

COSSARO Candidate Species at Risk Evaluation
for
Silver Chub (*Macrhybopsis storeriana*)

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

Assessed by COSSARO as THREATENED

May 2012

Final

Le **Méné à grandes écailles** (*Macrhybopsis storeriana*) est un méné de grande taille des rivières et des lacs du centre et de l'est de l'Amérique du Nord. En Ontario, il semble n'être présent que dans le lac Érié. Poisson fourrage abondant à une certaine époque dans le lac Érié, la faible qualité de l'eau a entraîné une chute importante de sa population durant les années 1960 et 1970. La population du Méné à grandes écailles a augmenté durant les années 1980 et 1990 avant de diminuer rapidement au début des années 2000. Les relevés au chalut de fond indiquent que la population de ce poisson à courte durée de vie connaît des fluctuations extrêmes. La population a diminué de 71 p. 100 entre 1996 et 2005 et reste loin sous les niveaux historiques, malgré une augmentation de 25 p. 100 au cours des cinq dernières années. La principale menace pour cette espèce est la baisse récente de la qualité de l'eau du lac Érié. Le Méné à grandes écailles est une **espèce menacée** en Ontario parce que ses populations ont diminué de façon marquée au cours des dix dernières années et que les changements récents de l'état du lac Érié pourraient nuire encore davantage à l'habitat et au rétablissement de cette espèce.

Cette publication hautement spécialisée, COSSARO Evaluation for Silver Chub n'est disponible qu'en anglais en vertu du Règlement 671/92 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez contacter le secrétariat de COSSARO par courrier électronique à l'adresse COSSAROsecretariat@ontario.ca.

PART 1 Current status and distribution

Current designations:

GRANK – G5 (Assessed 18 Sep 1996) (NatureServe, accessed 07 May 2012)

NRANK Canada – N3 (Assessed 09 Sep 2011) (NatureServe, accessed 07 May 2012)

COSEWIC¹ – Endangered (Great Lakes-Upper St. Lawrence population) (COSEWIC, May 2012); Not at Risk (Saskatchewan - Nelson River populations) (COSEWIC, May 2012)

SARA – Special Concern (Schedule 1) (Environment Canada 2012)

ESA 2007 – Special Concern (Ontario Ministry of Natural Resources 2012)

SRANK – S2 (NHIC/NatureServe, accessed 07 May 2012)

Distribution in Ontario:

In Ontario the Silver Chub currently occurs in the western basin of Lake Erie, with scattered records into the central basin. The Silver Chub was historically recorded in Ontario from Lake St. Clair and the extreme southern section of Lake Huron (COSEWIC 2012). Michigan records include the Detroit River (Derosier 2004). Nash (1908) notes this species has been taken from Lake Ontario in Ontario, but no subsequent records from Ontario support this. Carlson & Daniels (2004) report that Silver Chub is extirpated from Lake Ontario in New York.

Distribution and status outside Ontario:

Silver Chub occurs only in North America. Its global population is secure (G5) and it occurs in 24 U.S. states and two Canadian provinces. It is found primarily in the Mississippi River system in the central U.S., but also occurs in Canada in Lake Winnipeg and associated rivers, and in the Lake Erie basin.

Specific areas of occurrence across its range are: Lake Erie drainage (Ontario, New York, Pennsylvania, Ohio, and Michigan); Assiniboine River, Manitoba; Red River drainage, Manitoba, south to Minnesota; Mississippi River basin, New York, Pennsylvania, and West Virginia west to Minnesota, Nebraska, Kansas, and Oklahoma, and south to Gulf Coast; Gulf Coast drainages from Mobile Bay basin, Alabama, to Lake Pontchartrain drainage, Louisiana; and an isolated population in Brazos River drainage, Texas.

The species tends to be common but seldom in large populations throughout its range (Page and Burr 1991).

¹ The species was considered a single unit and designated Special Concern in April 1985. Status re-examined and confirmed in May 2001. Split into two populations in May 2012.

PART 2 Eligibility for Ontario status assessment

2.1 Application of eligibility criteria

Taxonomic Distinctness

Yes - Silver Chub is universally recognized as a full and distinct species.

