

**Ontario Species at Risk Evaluation Report for
Rainbow (*Villosa iris*)**

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

Assessed by COSSARO as Special Concern

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Final

Villeuse irisée (*Villosa iris*)

La villeuse irisée est une petite moule d'eau douce qui tient son nom de l'intérieur de sa coquille blanc-argenté et iridescent. Elle préfère les rivières de petite et de moyenne taille, mais on la trouve aussi dans certains lacs. Il est difficile de différencier les mâles des femelles. Le frai survient à la fin de l'été, et le glochidium (larve), conservé tout l'hiver, est libéré au début du printemps. Les glochidia parasitent les poissons, privilégiant plusieurs espèces. Adulte, la villeuse irisée est un organisme filtreur, alors que les juvéniles s'enfouissent complètement dans le substrat. Au Canada, on ne trouve les villeuses irisées que dans le Sud de l'Ontario.

L'espèce est probablement disparue des rivières Niagara et Detroit et de la plupart de ses habitats antérieurs dans les lacs Érié et St. Clair, et le déclin de sa population se poursuit dans le delta de la rivière Sainte-Claire. On compte des populations assez importantes dans les bassins versants des rivières Maitland, Saugeen et Trent. La villeuse irisée reste répandue en Ontario, dépassant les valeurs minimales d'une espèce menacée quant à la taille et au déclin de sa population et de son aire de distribution. La dégradation de la qualité de l'habitat de la villeuse irisée se poursuit en Ontario, et ses deux plus grandes menaces – les espèces envahissantes (particulièrement la moule zébrée et le gobie à taches noires) et la pollution –, plutôt que de s'atténuer, pourraient s'intensifier avec le temps.

La villeuse irisée a été dégradée au rang d'espèce préoccupante. L'étendue de sa distribution et le recensement de nouvelles populations (notamment dans le bassin de la baie de Quinte) justifient sa classification comme espèce préoccupante.

Cette publication hautement spécialisée «COSSARO Candidate Species at Risk Evaluation for Rainbow» n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n'est pas obligatoire de la traduire en vertu de la Loi sur les services en français. Pour obtenir des renseignements en français, veuillez communiquer avec le ministère des Richesses naturelles et des Forêts au recovery.planning@ontario.ca.

Executive summary

Rainbow (formerly referred to as Rainbow Mussel on the SARO List) is a small freshwater mussel that gets its name from the silvery white and iridescent inner shell. Rainbow prefers small to medium-sized rivers, but can also be found in inland lakes. It is difficult to tell males and females of this species apart. It spawns in the late summer and releases glochidia (larvae) in the early spring after brooding them overwinter. Glochidia are parasitic on fishes, and have several potential host species. Adult Rainbow are filter feeders, whereas juveniles live completely burrowed in the substrate. In Canada, Rainbow are found only in southern Ontario.

This species has likely been extirpated from the Niagara and Detroit rivers and most of its previously inhabited areas within Lakes Erie and St. Clair. A declining population remains in the St. Clair River delta. Relatively large populations remain in the Maitland, Saugeen and Trent River watersheds. Rainbow remains widespread in Ontario and is above the minimum values for Threatened according to both population size/decline and range size/decline. The quality of Rainbow habitat continues to decline in Ontario, and the two greatest threats to Rainbow, invasive species (particularly dreissenid mussels and Round Goby) and pollution have not been abated and may worsen over time.

Rainbow has been downlisted to Special Concern. A widespread distribution and the identification of previously unknown populations (e.g., Bay of Quinte drainage) support the listing of this species as Special Concern.

1. Background information

1.1. Current designations

- GRANK: G5Q (NatureServe 2016)
- NRANK Canada: N2N3
- COSEWIC: Special Concern (November 2015)
- SARA: Endangered (Schedule 1)
- ESA 2007: Threatened (2007)
- SRANK: S2S3

1.2. Distribution in Ontario

Records of Rainbow in Ontario come from the Ausable, Bayfield, Detroit, Grand, Maitland, Moira, Niagara, Salmon, Saugeen, Sydenham, Thames and Trent river watersheds, as well as Lakes Ontario, Erie and St. Clair. The species appears to have been lost from the lower Great Lakes and connecting channels, except for the delta area of Lake St. Clair, and is still extant in all rivers that it historically occupied, with the exception of the Detroit and Niagara rivers.

