A method to assess the general status of freshwater fishes in Ontario, in support of the Wild Species 2025 General Status of Species in Canada report

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ABSTRACT

Dunn, A.D., Colm, J.E., Pratt, T.C., and Drake, D.A.R. 2025. A method to assess the general status of freshwater fishes in Ontario, in support of the *Wild Species* 2025 General Status of Species in Canada report. Can. Man. Rep. Fish. Aquat. Sci. 3334: vii + 27 p. https://doi.org/10.60825/5zn2-pv30

As part of commitments to monitor, assess, and report on the status of wildlife species in Canada, a report series, *Wild Species: General Status of Species in Canada*, was created and is updated quinquennially on a jurisdictional basis. In support of the 2025 *Wild Species* report, an assessment was undertaken on 159 freshwater fishes in Ontario using NatureServe's Conservation Rank Calculator. Species data were compiled from regional data sources, historical range mapping, and published literature, and analyzed using GIS to complete the calculator. Calculated ranks were reviewed by species experts, and a new rank was assigned when the calculated rank did not reflect the species' true status. Of the 159 species assessed, 42 species were ranked as S5 (least imperilled), 41 species as S4, 15 species as S3, nine species as S2, eight species as S1 (most imperilled), six species spanned two ranks, five were unrankable due to limited information, four were considered extirpated, and ranks were not applicable for the remaining 29 species as they are not native to Ontario. Compared to the previous assessment in 2020, 31 species experienced a change in rank. Four of the changed ranks are believed to reflect a genuine change in status (two positive, two negative), and the remaining 27 changes relate to taxonomy, new information, or a new interpretation (largely methodological). Some of the highest weighted factors in the calculator were described by the land-based area of Ontario, resulting in challenges in interpretation and/or completion for freshwater fishes. Deviations from the calculator and potential improvements for assessing freshwater species are discussed.

RÉSUMÉ

Dunn, A., Colm, J.E., Pratt, D., and Drake, D.A.R. 2025. A method to assess the general status of freshwater fishes in Ontario, in support of the *Wild Species* 2025 General Status of Species in Canada report. Can. Man. Rep. Fish. Aquat. Sci. 3334: vii + 27 p. https://doi.org/10.60825/5zn2-pv30

Dans le cadre des engagements à surveiller et à évaluer la situation des espèces sauvages au Canada et à en faire rapport, une série de rapports intitulée Espèces sauvages : la situation générale des espèces au Canada a été créée et est mise à jour tous les cinq ans. À l'appui du rapport *Espèces sauvages* 2025, une évaluation a été entreprise sur 159 poissons d'eau douce en Ontario à l'aide du calculateur de cote de conservation de NatureServe. Les données sur les espèces ont été compilées à partir de sources de données régionales, de cartes historiques des aires de répartition et de publications publiées, et analysées à l'aide d'un SIG pour compléter le calculateur. Les classements calculés ont été examinés par des experts de l'espèce, et un nouveau classement a été attribué lorsque le classement calculé ne reflétait pas la véritable situation de l'espèce. Sur les 159 espèces évaluées, 42 espèces ont été classées S5 (moins en péril), 41 espèces S4, 15 espèces S3, neuf espèces S2, huit espèces S1 (la plus en péril), six espèces se classaient dans deux rangs, cinq étaient inclassables en raison de l'information limitée, quatre étaient considérées comme disparues de l'Ontario et les 29 autres espèces ne s'appliquaient pas, car elles ne sont pas indigènes de l'Ontario. Par rapport à l'évaluation précédente en 2020, 31 espèces ont connu un changement de classement. Quatre des classements modifiés sont censés refléter un véritable changement de statut (deux positifs, deux négatifs), et les 27 autres changements concernent la taxonomie, de nouveaux renseignements ou une nouvelle interprétation (principalement méthodologique). Certains des facteurs les plus pondérés dans la calculatrice ont été décrits par la taille de la région terrestre de l'Ontario, ce qui a entraîné des difficultés d'interprétation ou d'achèvement pour les poissons d'eau douce. Les écarts par rapport au calculateur et les améliorations potentielles pour l'évaluation des espèces d'eau douce sont discutés.

INTRODUCTION

Approximately 80,000 terrestrial and aquatic species are known to occur in Canada (excluding viruses and bacteria), with many more species likely undetected owing to insufficient sampling effort and the arrival of new species (Canadian Endangered Species Conservation Council [CESCC] 2022). Many species are experiencing changes in abundance or distribution due to changes in the environment, largely stemming from impacts of human activities. Understanding the state of species in Canada and the effectiveness of conservation measures has become a significant priority for community members, public and private entities, and government agencies across the country.

In 1996, under the Accord for the Protection of Species at Risk, wildlife ministers in Canada made the commitment to "monitor, assess and report regularly on the status of all wild species" in Canada. This commitment was further solidified in 2002 by the federal government in section 128 of the *Species at Risk Act* (SARA), which stipulated that "five years after this section comes into force and at the end of each subsequent period of five years, the Minister must prepare a general report on the status of wildlife species" (CESCC 2022). As a result of that commitment, the *Wild Species: General Status of Species in Canada* reporting series was created. The reports generated from the *Wild Species* series effectively fulfill the requirements of both commitments, while also providing a useful tool that summarizes research, data, and expert opinion to inform the status of species across the country (CESCC 2022). The reports serve to catalogue all species occurring in Canada and their distributions, and are a first step in identifying species that are potentially at risk of extinction.

Through the *Wild Species* reporting, species are assessed using a standardized approach in each province or territory in Canada, and then species ranks are rolled up to a national level. In 2020, 224 species of freshwater fish, including established non-native fishes, were identified and assessed in Canada (CESCC 2022). Of those, 156 species were identified as occurring in Ontario and were assessed at the species level across the province. The 2025 assessment re-evaluated these species using the Conservation Rank Calculator developed by NatureServe (Faber-Langendoen et al. 2012) to determine and/or confirm the species' status and summarize supporting information. The approach with which the data were analyzed and summarized for inclusion in the Conservation Rank Calculator is provided herein.

METHODS

Multiple steps were completed to ensure that a comprehensive review of the species present in Ontario was undertaken. Steps taken with detailed measures are provided below.

1. REVISING THE SPECIES LIST

To ensure both accuracy in species naming and to include updated taxonomy, an initial review of the species list from the 2020 *Wild Species* general assessments was completed. In doing so, species were reviewed with the following considerations:

Taxonomy:

A review of all scientific names and common names in both French and English was completed. Taxonomic revisions from Page et al. (2023) were incorporated, and the American Fisheries Society (AFS) Fish Name Spellchecker (2024) was used to verify species spelling for accuracy. Any additions or changes to the species taxonomy were identified in separate columns to easily identify and maintain records of changes for each species. Only biological species were assessed; subspecies, recognized designatable units, hybrids, or varieties were not considered.

Presence in Ontario:

A review of species found in Ontario was completed, first by reviewing the original species list of Ontario freshwater fishes assessed as part of the 2020 *Wild Species* report. This list was then compared to other data sources including jurisdictional conservation data centres, species reference manuals, citizen science reporting, and reference websites. Specific resources reviewed as part of the 2025 assessment included:

- NatureServe
- Ontario Natural Heritage Information Centre
- iNaturalist
- Ontario Freshwater Fish Life History Database
- A Field Guide to Freshwater Fishes of Ontario (Holm et al. 2022)
- Species at Risk Public Registry
- DFO Fish Biodiversity Database for Ontario

Species identified as being native to Ontario, and introduced species with established populations or that have been detected across multiple years within Ontario waters, were confirmed on the list.