Designatable Units

COSEWIC (2012) identified 2 designatable units for the species in Canada:

- DU1: the Great Lakes-Upper St. Lawrence River biogeographic zone, which represents the Ontario population.
- DU2: the Saskatchewan-Nelson River biogeographic zone.

Native Status

Yes - Known from Lake Erie from at least 1929 (Kinney 1954). The Silver Chub is also included in the report by Nash (1908).

Presence/Absence

Present - Collected in 2010 from Lake Erie in Ontario (COSEWIC 2012) and from Lake Erie in Ohio in 2011 (USGS 2012).

2.2 Eligibility results

1. The putative taxon or DU is valid. **Yes**
2. The taxon or DU is native to Ontario. **Yes**
3. The taxon or DU is present in Ontario, extirpated from Ontario or extinct? **Present**

PART 3 Ontario status based on COSSARO evaluation criteria

3.1 Application of primary criteria (rarity and declines)

1. Global Rank

Not in any category

G5. (NatureServe, accessed 07 May 2012). The species is globally secure.

2. Global Decline

Not in any category

Silver Chub is extirpated/possibly extirpated from approximately 18% of US watersheds within its historical range (based on watershed distribution/ status map in NatureServe) and it remains globally secure. (NatureServe, accessed 07 May 2012) There is no Special Concern category for this criterion and the threshold for Threatened (>30% range contraction or >30% population decline) is not met.

3. Northeastern North America Ranks

Special Concern

Silver Chub is ranked S1, S2, SH, or SX in 3 of 11 (27%) of northeastern North America jurisdictions (see Appendix 1). For jurisdictions that border Lake Erie, the Silver Chub is ranked as SH (New York), S2 (Ontario), S2S3 (Michigan), S3S4 (Pennsylvania) and S4 (Ohio). It is currently listed as Special Concern in Ontario and Michigan. Silver Chub was listed as Endangered in Pennsylvania, but was delisted in 2010.

4. Northeastern North America Decline

Threatened

While there is limited evidence of a widespread decline of Silver Chub in Northeastern North America (see Appendix 1), it is extirpated/ possibly extirpated from approximately 50% (7/14) of U.S. watersheds along Lake Erie and Lake St. Clair (based on watershed distribution/ status map in NatureServe) and declines have been documented in Lake Erie. The population within Lake Erie/St. Clair basin is not connected to populations outside of the Great Lakes watershed. Based on documented extirpations within the U.S. and the eastern and central basin of Lake Erie (see section 6) this decline represents significant range contraction.

5. Ontario Occurrences

Threatened

There are six extant Element Occurrences of Silver Chub in the NHIC database (NHIC, accessed 07 May 2012) and 10+ occurrences in Mandrak & Crossman (1992). Recent

records for Silver Chub in Ontario (and Ohio) are all within the western basin of Lake Erie. Since there are fewer than 20 occurrences in Ontario, the species meets the threshold for threatened status in the province under this criterion, although the definition of an element occurrence for a lake fish is problematic. COSEWIC (2012) suggests the Silver Chub population is currently ~2.5 million in Ontario, based on recent estimates.

6. Ontario Decline Endangered

Silver Chub meets the threshold for endangered status under this criterion because there has been a non-cyclical population decline of >50% decline in Ontario population over last 10 years based on Interagency Trawl Index Data (2000-2010) (COSEWIC 2012).

Population declines are difficult to quantify in this species because it appears to be subject to very rapid fluctuations. For example, this species was thought to occur in similarly low numbers from 1967 to 1979, but increased dramatically to ~46.9 million in 1999, and then rapidly declined to its current level. Estimating population size for this species is also difficult because it is a small bottom-feeder, and estimates appear to vary greatly depending on the type of sampling gear employed and ability of surveyors to distinguish this species from the more common Spottail Shiner (*Notropis hudsonius*) (see Boyko & Staton 2010). This introduces uncertainty into population estimates. While there has been a significant decline over the last ten years, recent surveys have indicated a slight rebound in population numbers. There has been a population increase of approximately 26% in the last five years, but the increase has not returned the population levels to historic levels.