1.3. Distribution and status outside Ontario

Rainbow was once widely distributed in eastern North America from New York and Ontario west to Wisconsin and south to Oklahoma, Arkansas and Alabama. In the United States it has been recorded from Alabama, Arkansas, Illinois, Indiana, Kentucky, Michigan, Missouri, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Tennessee, Virginia, West Virginia and Wisconsin/ Rainbow is considered overall secure in the U.S. (N5), but is legally considered Endangered in several states - (Alabama (S3), Arkansas (S2S3), Illinois (S1), Indiana (S3), Michigan (S2S3), New York (S2S3), North Carolina (S1), Oklahoma (S1), Pennsylvania (S1), West Virginia (S2), and Wisconsin (S1)). The current and historical distributions of Rainbow are comparable, although the species has been declining across the western part of its range in the United States (Cummings and Mayer 1992; Haag 2012).

1.4. Ontario conservation responsibility

The Rainbow distribution in North America covers a range of approximately 200,000-2,500,000 km² (NatureServe, 2015), of which approximately 48,000 km² is in Ontario (<25%) (COSEWIC, 2016).

1.5. Direct threats

The COSEWIC threats calculator identified invasive species and pollution as the two high-impact threats for Rainbow (COSEWIC, 2016). The overall threat impact was calculated as very high.

1) Invasive species (mainly in the eastern locations and Lake St. Clair)

These include the dreissenid mussels Zebra Mussel (*Dreissena polymorpha*) and Quagga Mussel (*D. rostriformis*) which have established in waterways where Rainbow reside, including the Thames, Trent and Moira rivers and Lake St. Clair. This is most notable in the Trent River watershed where dreissenids can form blankets of shells effectively smothering anything below, and where their substrate can include unionid mussels. The invasive Round Goby (*Neogobius melanostomus*) can also negatively impact Rainbow populations by disrupting the host fish relationship, in effect acting as a sink for glochidia and competing with hosts. However, this threat is lessened by the fact that Rainbow has a number of fish host species (including species with large and stable population sizes) in Canada; these include Striped Shiner (*Luxilus chrysocephalus*), Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), Green Sunfish (*Lepomis cyanellus*), Greenside Darter (*Etheostoma blennioides*), Rainbow Darter (*Etheostoma caeruleum*), Yellow Perch (*Perca flavescens*), Mottled Sculpin (*Cottus bairdii*) and Rock Bass (*Ambloplites rupestris*) (COSEWIC, 2016).

2) Pollution (mainly the southwestern locations)

Southwestern Ontario populations of Rainbow are surrounded primarily by agricultural land and urban centres fitted with wastewater treatment facilities. As such, their watersheds are prone to run-off of known toxins to Rainbow (e.g. road salt, endocrine disruptors, ammonia, mercury and copper), phosphorous/nitrogen and increased erosion. In addition, the Moira River has had chronic loading of arsenic and copper from mining activities upstream of where Rainbow reside. Other potential threats include damming and other system modifications, the severity of which are unknown.

1.6. Specialized life history or habitat use characteristics

The glochidia (larvae) of Rainbow are, like most unionid species, parasitic on fish, and have multiple host species. Although Round Goby is a potential threat to host species, host fishes are considered a minor limiting factor for Rainbow (COSEWIC, 2016).

2. Eligibility for Ontario status assessment

2.1. Eligibility conditions

2.1.1. Taxonomic distinctness

Yes. *Villosa iris* (L. Lea, 1829) is considered a valid and distinct species (Turgeon et al. 1998).

2.1.2. Designatable units

No. There are no known differences among populations that would justify more than a single DU.