2. ASSESSMENT PRIORITIZATION

The species list was reviewed to ensure that species with inconsistent rankings across resources, or with new available data were prioritized for reassessment in 2025. This prioritization followed the steps below:

1. Species ranks from the 2015 and 2020 *Wild Species* reports were added to the 2025 species list and compared to highlight species where a change in status had occurred in Ontario based on previous assessments.
2. Species ranks from additional published sources were added to determine variation between sources. This included rank information from NatureServe, the Ontario Natural Heritage Information Centre, and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status assessment reports. All ranks were compared to determine consistency across the different platforms. Species with large discrepancies across platforms were highlighted.
3. The 2025 species list was then compared against the Species at Risk Public Registry to identify species with a recent and/or updated COSEWIC assessment.
4. A further evaluation was completed against the 2022 COSEWIC Freshwater Fishes Species Specialist Sub-committee Candidate List (unpublished) to identify species with potential at-risk status. Candidate species were categorized from expert comments on the candidate list as follows:
    - Candidate 1: Comments identified species with “possible at-risk status”.
    - Candidate 2: Comments identified potential fluctuations in candidacy status (e.g., added to the list, removed, re-added).
    - Candidate 3: Comments identified that species is likely not at risk or relatively stable in Ontario.

From this information, species were prioritized based on variation in published ranks, followed by candidacy status. While this prioritization step was completed as a precautionary measure, all species considered present (as defined above) in Ontario were assessed as part of the 2025 reassessment process.

3. RANK ASSESSMENT:

The rank assessment process for freshwater fishes in Ontario used the Conservation Rank Calculator developed by NatureServe (Faber-Langendoen et al. 2012). The Conservation Rank Calculator is a tool that automates and standardizes the assignment of a conservation rank. The calculator uses 10 different conservation status factors, and a minimum of two from the core eight (two factors are optional) are required to develop the calculation (Table 1). The two (minimum) conservation status factors must include either two rarity category factors with at least one of either the “Range Extent” or “Area of Occupancy”, or one rarity category factor and a second factor from either the threats or trends categories (Faber-Langendoen et al. 2012).

Table 1. Conservation Status Categories and Factors used as part of the Conservation Rank Calculation (adapted from Faber-Langendoen et al. 2012). The Rarity factor has a weighting of 0.7, and the Threat factor has a weighting of 0.3.

Conservation Status Category	Conservation Status Factor
Rarity: Range/Distribution	Range Extent
Rarity: Range/Distribution	Area of Occupancy
Rarity: Abundance/Condition	Number of Occurrences
Rarity: Abundance/Condition	Population Size
Rarity	Good viability/Ecological Integrity
Rarity	Environmental Specificity
Threat	Assigned Overall Threat Impact
Threat	Intrinsic Vulnerability
Trends	Short-term trend
Trends	Long-term trend

It is important to note that the Conservation Rank Calculator was designed with terrestrial species and ecosystems in mind. As such, some parameters were interpreted differently to accommodate estimates of freshwater fishes within lakes and flowing waters. For instance, distribution size (or range extent) estimates in the calculator (i.e., dropdown options) are based on the land area of Ontario and, although alternate methods for aquatic species could have used drainage areas or linear/area calculations of streams and rivers, this detailed information was largely unavailable. Instead, to align with the range extent dropdown options in the calculator, a visual estimate was made by comparing species range maps against identified ecozones in Ontario (Figure 1; Ontario Ministry of Environment, Conservation and Parks 2024). This method was used to try to standardize estimates of area across the province. In doing so, land-based estimates incorporated an approximation of the percent area covered by a species’ distribution within each ecozone in the province (see Table 2 for details and Figure 2 for an example). The calculator offers distribution size ranges that accommodated this method well. For example, aquatic species with very localized distributions could be described with a distribution size ranging 5,000–20,000 km², widely distributed species could be described with a distribution size ranging 200,000–2,500,000 km², or those for which the true distribution size is unknown could be described with a distribution size ranging 5,000–>2,500,000 km^2 .

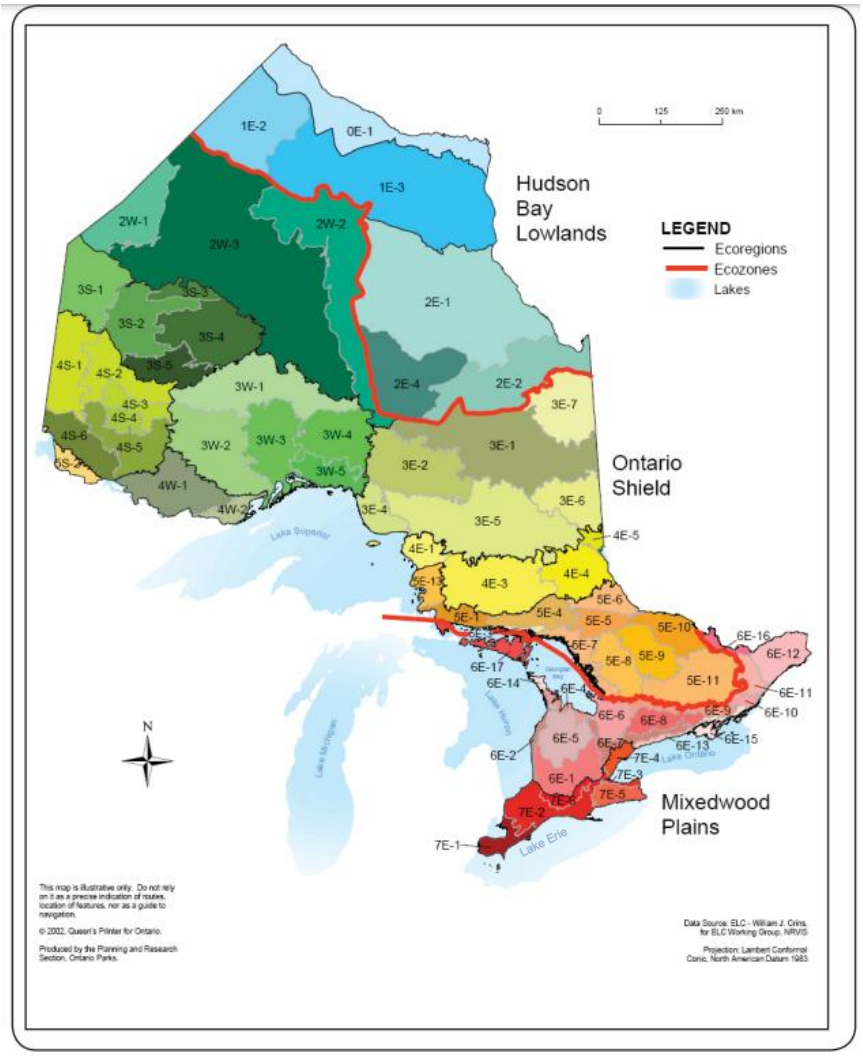


Figure 1. Ontario ecozones, ecoregions, and ecodistricts (Adapted from Ontario Ministry of Environment, Conservation and Parks [OMECP] 2024). See [The ecosystems of Ontario – Part 1: ecozones and ecoregions | ontario.ca](#) for detailed map legend.

Table 2. Approximate percent coverage and area of ecozones in Ontario (adapted from Appendix 1 in Nature Serve Rank Calculator and OMECP 2024).

