be a continued decline based on continuing declines in habitat, but there are insufficient data to determine.</p>
<p>Is there an observed, inferred, or projected continuing decline in number of sub-populations or EOs?</p>	<p>Unknown. Suspected decline based on continuing declines in habitat, but there are</p>

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Extent and occupancy attributes	Value
	insufficient data to determine.
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown. Suspected decline based on continuing declines in habitat, but there are insufficient data to determine.
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes. There is a projected continuing decline in quality of habitat.
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

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

Sub-population (or total population)	Number of mature individuals
Ausable R,	24,000 (\pm 7,000)
Sydenham R.	5,400,000 (\pm 1,600,000)
Thames R.	2,400,000 (\pm 1,100,000)
Total	7,824,000 (\pm 2,707,000)

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is Unknown

Threats

A threats calculator prepared for the Purple Wartyback was completed in October 17, 2019 by COSEWIC.

- i. Threat 9: Pollution (MEDIUM-LOW impact)
- ii. Threat 11: Climate Change and Severe Weather (MEDIUM – LOW impact)
- iii. Threat 8: Invasive and other problematic species and genes (LOW impact)

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What additional limiting factors are relevant?

Freshwater mussels of the Family Unionidae are obligate parasites and cannot complete their life cycle without a period of encystment on a vertebrate host. Purple Wartyback hosts are believed to be Channel Catfish, Black Bullhead, and Yellow Bullhead.

Rescue effect

Rescue effect attribute	Value
Does the broader biologically relevant geographic range for this species extend beyond Ontario?	Yes
Status of outside population(s) most likely to provide immigrants to Ontario	U.S. populations in the adjacent Great Lakes states range from vulnerable to possibly extirpated.
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Possibly
Would immigrants be adapted to survive in Ontario?	Possibly
Is there sufficient suitable habitat for immigrants in Ontario?	Yes
Are conditions deteriorating in Ontario?	Yes
Is the species of conservation concern in bordering jurisdictions?	Yes
Is the Ontario population considered to be a sink?	No
Is rescue from outside populations likely?	No

Sensitive species

No data sensitivity with this species.

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Acronyms

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

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

ESA: Endangered Species Act

EO: Element occurrence (as defined by NHIC)

EOO: extent of occurrence

GRANK: global conservation status assessments

IAO: index of area of occupancy

IUCN: International Union for Conservation of Nature and Natural Resources

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

S2: Imperiled

S3: Vulnerable

S4: Apparently Secure

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