2.1.3. Native status

Yes. The earliest records of this species in Canada were collected in the 1890s by J. Macoun, who found specimens in the Detroit River near Windsor, the Grand River near Cayuga, and the Thames River near Chatham (specimens held by the Canadian Museum of Nature) (COSEWIC 2006).

2.1.4. Occurrence

Extant (see Distribution in Ontario).

2.2. Eligibility results

Rainbow (*Villosa iris*) is eligible for status assessment in Ontario.

3. Ontario status assessment

3.1. Application of endangered or threatened status in Ontario

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

Does not apply. The number of mature individuals is unknown but estimated to be over 7 million. Although there have been observed declines in EOO and IAO, inferred declines based on these changes in number of individuals are below threshold values. “There is strong evidence of recent recruitment in six of the seven subpopulations examined” (COSEWIC 2016).

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

Does not apply. Both the EOO (48,051 km²) and AOO (2,532 km² continuous within water bodies) are above the thresholds for Threatened (<20,000 km² and < 2,000 km², respectively), the population is not severely fragmented (although subpopulations are separated from one another making dispersal unlikely), and there are more than 10 locations. However, a continued decline in EOO, AOO, area, extent and quality of habitat, and number of locations or subpopulations is inferred due to continuing high impact threats (pollution and invasive species).

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

Does not apply. The number of mature individuals is unknown but estimated to be over 7 million. Furthermore, recent surveys identified individuals at previously unknown locations. Although populations at two sites are declining, there is no evidence for an overall decline in recent years.

3.1.4. Criterion D – Very small or restricted total population

Does not apply. D1 is not applicable as the population is neither very small nor

restricted. Does not meet criteria for Threatened D2 with both the AOO and number of locations being well above the typical thresholds. Although the species is subject to threats caused by human activities such as invasive species and pollution, the effects of these threats will not lead to critical endangerment or extinction within 1 or 2 generations (i.e. 15-30 years) after the threats occur.

3.1.5. Criterion E – Quantitative analysis

Insufficient information (analyses have not been done).

3.2. Application of Special Concern in Ontario

Special Concern. Systematic and targeted sampling of watersheds for freshwater mussels began in 1997, and the 341 records collected between 1997 and 2014 show that Rainbow still reside in the majority of the 14 historical waterbodies plus the Bayfield River (COSEWIC, 2016). Recent surveys identified large numbers of individuals in previously unknown localities. However, Rainbow has been extirpated from the Detroit River, Lake Erie, Niagara River, and Lake Ontario. Furthermore, two extant populations (Ausable River and Lake St. Clair) are declining, and the species remains susceptible to high-impact threats (identified by the COSEWIC threats calculator) that are unlikely to abate, and may indeed increase, in the foreseeable future: invasive species (particularly dreissenid mussels and Round Gobies) and pollution. These threats contribute to an ongoing decline in habitat quality, which means that Rainbow may become threatened in the future if extant populations are not managed. The Special Concern modifier thus applies as the species is likely to become Threatened if factors suspected of negatively influencing the persistence of the species are neither reversed nor managed with demonstrable effectiveness

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

N/A. Ontario represents a small percentage of the global population and range,

3.3.2. Rescue effect

Rescue effect is unlikely.

Other status categories

3.3.3. Data deficient

N/A

3.3.4. Extinct or extirpated

N/A

3.3.5. Not at risk

N/A

4. Summary of Ontario status

Rainbow (*Villosa iris*) is classified as Special Concern in Ontario based on meeting the criterion that the species is likely to become Threatened if threats that have been identified as high-impact (i.e. invasive species, pollution) are neither reversed nor managed with demonstrable effectiveness.

5. Information sources

COSEWIC. 2006. [COSEWIC assessment and status report on the Rainbow mussel *Villosa iris* in Canada.](#) Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 38 pp.

COSEWIC. 2016. [COSEWIC assessment and status report on the Rainbow *Villosa iris* in Canada.](#) Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 82 pp.

Cummings, K.S., and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. 194 pp.