Ecozone	Percentage Land Cover	Area (km²)
Mixedwood Plains	8.60%	78,926
Ontario Shield	66.20%	607,545
Hudson Bay Lowlands	25.20%	231,270
Area of Ontario		**917,741**

3.1 Compiling Species Information

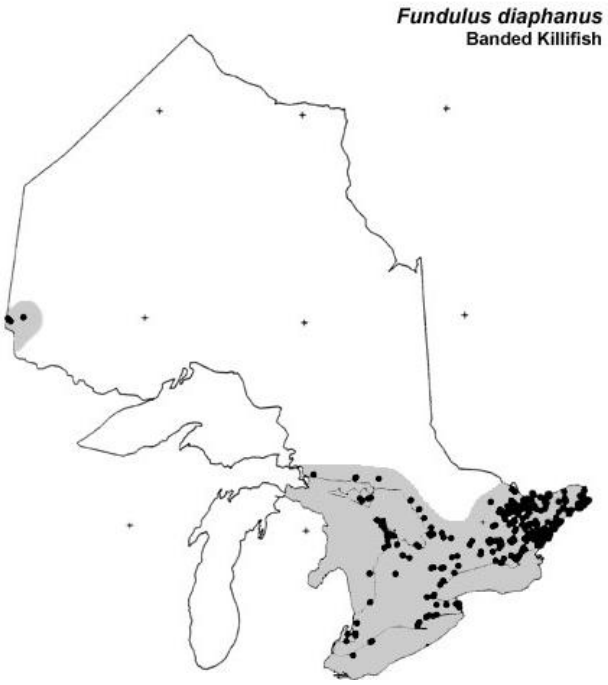
Recent and historical occurrence information for each species was compiled. A combination of inventory data, published research, and expert opinion was used to fill out the conservation status categories in the rank calculator. In an effort to provide quantitative data, specifically for the Rarity component of the calculator, Fisheries and Oceans Canada (DFO) datasets[1] were used (Fish Biodiversity Database, and DFO unpublished data). These datasets are geographically restricted and could only be used for a small number of species, largely those whose ranges fell mainly within southwestern Ontario. Although the reporting date is 2025, the assessments are conducted 1–3 years (taxon-dependent) prior to the reporting year, making the relevant data cycle for the 2025 assessment approximately 2018-2023; however, 2015 was selected as the current cutoff considering the generally limited sampling conducted over a five year period, and the fact that data were not compiled for the previous assessment. Where quantitative data were limited or unavailable (notably in Ontario's far north), qualitative information and historical range mapping were used, and species experts were consulted to provide context and assessment information to assist in informing the ranks.

Rarity

1. Species range maps were reviewed using the Ontario Freshwater Fish Life History Database (OFFLHD) (2024). Range maps within the OFFLHD were adapted from Mandrak and Crossman (1992a).
2. Data within the DFO datasets were compiled and grouped into two distinct time periods: 2002–2014, identified as "historical" (for the purposes here), and 2015–2023 as "recent" (representing the current assessment period with a buffer). Files (.csv) were then uploaded to QGIS Prizen version 3.34 and converted to species-specific point feature layers for viewing in GIS.
3. Range extent – The GIS layers were reviewed individually and compared against the known range in the OFFLHD. Where recent species observations fell largely within the known species' range, the range extent was not estimated within the Conservation Rank Calculator and an area of occupancy was determined instead (detailed in step 4 below). In some instances, the recent observations in the layers covered the majority of the known species' range, but with some areas likely unsampled; additional comments were added in these instances to describe the presumed differences between the known and "recent" range. In some instances, both the range extent and area of occupancy were added, allowing the calculator to determine the best calculation.

   Where recent quantitative data were not available, range extent was estimated by comparing the known species' range in the OFFLHD against the ecozones of Ontario (Figure 1). An estimate of percent land cover was determined based on the approximate coverage of the known species' range in each ecozone (Table 2). The percentage was multiplied against the total area of the province to obtain the estimated land-based range size for the species (an example for Banded Killifish *Fundulus diaphanus* is shown in Figure 2).

[1] Note that additional datasets are available in Ontario but they could not be compiled at the scale required for this assessment in time.



Banded Killifish is found almost exclusively in the Mixedwood Plains, which covers 8.6% of the land area in Ontario (Figure 1, Table 2), and southern limit of the Ontario Shield, with the exception of a small population on the western limit of the Ontario Shield. Based on this distribution, the visually estimated area of range extent for Banded Killifish is ~11% of Ontario.

917,741 (total land area of Ontario) X 11% (coverage by Banded Killifish) = 100,951 km² (range extent).

*Figure 2. Example of a Range Extent estimation for Banded Killifish (*Fundulus diaphanus*). Black dots represent occurrences of Banded Killifish, and grey shading represents the presumed distribution of the species in the province.*

4. Area of occupancy – The area of occupancy was calculated using 1x1 km² grid cells in relation to species observations. A index of grid cells was first created for the full extent of the province of Ontario. This was done within QGIS by selecting vector-research tools, create grid (filling in parameters of 1 km vertical to 1 km horizontal), setting the grid coordinates to WGS 84-Pseudo Mercator, and running the processing tool. The resulting grid was clipped to the provincial boundary.

   To determine the area of occupancy, species observation data were used to identify all 1x1 km² grid cells where an observation was recorded. This was conducted for both the "historical" and "recent" data for each species. Grid cells where observations have occurred were identified by opening the processing toolbox - vector selection - extract by location. In the parameters field, the grid feature layer (Grid Ontario Clip) was selected under "extract features from". Under "Where the features" the "contain" analysis was selected. Under "by comparing to the features from" the species' layer of interest was selected (an example for Pugnose Shiner *Miniellus anogenus* historical range is shown in Figure 3). The analysis was run and a layer of the results was created identifying each 1x1 km² where the species had been observed. Grid cells identified in the associated attribute table were tallied and added to the rank calculator as appropriate. Note that in some instances, both the historical and recent occurrence information was used to calculate area of occupancy for the rank calculator. This was largely done in instances where both historical and recent information illustrated the full known range of the species, whereas the recent information was suspected of being reflective of recent sampling effort only. The resulting data were reviewed to determine the most appropriate area of occupancy for the species.

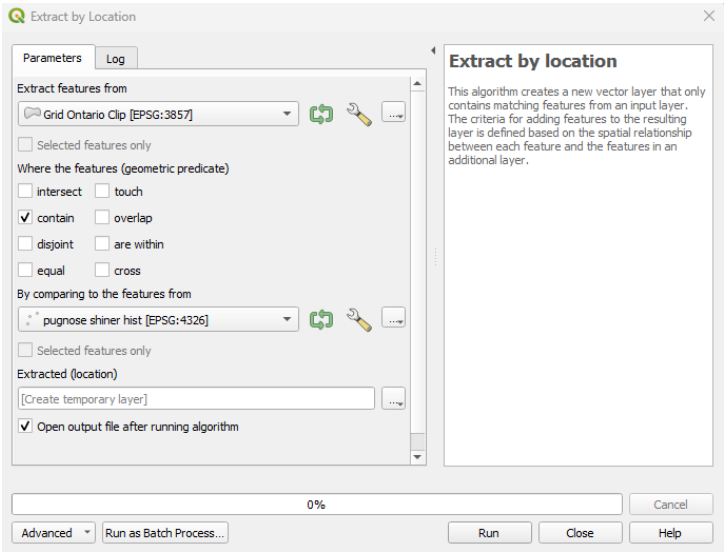


Figure 3. Example of an "Extract by Location" analysis in QGIS 3.34

5. Number of occurrences – The same method was used as above for area of occupancy; however, the "extract features from" layer was changed from the 1x1 km^2 grid to a layer encompassing the quaternary watersheds across Ontario (obtained from Ontario GeoHub). The analysis was run and the number of quaternary watersheds that contained the species was then included in the attribute table and added to the Conservation Rank Calculator. As with area of occupancy, historical occurrences were added with supporting comments in the Conservation Rank Calculator when appropriate.

