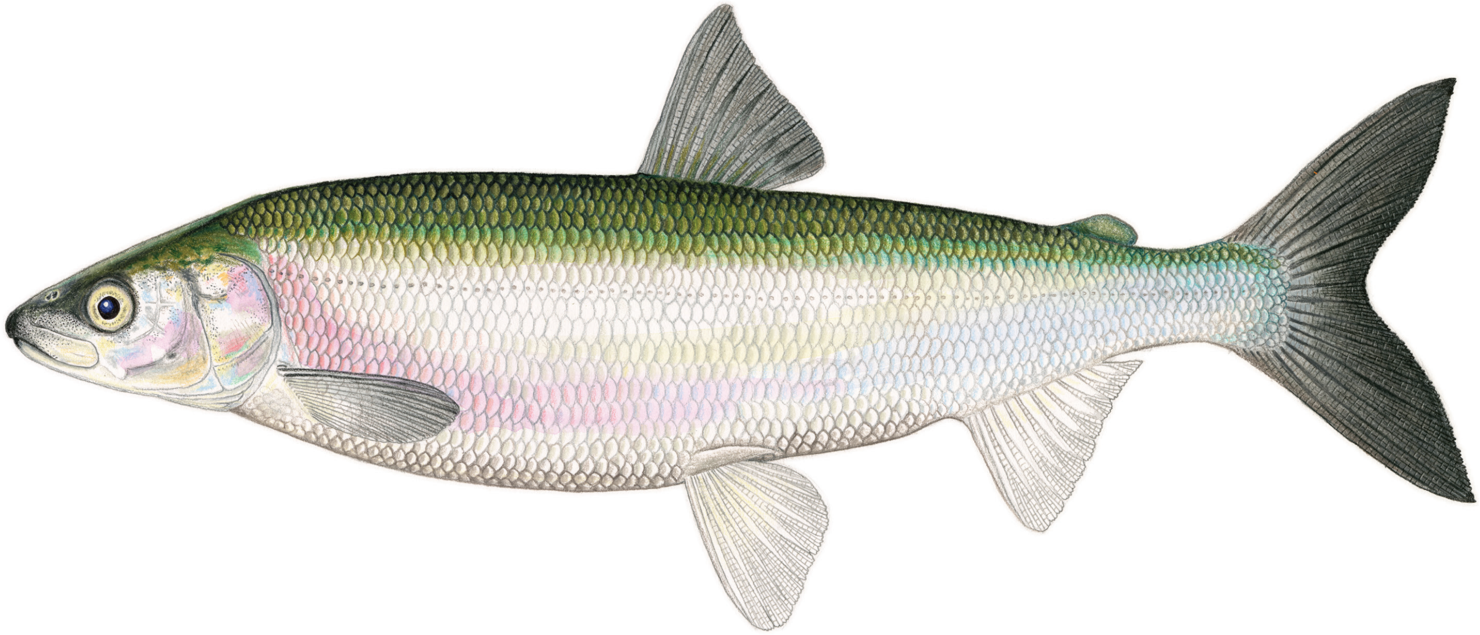

Illustration: Paul Vecsei

Shortnose Cisco

(Coregonus reighardi) in Ontario

Ontario Recovery Strategy Series

2018

Ministry of the Environment, Conservation and Parks

Ontario

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the *Endangered Species Act 2007* (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of the Environment, Conservation, and Parks Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

Recommended citation

Mandrak, N.E. 2018. Recovery Strategy for the Shortnose Cisco (*Coregonus reighardi*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ministry of the Environment, Conservation and Parks, Peterborough, Ontario. v + 10 pp. + Appendix.

Cover illustration: Illustration by Paul Vecsei from Eshenroder (2016), reprinted with permission of the Great Lakes Fishery Commission.

ISBN 978-1-4868-2764-0 (HTML)
ISBN 978-1-4868-2765-7 (PDF)

Cette publication hautement spécialisée « Recovery strategies prepared under the Endangered Species Act, 2007 », n'est disponible qu'en anglais en vertu du Règlement 411/97 qui en exempte l'application de la Loi sur les services en français. Pour obtenir de l'aide en français, veuillez communiquer avec recovery.planning@ontario.ca.