Haag, W.R. 2012. North American Freshwater mussels. Cambridge University Press, New York, New York. 505 pp.

NatureServe. 2015. [NatureServe Explorer: An online encyclopedia of life \[web application\].](#) Version 7.1. NatureServe, Arlington, Virginia. Accessed June 23, 2016.

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. 526 pp.

Appendix 1: Technical summary for Ontario

Species: Rainbow (*Villosa iris*)

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.	15 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 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. 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. (Request value from MNR or use http://geocat.kew.org/)	48,051 km ²
Area of occupancy (AOO). (Request value from MNR or use http://geocat.kew.org/)	2,532 km ²

<p>Is the total population severely fragmented? (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>a. No b. Yes</p>
<p>Number of locations (<i>as defined by COSEWIC</i>).</p>	<p>14 (range 11 – 17). Based on High impact threat of Invasive nonnative/alien species (in particular dreissenids and Round Goby) and the Medium-High impact threats of Household sewage and urban wastewater and Agricultural and forestry effluents.</p>
<p>Number of NHIC Element Occurrences (<i>Request data from MNRF</i>)</p>	<p>Data not available.</p>
<p>Is there an observed, inferred, or projected continuing decline in extent of occurrence?</p>	<p>Observed past decline of 38% from 1890-2014. Inferred continuing decline based on continuing threats (pollution and invasive species). St. Clair delta location is very small and apparently still declining. If lost this will result in a reduction in EOO</p>
<p>Is there an observed, inferred, or projected continuing decline in area of occupancy?</p>	<p>Observed past decline of 30% since 1997. Inferred continuing decline based on continuing threats (pollution and invasive species). St. Clair delta location is very small and apparently still declining. If lost this will result in a reduction in AOO</p>
<p>Is there an observed, inferred, or projected continuing decline in number of populations?</p>	<p>Inferred continuing decline based on continuing threats (pollution and invasive species). St. Clair delta location is very small and apparently still declining. If lost this will result in a reduction of number of subpopulations.</p>

Is there an observed, inferred, or projected continuing decline in number of locations?	Inferred continuing decline based on continuing threats (pollution and invasive species). St. Clair delta location is very small and apparently still declining. If lost this will result in a reduction of locations.
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Observed 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)	N of Mature Individuals
Ausable River	5,900-18,000
Bayfield River	74,000
Grand River	4,700-45,000
Lake St. Clair	1,500
Maitland River	2,000,000 - 6,500,000
Moira River	Unknown
Salmon River	Unknown
Saugeen River	520,000 – 880,000
Sydenham River	17,000 – 18,000
Thames River	48,000 – 94,000
Trent River	Unknown

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. N/A

Rescue effect

Rescue effect attribute	Likelihood
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Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Possible for St. Clair delta location, unlikely for all others
Would immigrants be adapted to survive in Ontario?	Probably
Is there sufficient suitable habitat for immigrants in Ontario?	Probably
Is the species of conservation concern in bordering jurisdictions?	Yes: Michigan S2S3 Pennsylvania S1 Ohio SNR New York S2S3
Is rescue from outside populations reliant upon continued intensive recovery efforts?	No

Appendix 2: Adjoining jurisdiction status rank and decline

Information regarding status rank and decline for Rainbow

Jurisdiction	Subnational rank	Population trend	Sources
Quebec	Not Present	N/A	NatureServe 2015
Manitoba	Not Present	N/A	NatureServe 2015
Michigan	S2S3	Unquantified	NatureServe 2015
Minnesota	Not Present	N/A	NatureServe 2015
Nunavut	Not Present	N/A	NatureServe 2015
New York	S2S3	Unquantified	NatureServe 2015
Ohio	SNR	Unquantified	NatureServe 2015
Pennsylvania	S1	Unquantified	NatureServe 2015
Wisconsin	S1	Unquantified	NatureServe 2015

Acronyms:

AOO: area of occupancy

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

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

EOO: extend 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

S2 : Imperiled

S3: Vulnerable