   In instances where recent quantitative data were insufficient or unavailable, the number of occurrences could not be calculated. An estimate was made for species where the number of historical occurrences could be easily counted (i.e., those with a very low number of observations), or those with a high to very high number of observations from the range mapping on the OFFLHD (2024). This estimate of occurrences was then re-evaluated using expert opinion and published data related to recent conditions and trends to determine the likelihood of change from historical observations.

   Note that number of "occurrences" is defined by NatureServe as: "number of extant locations (stands) of an ecosystem, or discrete areas occupied by a species (typically subpopulations, populations, or metapopulations)" (Faber-Langendoen et al. 2012). This definition is more appropriate for terrestrial species or ecosystems. An occurrence was interpreted here as a quaternary watershed that contained one or more species observations, recognizing that this approach does not fully align with conventional interpretations of aquatic occurrences; however, this method does align with the rank calculator.

6. Population Size – An assessment of population size was completed where data were available. This attribute was only used for extremely common species where range maps clearly identified dense patches (i.e., likely a large population) or in instances where published research identified a population size or index of population size. No abundance estimates were calculated as part of this assessment.

7. Good viability/Ecological integrity – Due to a lack of information across the species' range, this category was not used.
8. Environmental specificity (optional) – This category was not used. Information on threats and intrinsic vulnerability was considered a more suitable parameter (where available) for use in the calculator.

Threats

This category was evaluated based on available literature and expert knowledge. Resources used for the assessment are identified in the reference section of this document.

9. Overall threat – Assessment was based on documented threats identified for the species within published research and/or reference materials. A gradient of threats was determined based on the drop-down categories available (e.g., Unknown, Low, Medium, High, Very High). Threats were only identified where they were clearly present; the broader uncertainty ranges were not used for assessed species.
10. Intrinsic vulnerability – Assessment was based on expert opinion and published literature identifying specific biological traits, habitat preferences, or sensitivities that make the species vulnerable to particular threats (regardless of the presence of a threat or not). Often, this reflected the unique biology of specialist species or those with low tolerances that may make them especially vulnerable to potential threats.

Trends

This category was evaluated based on available literature and expert knowledge. Resources used for the assessment are identified in the reference section of this document.

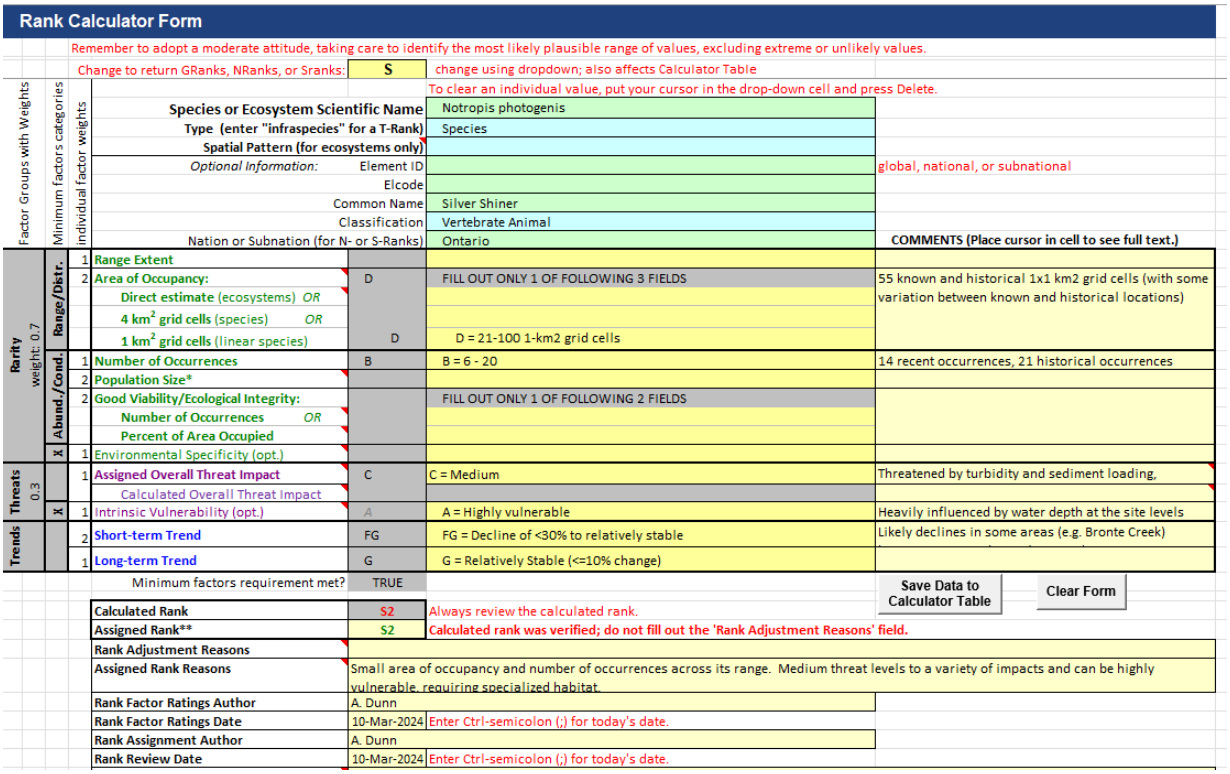
11. Short-term trends – Assessed as identified and/or published trends in distribution or abundance within 10 years or approximately three generations for the species, whichever is longer. Assessment was based on the suspected direction of the trend (e.g., relatively stable, increase or decline). The potential magnitude of the trend was estimated unless supported by published information.
12. Long-term trends – Assessed as known trends in distribution or abundance in the literature or substantial anecdotal trends that are described within the past ~200 years. Assessment was based on the suspected direction of the trend (e.g., relatively stable, increase or decline). The potential magnitude of the trend was estimated based on expert opinion unless supported by published information.

Note that for some species, trends, especially short-term trends, were unavailable due to limited information. Similarly, for some species, sampling effort may have provided a false indication of trends, either due to limited new information or conversely the illusion of increasing trends owing to an increase in sampling effort. Where this type of information had the potential to impact the trend assessment, it was documented in the comment section and not included as part of the category assessment and overall rank calculation.

3.2 Populating the Rank Calculator:

For each species, the calculator was completed for each applicable conservation status factor through the use of the dropdown menus. These identified a range of values sufficient to address the particular conditions of each species. Information was compiled into the calculator, meeting at least the minimum requirements for rank calculation as identified in Faber-Langendoen et al. (2012). Information provided to the calculator was supported by comments in the adjacent field as exemplified in Figure 4. Comments included an explanation of the reasoning or estimates

used in the calculation as well as references to any published information. Comments were kept brief to provide sufficient information to support the assessment while also making the supporting information easily understood by all audiences (e.g., ranging from the public to species specialists).



Rank Calculator Form

Remember to adopt a moderate attitude, taking care to identify the most likely plausible range of values, excluding extreme or unlikely values.

Change to return GRanks, NRanks, or Sranks: **S** change using dropdown; also affects Calculator Table

To clear an individual value, put your cursor in the drop-down cell and press Delete.