7. Ontario's Conservation Responsibility Not in any category

Less than 10% of range of Silver Chub occurs in Ontario. This species is widespread in the U.S. and occurs in 272 watersheds (HUC-8). There are Heritage Program database records for Silver Chub in 76 US watersheds (NatureServe 2012).

3.2 Application of secondary criteria (threats and vulnerability)

8. Population Sustainability Threatened

Based on documented population declines over the last decade there is evidence that Silver Chub had experienced reproductive or recruitment failure.

Based on past population trends, it does appear that this species can be sustained at very low numbers for many generations and is then capable of rapid recovery in response to environmental changes. Ecological models for this species will be prepared in 2012-2013 (M. Koops, DFO, pers. comm.).

9. Lack of Regulatory Protection for Exploited Wild Populations **Not in any category**

Silver Chub is not a legal baitfish in Ontario and its small size means that it is unlikely to be included in incidental catch of commercial harvest (COSEWIC 2012).

10. Direct Threats **Threatened**

The 2010 Management Plan for Silver Chub concluded that the exact nature and extent of the threats currently facing the Silver Chub are unknown (Boyko & Staton 2010). While the Silver Chub occurs over a wide range in a variety of habitat types and has demonstrated an ability to switch food sources, it is sensitive to low oxygen levels and water quality.

Recent declines in Lake Erie water quality may be a threat to this species in Ontario. While the water quality of Lake Erie improved dramatically in the early 2000s, resulting in a recovery of eutropy-intolerant fishes (Ludsin et. al 2001), there has been a return of severe algal blooms and an increase in the extent and duration of anoxia/hypoxia in the western and central basins. The causes of these conditions are not fully understood. While total phosphorus levels have declined in Lake Erie, there has been an increase in nearshore phosphorus and levels of soluble reactive phosphorus (Lake Erie LaMP 2011). Higher levels of phosphorus result in higher production of algae. When this algae decomposes it uses up oxygen in the water. Kinney (1954) noted that Silver Chub died in an aquarium when oxygen levels fell to 4.4 mg/l, and this species would not survive in the anoxic conditions that have been recently been present in the western basin of Lake Erie. Sensitivity of Silver Chub to changes in water quality has also been noted outside of the Great Lakes basin. The decline and virtual disappearance of Silver Chub from the lower Kansas River basin (1991-2003) may reflect a lag in the response time from past perturbations (Gibo et. al 2010).

Climate change could result in increased periods of hypoxia through warmer lake temperatures and more severe storm events that flush additional phosphorus into the lake. In addition to directly impacting Silver Chub, low oxygen levels also reduce the number of mayflies (*Hexigenia* spp.) that this species feeds upon. This combination of low oxygen levels and a reduction in food supply could lead to the degraded habitat conditions of the 1960s and 70s that resulted in very low numbers, and the perceived extirpation, of Silver Chub from Lake Erie.

It should be noted that these threats are uncertain. While there have been extreme algal blooms and low oxygen levels in some recent years, these conditions did not occur in 2012 due to lower spring and early summer precipitation (resulting in fewer nutrients being flushed into Lake Erie). Water clarity in the western basin in 2012 has been near the highest on record (NOAA 2012; Reuter, Ohio State University, pers. comm.).

The 2012 Great Lakes Water Quality Agreement includes an Annex on managing nutrients in the Great Lakes and an ecosystem objective to limit the extent of hypoxic zones. While this bi-national agreement does not mitigate the immediate issues associated with the threat of declining water quality in Lake Erie, it does reflect a commitment to manage this threat in the future (Environment Canada 2012).

Invasive species may also be impacting Silver Chub. The introduction of dreissenid mussels may have benefitted Silver Chub by providing a new food source and increasing benthic productivity. Population increases of Silver Chub increased shortly after the introduction of Zebra Mussels to Lake Erie. The more recent introduction of Round Goby has likely had a negative impact on Silver Chub. Round Goby compete for food resources and may feed on Silver Chub eggs and larvae. Other non-native fishes including White Perch, and changing top-down population regulation of Silver Chub by increasing numbers of native Walleye and Yellow Perch may also have resulted in recent population declines (COSEWIC 2012).