Factor Groups with Weights | Minimum factors categories | Individual factor weights

				Species or Ecosystem Scientific Name	Notropis photogenis	
				Type (enter "infraspecies" for a T-Rank)	Species	
				Spatial Pattern (for ecosystems only)		
				Optional Information: Element ID		global, national, or subnational
				Elcode		
				Common Name	Silver Shiner	
				Classification	Vertebrate Animal	
				Nation or Subnation (for N- or S-Ranks)	Ontario	**COMMENTS (Place cursor in cell to see full text.)**
Rarity weight: 0.7	**Range/Distr.**	1	**Range Extent**			
		2	**Area of Occupancy:**	D	FILL OUT ONLY 1 OF FOLLOWING 3 FIELDS	55 known and historical 1x1 km2 grid cells (with some variation between known and historical locations)
			Direct estimate (ecosystems) *OR*			
			4 km² grid cells (species) *OR*			
			1 km² grid cells (linear species)	D	D = 21-100 1-km2 grid cells	
	Abund./Cond.	1	**Number of Occurrences**	B	B = 6 - 20	14 recent occurrences, 21 historical occurrences
		2	**Population Size***			
		2	**Good Viability/Ecological Integrity:**		FILL OUT ONLY 1 OF FOLLOWING 2 FIELDS	
			Number of Occurrences *OR*			
			Percent of Area Occupied			
	x	1	Environmental Specificity (opt.)			
Threats 0.3		1	**Assigned Overall Threat Impact**	C	C = Medium	Threatened by turbidity and sediment loading,
			Calculated Overall Threat Impact			
	x	1	Intrinsic Vulnerability (opt.)	A	A = Highly vulnerable	Heavily influenced by water depth at the site levels
Trends		2	**Short-term Trend**	FG	FG = Decline of <30% to relatively stable	Likely declines in some areas (e.g. Bronte Creek)
		1	**Long-term Trend**	G	G = Relatively Stable (<=10% change)	

Minimum factors requirement met? TRUE

Save Data to Calculator Table | Clear Form

Calculated Rank	S2	Always review the calculated rank.
Assigned Rank**	S2	**Calculated rank was verified; do not fill out the 'Rank Adjustment Reasons' field.**
Rank Adjustment Reasons		
Assigned Rank Reasons	Small area of occupancy and number of occurrences across its range. Medium threat levels to a variety of impacts and can be highly vulnerable, requiring specialized habitat.	
Rank Factor Ratings Author	A. Dunn	
Rank Factor Ratings Date	10-Mar-2024	Enter Ctrl-semicolon (;) for today's date.
Rank Assignment Author	A. Dunn	
Rank Review Date	10-Mar-2024	Enter Ctrl-semicolon (;) for today's date.

*Figure 4. Conservation Rank Calculator example using Silver Shiner (*Notropis photogenis*).*

3.3 Final Rank Classification and Verification

Data summarized for all categories and the associated comments were entered into the Conservation Rank Calculator form and a rank was returned for all species. As this is a jurisdictional exercise, the sub-national designation ("S" in the excel version of the calculator) was selected. Ranks are defined in Table 3. The calculated ranks and supporting documentation and justifications were then added to the 2025 species list. Species experts within Ontario completed a final review of the ranks to ensure they aligned with the expert's understanding of the species' status in Ontario. In situations where final expert judgement differed from the rank calculator, expert judgement and rationale was retained as the final rank and the reasons for adjusting the rank were documented.

Table 3. Sub-national Conservation Ranks (NatureServe 2024).

RANK	DEFINITION
SX	**Presumed Extirpated:** Species or ecosystem is believed to be extirpated from the jurisdiction (i.e., nation, or state/province). Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered. [equivalent to "Regionally Extinct" in IUCN Red List terminology]

RANK	DEFINITION
SH	**Possibly Extirpated:** Known from only historical records but still some hope of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. Examples of such evidence include (1) that a species has not been documented in approximately 20-40 years despite some searching and/or some evidence of significant habitat loss or degradation; (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is no longer present in the jurisdiction.
SU	**Unrankable**: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable**: A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities, for several possible reasons (e.g., long distance migrants, hybrids without conservation value, or non-native species).
S1	**Critically Imperiled:** At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
S2	**Imperiled:** At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
S3	**Vulnerable:** At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
S4	**Apparently Secure:** At a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
S5	**Secure:** At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.

RESULTS

Through the 2025 *Wild Species* general status assessment, a total of 159 freshwater fishes known to be present in Ontario were assessed using the Conservation Rank Calculator. A total of 42 species were ranked as S5, 41 species as S4, 15 species as S3, nine species as S2, and eight species as S1 (Table A1, Figure 5). Six species spanned at least two ranks, five species were unrankable due to limited information (SU), four species were ranked as presumed extirpated (SX), and ranks were not applicable (SNA) for 29 species, most of which are not native to Ontario (Table A1, Figure 5). Species ranked as S3 or higher (i.e., more at-risk) were represented by 11 families, and species ranked as S1 spanned five families. The computed and assigned (final) ranks by species are found in Appendix 1.

For 23 species, the calculated rank was assigned a new rank based on expert opinion. In three cases, the assigned rank was more conservative than the calculated rank (e.g., calculated rank was S2, assigned rank was S1); in the remaining 20 cases, the assigned rank was less conservative than the calculated rank (e.g., calculated rank was S3, assigned rank was S4).

Compared to the 2020 Wild Species report, there was no change in rank for 128 species, and a change in rank for 27 species; the remaining four species experienced a taxonomic change. Of

the 27 species where the rank changed, four species reflected a (presumed) genuine change in status: Spotted Sucker (*Minytrema melanops* S2 to S3), Silver Chub (*Macrhybopsis storeriana* S2 to S3), Pugnose Shiner (S2 to S1S2), and Pugnose Minnow (*Opsopoeodus emiliae* S2 to S1). Six rank changes resulted from new information being available (not reflecting a genuine change in status), and 15 changes resulted from a new interpretation of the same information (note that this is largely related to methodology; the rank calculator was not used in previous assessments, which relied on expert opinion only). Two rank changes from 2020 are believed to be a result of incorrect data used previously; it is thought that the ranks of the two Fundulidae species were mistakenly switched in 2020.

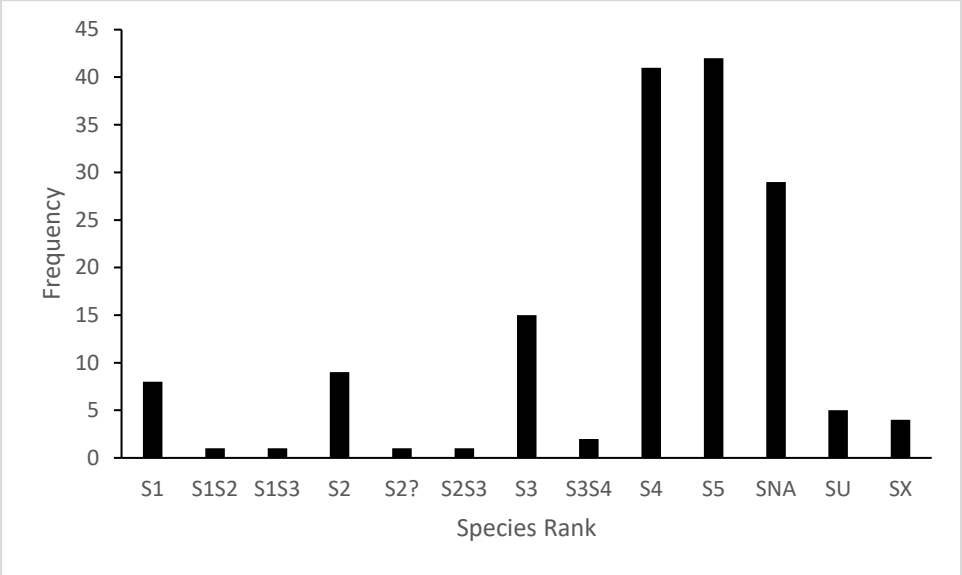


Figure 5. Histogram of the final ranks for 159 freshwater fishes in Ontario for the 2025 Wild Species report.

DISCUSSION

The Conservation Rank Calculator was used to standardize the assessment of conservation ranks for freshwater fishes in Ontario. Use of the calculator drew heavily on species' range size and occurrence data in the determination of the overall calculated rank. In the absence of these data, other published data and reference material were considered; however, the majority of published information was older than the most recent *Wild Species* reporting (2020), which this reassessment was to update. Expert opinion was then used to determine whether changes beyond the published works were warranted and the species were assessed accordingly. To improve reliability of future reporting, it is recommended that more standardized sampling be conducted, and that comprehensive datasets be compiled from all available sources across the province.

There were a small number of revisions made to the list of species being assessed. Several of these were simply taxonomic changes, where new scientific names have been accepted (e.g., several members of the *Notropis* genus being moved to *Miniellus*). There were two cisco species that were resurrected from previous taxonomic classifications and added to the list, Nipigon Cisco (*Coregonus nipigon*) and Longjaw Cisco (*C. alpenae*), and the former Blacknose Dace was split into two species, Eastern Blacknose Dace (*Rhinichthys atratulus*) and Western

Blacknose Dace (*R. obtusus*), the former of which is not believed to occur in Ontario (Holm et al. 2022). Additionally, the authors proposed to split Atlantic Salmon (*Salmo salar*) into a historical native population (extirpated - SX) and a stocked population (SNA) to clarify why the species is considered extirpated but may still be found in the province. Lastly, when reviewing the species list, a handful of potential new invasive species on the horizon were considered but, ultimately, did not meet the criteria for inclusion at this time as there were insufficient observations to consider them present (according to the definition in methods) in Ontario.

The 2025 assessment is the first time that the Conservation Rank Calculator was used in full to calculate species' ranks for freshwater fishes in Ontario; expert opinion was used in previous assessments. There were several areas where the methods and definitions associated with the calculator posed challenges, some of which related to the fact that the calculator was designed primarily with terrestrial species in mind. One issue was that the NatureServe definition of "occurrence" (number of discrete areas occupied by the species; Faber-Langendoen et al. 2012) did not apply easily to aquatic ecosystems. Here, occurrences were considered to be the number of quaternary watersheds in which a species was found. This applied definition aligned reasonably well with dropdowns in the calculator for most riverine and inland species, but did not work well for species that occur predominantly or exclusively in the Great Lakes. Finally, determining which data to use to best reflect the species' current status was challenging. Freshwater fishes are chronically under-sampled. Relatively little sampling occurs over a five-year time span (i.e., the time between assessments), meaning that, for most species, historical data were used to populate the calculator and then expert opinion was used to determine whether the historical data were believed to reflect a species' current situation. Even for very common species that are frequently encountered, it is unlikely that they are sampled across their entire range, making it challenging to use exclusively new data representative of the years since the last assessment. Presenting a rank that was calculated using historical data with few or no recent occurrences may overstate confidence in a species' status. An additional field to describe whether the previous rank was carried forward because no new data exist would improve the transparency of the process, as would including a measure of confidence in the rank.

As noted, the calculator and its dropdown menu options and thresholds were designed for terrestrial species, so modifications were required for evaluating freshwater fishes. The approach used here of approximating range extent of aquatic species by overlaying a species' distribution on the ecozones of Ontario and then estimating land cover area by approximating the coverage of each ecozone over the total area of the province aligned reasonably well with the dropdowns in the calculator for many species. This, coupled with the broad ranges of values for the conservation rank factors offered in the calculator's dropdown menus provided a reasonable workaround for freshwater species. However, these approaches/options are imperfect, and may not be applied consistently by all assessors across Canada, leading to a breakdown in standardization. Additionally, risk to a species may be over or underestimated, depending on the proportion of that land area that is wetted. A possible solution is having a dropdown menu with range sizes reflective of the available freshwater habitat in each jurisdiction, or having proportional size options as opposed to absolute options. Use of an equal area projection (such as NAD 83 Ontario MNR Lambert) for the grid cells used to assess the rarity factors could improve area-based estimates. A final consideration is that this approach required extensive use of GIS tools to adequately complete the range extent and/or area of occupancy fields in the calculator, at least one of which is mandatory. Resources (both technological and personnel) may not always or widely be available to undertake this work.

Despite the issues discussed above, the calculator frequently (80.5%) computed the same ranks as those determined by expert opinion during the previous assessment in 2020. Of those

that differed from the 2020 rank, 15 were the result of a new interpretation of the same information, likely related to the calculator being used to calculate ranks in a more standardized way. There were four species for which a (presumed) genuine change in status occurred. Two of these species, Spotted Sucker and Silver Chub, have experienced increases in distribution and abundance, respectively, in Ontario in recent years and, thus, a decrease in rank. For Spotted Sucker, this is believed to be related to improved habitat conditions in Lake Erie and climate change enabling a range expansion (MacGuigan et al. 2023). Silver Chub increases in Lake Erie may be related to increasing food supply (Fisheries and Oceans Canada 2025). Both Pugnose Minnow and Pugnose Shiner experienced an increase in rank reflective of the apparent loss of both species from historical locations likely resulting from habitat degradation (Gáspárdy et al. 2025, Fisheries and Oceans Canada 2022). Although some populations of Pugnose Shiner may be increasing in abundance, other populations have been lost. Some rank changes from 2020 were the result of new information. For example, in 2020, the Shortnose Cisco (*C. reighardi*) was thought to be possibly extirpated (rank SH). Genetic analysis of recently sampled individuals in Lake Superior revealed that specimens identified as Shortjaw Cisco (*C. zenithicus*, previously ranked S2), were actually Shortnose Cisco (Gorman et al. 2025) resulting in both species receiving a new rank of S1 for 2025. More information is needed to better understand the current status of both species.

In the current assessment, the calculator generally computed ranks that aligned with the judgements of the experts who reviewed them. However, there were some instances where the calculated ranks were adjusted and an assigned rank was retained. A species' range size appeared to receive the most weight in calculating the rank, and for many species, the calculated rank was driven by their distribution being restricted to southern Ontario. This often resulted in a calculated rank of S3; however, for many of these species, there was no evidence of decline, the species was believed to be stable or increasing, and their situation more closely aligned with the definition of S5. In cases where a species only ever occurred in a small portion of Ontario but was stable or increasing with few or no known threats and the calculated rank was S3, the species was assigned a rank of S4; a rank of S5 was reserved for species that occurred throughout the majority of the land area of Ontario that were stable or increasing with few or no known threats. Although this decision to adjust ranks is not perfect (i.e., even those species that were assigned a rank of S4 may still meet the definition of S5), it was intended to keep true to the calculated ranks as close as possible, while better aligning with the definition of the ranks.