Based on past population fluctuations of Silver Chub in Ontario and the uncertainty of future environmental changes, it is possible that there could be a severe decline at >50% of sites occupied by this species.

11. Specialized Life History or Habitat-use Characteristics

Not in any category

This Silver Chub does not have any specialized life history or habitats and habitat does not appear to be limited. Silver Chub occurs in a wide range of habitats over its range. The Silver Chub occurs in large lakes and connecting rivers. In Ontario it is usually collected over a sand or gravel substrate, and is not associated with aquatic vegetation (COSEWIC 2012). It inhabits turbid waters in Manitoba, and mainly clean gravel and sand in other areas (COSEWIC 2012). The species occurs at or near the bottom of water bodies where it feeds on insects, crustaceans, and mussels, including dreissenid mussels (COSEWIC 2012).

3.3 COSSARO evaluation results

1. Criteria satisfied in each status category

Number of primary and secondary criteria met in each status category:

Endangered – [1/0]

Threatened – [2/2]

Special Concern – [1/0]

Number of Ontario-specific criteria met in each status category

Endangered – [1]

Threatened – [1]

Special Concern – [0]

2. Data Deficiency

No

3. Status Based on COSSARO Evaluation Criteria

The application of COSSARO evaluation criteria suggests that **Silver Chub** is **Threatened** in Ontario.

PART 4 Ontario status based on COSEWIC evaluation criteria

4.1 Application of COSEWIC criteria

Regional (Ontario) COSEWIC Criteria Assessment

Criterion A – Decline in Total Number of Mature Individuals

Endangered. Meets A2b for Endangered because of an observed reduction in an index of abundance of the number of individuals over the last 10 years of >70% (based on several methods yielding estimates of 71, 97, 99% reductions) in Canadian waters. The population has been increasing in recent years, including 2011 results not included in COSEWIC assessment (USGS 2012).

Criterion B – Small Distribution Range and Decline or Fluctuation

Threatened. Meets Threatened under B2a,b(i,ii,iv,v),c(iv) because IAO <2,000km² and <10 locations.

Criterion C – Small and Declining Number of Mature Individuals

Not in any category

Criterion D – Very Small or Restricted Total Population

Not in any category

Criterion E – Quantitative Analysis

Not in any category

Rescue Effect

Yes. The Ontario population of Silver Chub is bi-national and the species appears to be increasing in the Ohio portion of Lake Erie (USGS 2012).

Special Concern Status

No

4.2 COSEWIC evaluation results

1. Criteria satisfied in each status category

Endangered – [Yes]

Threatened – [Yes]

Special Concern – [No]

2. Data Deficiency

No

3. Status Based on COSEWIC Evaluation Criteria

The application of COSEWIC evaluation criteria suggests that **Silver Chub** is **Endangered** in Ontario.

PART 5 Ontario status determination

5.1 Application of COSSARO and COSEWIC criteria

COSSARO and COSEWIC criteria give the same result. **No**

The difference in the result occurs because only one COSSARO criterion for Endangered is met (Criterion 6, Ontario decline). One additional primary or secondary criterion that meets the threshold of Endangered would be required for the status of Silver Chub to be assigned as Endangered. A COSSARO assignment of Threatened applies as there are four criteria that are met (4,5,8,10).

COSEWIC has assessed Silver Chub as Endangered because one criterion (A: decline in total number of individuals) has been met.

There is no disagreement in the application of the available information on this species. There has been a significant decline in this species from 1996-2005. This decline meets the both the COSSARO and COSEWIC criterion for Endangered. The difference in results is because of different thresholds for the assigning an overall status of Endangered (i.e. one criterion for COSEWIC and two for COSSARO).