The heavy weighting on range extent in the calculator is arguably of greatest significance in Ontario where the breadth of climatic conditions experienced from south to north is so broad. Many freshwater fishes are at the northern edge of their range and are only found in southern or southwestern Ontario. Regardless of population size, trends, or threats, the small range extent of these species resulted in a relatively high conservation rank. An option for completing the calculator for these species could be to take the proportion of quaternary watersheds a species occurs in out of the total number of quaternary watersheds found within the post-glacial refugia of origin (Mandrak and Crossman 1992b) thus reducing the total area over which the species is expected to occur. This would require an amendment to the conservation range factors towards proportional options rather than absolute.

Overall, use of the conservation rank calculator allowed for a data-driven, standardized approach to assessing the general status of freshwater fishes in Ontario. However, the lack of recent, standardized sampling for most species meant that expert opinion was still required for more than verification of the calculated ranks. Additionally, some adjustments could be made to the calculator to better accommodate freshwater species. Use of the calculator coupled with

careful expert validation, and applying a consistent approach for factoring in available freshwater habitats will be important for reassessing species in 2030.

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APPENDIX 1

*Table A1. Summary of 2025 Wild Species general status assessment of freshwater fishes in Ontario. Scientific and Common names are bolded where a taxonomic revision has occurred. The calculated rank was computed with data, and the assigned rank represents the final retained rank; it is noted when the computed rank differed from the assigned rank, and an * indicates that the assigned rank was higher (i.e., more conservative) than the computed rank. The 2020 Wild Species report rank is included, and a reason for change in rank from that assessment is reported; note that the methods used in 2020 (expert opinion) differed from 2025 (rank calculator + expert validation). A "?" after the rank indicates variability across metrics (spread in scores from different conservation status factors) resulting in uncertainty.*

Scientific Name	Common Name	2025 Calculated Rank	2025 Assigned Rank	Computed different from Assigned	2020 Rank	Reason for Change since 2020
Acipenser fulvescens	Lake Sturgeon	S3S4	S3S4		S3S4	No change
Alosa pseudoharengus	Alewife	SNA	SNA		SNA	No change
Alosa sapidissima	American Shad	SNA	SNA		SNA	No change
Ambloplites rupestris	Rock Bass	S5	S5		S5	No change
Ameiurus melas	Black Bullhead	S4	S4		S4	No change
Ameiurus natalis	Yellow Bullhead	S4?	S4	Yes	S4	No change
Ameiurus nebulosus	Brown Bullhead	S5	S5		S5	No change
Amia ocellicauda	**Emerald Bowfin**	S3S4	S4	Yes	S4	No change
Ammocrypta pellucida	Eastern Sand Darter	S2	S2		S2	No change
Anguilla rostrata	American Eel	S1	S1		S1?N	New interpretation
Apeltes quadracus	Fourspine Stickleback		SNA		SNA	No change
Aplodinotus grunniens	Freshwater Drum	S3S4	S4	Yes	S5	New Interpretation
Campostoma anomalum	Central Stoneroller	S3	S4	Yes	S4	No change
Carassius auratus	Goldfish		SNA		SNA	No change
Carpiodes cyprinus	Quillback	S3	S3		S4	New Interpretation

Scientific Name	Common Name	2025 Calculated Rank	2025 Assigned Rank	Computed different from Assigned	2020 Rank	Reason for Change since 2020
Catostomus catostomus	Longnose Sucker	S5	S5		S5	No change
Catostomus commersonii	White Sucker	S5	S5		S5	No change
Chrosomus eos	Northern Redbelly Dace	S5	S5		S5	No change
Chrosomus neogaeus	Finescale Dace	S4	S5	Yes	S5	No change
Clinostomus elongatus	Redside Dace	S1	S1		S1	No change
Coregonus alpenae	**Longjaw Cisco**		SU			Taxonomic Revision
Coregonus artedi	Cisco (Lake Herring)	S4S5	S5	Yes	S5	No change
Coregonus clupeaformis	Lake Whitefish	S5	S5		S5	No change
Coregonus hoyi	Bloater	S3	S3		S4	New Interpretation
Coregonus johannae	Deepwater Cisco		SX		SX	No change
Coregonus kiyi	Kiyi	S3	S3		S3?	No change
Coregonus nigripinnis	Blackfin Cisco		SU		SU	No change
Coregonus nipigon	**Nipigon Cisco**		SU		SU	No change
Coregonus reighardi	Shortnose Cisco	S2	S1	Yes*	SH	New Information
Coregonus zenithicus	Shortjaw Cisco	S1S2	S1	Yes*	S2	New Information
Cottus bairdii	Mottled Sculpin	S4	S4		S5	New Interpretation
Cottus cognatus	Slimy Sculpin	S4	S5	Yes	S5	No change
Cottus ricei	Spoonhead Sculpin	S3S4	S3S4		S4	New Interpretation
Couesius plumbeus	Lake Chub	S5	S5		S5	No change
Ctenopharyngodon idella	Grass Carp		SNA		SNA	No change
Culaea inconstans	Brook Stickleback	S5	S5		S5	No change
Cyprinella spiloptera	Spotfin Shiner	S3S4	S4	Yes	S4	No change
Cyprinus carpio	Common Carp		SNA		SNA	No change

Scientific Name	Common Name	2025 Calculated Rank	2025 Assigned Rank	Computed different from Assigned	2020 Rank	Reason for Change since 2020
Dorosoma cepedianum	Gizzard Shad	S4	S4		S4	No change
Erimystax x-punctatus	Gravel Chub	SX	SX		SX	No change
Erimyzon sucetta	Lake Chubsucker	S2	S2		S2	No change
*Esox americanus**	American Pickerel	S2	S2		S3	New Interpretation
Esox lucius	Northern Pike	S5	S5		S5	No change
Esox masquinongy	Muskellunge	S4	S4		S4	No change
Esox niger	Chain Pickerel		SNA		SNA	No change
Etheostoma blennioides	Greenside Darter	S3	S4	Yes	S4	No change
Etheostoma caeruleum	Rainbow Darter	S4	S4		S4	No change
Etheostoma exile	Iowa Darter	S5	S5		S5	No change
Etheostoma flabellare	Fantail Darter	S4	S4		S4	No change
Etheostoma microperca	Least Darter	S4	S4		S4	No change
Etheostoma nigrum	Johnny Darter	S5	S5		S5	No change
Etheostoma olmstedi	Tessellated Darter	S3	S3		S4	New Interpretation
Exoglossum maxillingua	Cutlip Minnow	S2	S2		S2	No change
Fundulus diaphanus	Banded Killifish	S4	S4		S2	Incorrect Data Previously
Fundulus notatus	Blackstripe Topminnow	S2	S2		S5	Incorrect Data Previously
Gasterosteus aculeatus	Threespine Stickleback	S4	S4		S4	No change
Gymnocephalus cernua	Ruffe		SNA		SNA	No change
Hiodon alosoides	Goldeye	S4	S4		S3	New Interpretation
Hiodon tergisus	Mooneye	S4	S4		S4	No change
Hudsonius hudsonius	Spottail Shiner	S5	S5		S5	No change

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Hybognathus hankinsoni	Brassy Minnow	S5	S5		S5	No change
Hybognathus regius	Eastern Silvery Minnow	S3	S3		S3	No change
Hypentelium nigricans	Northern Hog Sucker	S4	S4		S4	No change
Ichthyomyzon castaneus	Chestnut Lamprey		SU		SU	No change
Ichthyomyzon fossor	Northern Brook Lamprey	S3	S3		S3	No change
Ichthyomyzon unicuspis	Silver Lamprey	S3	S3		S3	No change
Ictalurus punctatus	Channel Catfish	S3S4	S4	Yes	S4	No change
Ictiobus bubalus	Smallmouth Buffalo		SNA		SNA	No change
Ictiobus cyprinellus	Bigmouth Buffalo	S3	S3		S2?	New Interpretation
Ictiobus niger	Black Buffalo		SNA		SNA	No change
Labidesthes sicculus	Brook Silverside	S3S4	S4	Yes	S4	No change
Lepisosteus oculatus	Spotted Gar	S1	S1		S1	No change
Lepisosteus osseus	Longnose Gar	S3	S4	Yes	S4	No change
Lepomis cyanellus	Green Sunfish	S4	S4		S4	No change
Lepomis gibbosus	Pumpkinseed	S5	S5		S5	No change
Lepomis gulosus	Warmouth	S1	S1		S1	No change
Lepomis humilis	Orangespotted Sunfish		SNA		SNA	No change
Lepomis macrochirus	Bluegill	S5	S5		S5	No change
Lepomis peltastes	Northern Sunfish	S3	S3		S3	No change
Lethenteron appendix	American Brook Lamprey	S4	S4		S3	New Interpretation
Lota lota	Burbot	S5	S5		S5	No change
Luxilus chrysocephalus	Striped Shiner	S3	S4	Yes	S4	No change
Luxilus cornutus	Common Shiner	S5	S5		S5	No change

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Lythrurus umbratilis	Redfin Shiner	S3	S3		S4	New Interpretation
Macrhybopsis storeriana	Silver Chub	S3	S3		S2	Genuine Change
Margariscus nachtriebi	**Northern Pearl Dace**	S5	S5		S5	No change
Micropterus dolomieu	Smallmouth Bass	S5	S5		S5	No change
Micropterus nigricans	Largemouth Bass	S5	S5		S5	No change
Miniellus anogenus	Pugnose Shiner	S2	S1S2	Yes*	S2	Genuine Change
Miniellus heterodon	Blackchin Shiner	S4	S4		S4	No change
Miniellus stramineus	Sand Shiner	S3S4	S4	Yes	S4	No change
Minytrema melanops	Spotted Sucker	S3	S3		S2	Genuine Change
Morone americana	White Perch		SNA		SNA	No change
Morone chrysops	White Bass	S3	S4	Yes	S4	No change
Moxostoma anisurum	Silver Redhorse	S4	S4		S4	No change
Moxostoma carinatum	River Redhorse	S2?	S2?		S2	New Interpretation
Moxostoma duquesnei	Black Redhorse	S2	S2		S2	No change
Moxostoma erythrurum	Golden Redhorse	S3	S4	Yes	S4	No change
Moxostoma macrolepidotum	Shorthead Redhorse	S5	S5		S5	No change
Moxostoma valenciennesi	Greater Redhorse	S3	S4	Yes	S4	No change
Myoxocephalus quadricornis	Fourhorn Sculpin		SNA		S4	New Interpretation
Myoxocephalus thompsonii	Deepwater Sculpin	S3	S3		S3?	No change
Neogobius melanostomus	Round Goby		SNA		SNA	No change
Nocomis biguttatus	Hornyhead Chub	S4	S4		S4	No change

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Nocomis micropogon	River Chub	S3S4	S4	Yes	S4	No change
Notemigonus crysoleucas	Golden Shiner	S5	S5		S5	No change
Notropis atherinoides	Emerald Shiner	S5	S5		S5	No change
Notropis bifrenatus	Bridle Shiner	S2S3	S2S3		S2	New Interpretation
Notropis heterolepis	Blacknose Shiner	S5	S5		S5	No change
Notropis photogenis	Silver Shiner	S2	S2		S2S3	New Information
Notropis rubellus	Rosyface Shiner	S4	S4		S4	No change
Noturus flavus	Stonecat	S4	S4		S4	No change
Noturus gyrinus	Tadpole Madtom	S3S4	S4	Yes	S4	No change
Noturus insignis	Margined Madtom		SNA		SU	New Interpretation
Noturus miurus	Brindled Madtom	S2	S2		S2	No change
Noturus stigmosus	Northern Madtom	S1	S1		S1	No change
Oncorhynchus gorbuscha	Pink Salmon		SNA		SNA	No change
Oncorhynchus keta	Chum Salmon		SNA		SNA	No change
Oncorhynchus kisutch	Coho Salmon		SNA		SNA	No change
Oncorhynchus mykiss	Rainbow Trout		SNA		SNA	No change
Oncorhynchus nerka	Sockeye Salmon		SNA		SNA	No change
Oncorhynchus tshawytscha	Chinook Salmon		SNA		SNA	No change
Opsopoeodus emiliae	Pugnose Minnow	S1	S1		S2	Genuine Change
Osmerus mordax	Rainbow Smelt	S5	S5		S5	No change
Paranotropis buchanani	Ghost Shiner	S3	S4	Yes	S2	New Information
Paranotropis volucellus	Mimic Shiner	S5	S5		S5	No change

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Perca flavescens	Yellow Perch	S5	S5		S5	No change
Percina caprodes	Logperch	S5	S5		S5	No change
Percina copelandi	Channel Darter	S2	S2		S2	No change
Percina maculata	Blackside Darter	S4	S4		S4	No change
Percina shumardi	River Darter	S1S3	S1S3		S4	New Information
Percopsis omiscomaycus	Trout-perch	S5	S5		S5	No change
Petromyzon marinus	Sea Lamprey		SNA		SNA	No change
Pimephales notatus	Bluntnose Minnow	S5	S5		S5	No change
Pimephales promelas	Fathead Minnow	S5	S5		S5	No change
Platichthys flesus	European Flounder		SNA		SNA	No change
Polyodon spathula	Paddlefish		SX		SX	No change
Pomoxis annularis	White Crappie	S3	S3		S4	New Interpretation
Pomoxis nigromaculatus	Black Crappie	S4	S4		S4	No change
Prosopium coulterii	Pygmy Whitefish	S3	S3		SU	New Information
Prosopium cylindraceum	Round Whitefish	S4	S4		S4	No change
Proterorhinus semilunaris	Freshwater Tubenose Goby		SNA		SNA	No change
Pungitius pungitius	Ninespine Stickleback	S5	S5		S5	No change
Pylodictis olivaris	Flathead Catfish		SNA		SNA	No change
Rhinichthys cataractae	Longnose Dace	S5	S5		S5	No change
Rhinichthys obtusus	**Western Blacknose Dace**	S5	S5		S5	Taxonomic Revision
Salmo salar	**Atlantic Salmon (Stocked population)**		SNA		SNA	Taxonomic Revision
Salmo salar	Atlantic Salmon (Historical native population)	SX	SX		SNA	Taxonomic Revision

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Salmo trutta	Brown Trout		SNA		SNA	No change
Salvelinus alpinus	Arctic Char		SU		SU	No change
Salvelinus fontinalis	Brook Trout	S5	S5		S5	No change
Salvelinus namaycush	Lake Trout	S5	S5		S5	No change
Sander canadensis	Sauger	S4	S4		S4	No change
Sander vitreus	Walleye	S5	S5		S5	No change
Scardinius erythrophthalmus	Rudd		SNA		SNA	No change
Semotilus atromaculatus	Creek Chub	S5	S5		S5	No change
Semotilus corporalis	Fallfish	S4	S4		S4	No change
Umbra limi	Central Mudminnow	S5	S5		S5	No change