Of the four COSSARO criteria that were assessed as Threatened, the two primary criteria (Northeastern North America decline and Ontario occurrences) are quantitative (recognizing that the application of Element Occurrences and sub-national vs. watershed boundaries for regional assessment are problematic for aquatic species). The two secondary criteria that were assessed as Threatened are more qualitative. However, as outlined in the report there is no definite evidence of recruitment failure (Criterion 8), and indeed the population appears to be increasing in the last five years. Direct threats to this species resulting in the risk of disappearance or serious decline in the future (Criterion 10) are somewhat speculative, partially because the threats to this species are poorly understood (as outlined in the 2010 Management Plan), and partially because this criterion is based on “sites”, which again is problematic in the assessment of aquatic species. The population of Silver Chub in the western basin of Lake Erie has proven to be extremely resilient to habitat changes. While there is evidence that some environmental conditions of the lake are changing, there is no evidence that Silver Chub is at risk of facing imminent extirpation from Ontario. However, steps are required to address factors (i.e. water quality and ecosystem changes in Lake Erie) that could lead to the endangerment of the Silver Chub in the future.

5.2 Summary of status evaluation

Silver Chub is classified as **Threatened** in Ontario.

Silver Chub is a large minnow that occurs throughout rivers and lakes of eastern and central North America. In Ontario, it appears to be restricted to Lake Erie. It was once

an abundant forage fish in Lake Erie, but experienced drastic population declines in response to poor water quality in the 1960s and 1970s. Silver Chub began to recover through the 1980s and 1990s and then declined rapidly in the early 2000s. Trawl surveys demonstrate that this short-lived fish has extreme population fluctuations. Numbers declined by 71% from 1996 to 2005, and while the population has increased by 25% over the last 5 years, it still much lower than historic levels. The primary threat to this species is the recent declines in Lake Erie water quality. Silver Chub is Threatened in Ontario because populations have significantly declined over the last 10 years, and recent changes in the condition of Lake Erie may further impair habitat and the recovery of this species.

Information Sources

1. Literature Cited

- Boyko, A.L. and S.K. Staton. 2010. Management Plan for the Silver Chub, *Macrhybopsis storeriana*, in Canada. *Species at Risk Act Management Plan Series*. Fisheries and Oceans Canada, Ottawa. vi + 21 pp.
- Carlson DM and RA Daniels. 2004. Status of Fishes in New York: Increases, Declines and Homogenization of Watersheds. *The American Midland Naturalist* 152(1):104-139. 2004.
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. COSEWIC status report on Silver Chub in Canada. 2-month Interim Status Report. April 2012.
- Derosier, A.L. 2004. Special Animal Abstract for *Macrhybopsis storeriana* (silver chub). Michigan Natural Features Inventory. Lansing, MI. 2 pp.
- Environment Canada. 2012a. Species at risk public registry. Available at: http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=114 . (Accessed: May 7, 2012).
- Environment Canada. 2012b. Great Lakes water quality agreement. Available at: <http://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=A1C62826-1&offset=5&toc=show> . (Accessed: September 14, 2012).
- Gibo, KB, WK Dodds and ME Eberle. 2010. Retrospective analysis of fish community change during a half-century of landuse and streamflow changes. *Journal of the North American Benthological Society* 29(3):970-987.
- Iowa Rivers Information System (IRIS). 2006. Iowa Aquatic Gap Fish Atlas. Available at: <http://maps.gis.iastate.edu/iris/fishatlas/> (Accessed: September 14, 2012).
- Kinney, E.M.S. 1954. A life history of the silver chub, *Hybopsis storeriana* (Kirtland), in western Lake Erie with notes on associated species. Ph.D. Thesis, Ohio State University, Columbus, Ohio.
- Koops, Marten. Personal communication, M. Koops (Department of Fisheries and Oceans) and D. Kraus, May 17, 2012.
- Lake Erie Lake-wide Management Plan. 2011. Annual Report. Available at: http://binational.net/lamp/le_ar_2011_en.pdf (Accessed: September 14, 2012).

- Ludsin, SA, MW Kershner, KA Blocksom, RL Knight, RA Stein. 2001. Life After Death in Lake Erie: Nutrient Controls Drive Fish Species Richness, Rehabilitation. *Ecological Applications*, Vol. 11, No. 3, pp. 731-746
- Mandrak, N.E. and E.J. Crossman. 1992. A checklist of Ontario freshwater fishes annotated with distribution maps. Royal Ontario Museum Life Sciences Miscellaneous Publication. Toronto, Ontario. v + 176 pp.
- Nash, C.W., 1908. Manual of vertebrates of Ontario. Legislative Assembly Ont., Canada. 107 p.
- National Oceanic and Atmospheric Administration. 2012. NOAA, partners predict mild harmful algal blooms for western Lake Erie this year. Available at: http://www.noaa.gov/stories2012/20120705_habs.html (Accessed: September 14, 2012).
- Natural Heritage Information Centre. 2012. Biodiversity Explorer. Available at: <https://www.biodiversityexplorer.mnr.gov.on.ca/nhicWEB/mainSubmit.do>. (Accessed: May 7, 2012).
- NatureServe. 2012. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: May 7, 2011).
- New York Department of Environmental Conservation (NYDEC). 2012. Endangered & Threatened Fishes Of New York: Silver Chub Fact Sheet. Available at: <http://www.dec.ny.gov/animals/26010.html> (Accessed: September 14, 2012).
- Ohio Department of Natural Resources. nd. Division of Wildlife - A to Z Species Guide - Silver Chub. Available at: <http://www.dnr.state.oh.us/Default.aspx?tabid=22328> (Accessed: September 14, 2012).
- Ontario Ministry of Natural Resources. 2012. Species at Risk in Ontario (SARO) List. Available at: <http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/276722.html>. (Accessed: May 7, 2012).
- Page, L.M. and B.M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.
- Pennsylvania Fish and Boat Commission (PFBC). 2012. Threatened and Endangered Species. Available at: <http://fishandboat.com/endang1.htm> (Accessed: September 14, 2012).

Reutter, Jeff. Personal communication, J. Reuter (Ohio State University) and D. Kraus, September 20, 2012.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Bull. Fish. Res. Board Can. 184. [1998 Reprint] Galt House Publications Ltd., Oakville, Ontario. xx + 966 pp.

Smith, P.W. 2002. The fishes of Illinois. University of Illinois.

Stauffer, J. R., Jr., J. M. Boltz, and L. R. White. 1995. The fishes of West Virginia. Proc. Acad. Nat. Sci. of Phil. 146:1-389.

U.S. Geological Survey (USGS). 2012. Fisheries research and monitoring activities of the Lake Erie biological station, 2011. Lake Erie Biological Station. Sandusky, OH. 37 pp.

2. Community and Aboriginal Traditional Knowledge Sources

No community knowledge or traditional Aboriginal knowledge was available.

3. Acknowledgements

Kevin Keretz (USGS Great Lakes Science Centre) provided a U.S. perspective on the status and trends of the Silver Chub in the Ohio portion of Lake Erie.

Appendix 1 Northeastern North America status rank and decline

Jurisdiction	Subnational Rank	Sources	Decline	Sources
CT	-			
DE	-			
IL	S5	NatureServe	No noted declines except polluted upper reaches of the Illinois River	Smith 2002
IN	S4	NatureServe	No information found on declines	
IA	SNR	NatureServe	No noted declines	IRIS 2006
LB	-			
KY	S4S5	NatureServe	No information found on declines	
MA	-			
MB	S3	NatureServe		
MD	-			
ME	-			
MI	S2S3	NatureServe	No noted declines. Only known from Lake St. Clair and Detroit River. Listed as Special Concern.	Derosier 2004
MN	SNR	NatureServe	No information found on declines	
NB	-			
NF	-			
NH	-			
NJ	-			
NS	-			
NY	SH	NatureServe	Listed as Endangered and considered extirpated	NYDEC 2012
OH	S4	NatureServe	No noted declines	Ohio DNR nd
ON	S2	NatureServe		
PA	S3S4	NatureServe	Delisted in 2010 (previously listed as Endangered)	PFBC 2012
PE	-			
QC	-			
RI	-			
VA	-			
VT	-			
WI	S3	NatureServe	No information found on declines	
WV	S3S4	NatureServe	No noted declines	Stauffer et al. 1995

Occurs as a native species in 13 of 29 northeastern jurisdictions

Srank or equivalent information available for 11 of 13 jurisdictions = (85%)

S1, S2, SH, or SX in 3 of 11 = (27%)