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Acknowledgments

Information was gratefully received from the following agencies and staff: Great Lakes Fishery Commission – Randy Eshenroder; Ontario Commercial Fisheries Association – Kevin Reid; OMNRF – Chris Davis, Jim Hoyle;Ontario Natural Heritage Information Centre; Parks Canada Agency – Scott Parker; Chippewas of Nawash Unceded Nation – Ryan Lauzon.

Declaration

The recovery strategy for the Shortnose Cisco was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The recommended goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

Responsible jurisdictions

Ontario Ministry of the Environment, Conservation and Parks
Fisheries and Oceans Canada
Parks Canada Agency

Executive summary

The *Endangered Species Act, 2007* (ESA) requires the Minister of the Environment, Conservation and Parks to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Shortnose Cisco (*Coregonus reighardi*) is listed as Endangered on the SARO List. The species is also listed as Endangered under the federal *Species at Risk Act* (SARA). Fisheries and Oceans Canada prepared the Recovery Strategy for the Shortnose Cisco (*Coregonus reighardi*) in Canada in 2012 to meet its requirements under the SARA. This recovery strategy is hereby adopted under the ESA. With the additions indicated below, the enclosed strategy meets all of the content requirements outlined in the ESA.

Sampling, from the last known collection dates to the present, has not yielded any additional Shortnose Cisco specimens in lakes Huron and Ontario. In Lake Huron, it appears that the cisco species have hybridized. Hybridization with other ciscoes, including reintroduced Bloater (*C. hoyi*) in Lake Ontario, and predation by reintroduced Lake Trout (*Salvelinus namaycush*) in lakes Huron and Ontario, may be new threats if a remnant population of Shortnose Cisco still exists. Therefore, consideration should be given to relevant recovery actions that would help to address these new threats when developing recovery initiatives for this species in Ontario. To date, there have been no recovery efforts specifically targeting Shortnose Cisco.

There is virtually no information on the habitat requirements of Shortnose Cisco. The area for consideration in developing a habitat regulation could include depths of 37 to 92 m in Lake Huron and 22 to 92 m in Lake Ontario in areas where its primary prey, Opossum Shrimp (*Mysis diluviana*) and a small bottom-dwelling invertebrate, *Diporeia* sp., occur.

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Adoption of federal recovery strategy

The *Endangered Species Act, 2007* (ESA) requires the Minister of the Environment, Conservation and Parks to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to the species.

The Shortnose Cisco (*Coregonus reighardi*) is listed as endangered on the SARO List. The species is also listed as endangered under the federal *Species at Risk Act* (SARA). Fisheries and Oceans Canada prepared the Recovery Strategy for the Shortnose Cisco (*Coregonus reighardi*) in Canada in 2012 to meet its requirements under the SARA. This recovery strategy is hereby adopted under the ESA. With the additions indicated below, the enclosed strategy meets all of the content requirements outlined in the ESA.

Species assessment and classification

Table 1. Species assessment and classification of the Shortnose Cisco (*Coregonus reighardi*). The glossary provides definitions for the abbreviations within, and for other technical terms in this document.

Assessment	Status
SARO list classification	Endangered
SARO list history	Endangered (2008)
COSEWIC assessment history	Threatened (1987), Endangered (2005, 2017)
SARA schedule 1	Endangered
Conservation status rankings	GRANK: GH NRANK: NH SRANK: SH

Species description and biology

Species description

Eshenroder et al. (2016) provides a more comprehensive description of Shortnose Cisco than that found in the federal recovery strategy. The body is only slightly laterally compressed, almost cylindrical in cross section, with its deepest point (22-26% of standard length) located just in front of the dorsal fin. The head is short (~23% of standard length), the snout truncate and medium in length, and the lower jaw included and lacking a symphyseal knob. The gill rakers are short and few in number (36.2±2.1, 30-43). The paired fins are short and often unpigmented, and the dorsal and caudal fins are pigmented. The snout and upper jaw have distinctive dark pigmentation.

In Lake Huron, it appears that the cisco species have hybridized. Eshenroder et al. (2016) hypothesized that certain morphological elements of Shortnose Cisco may still exist in Lake Huron, but have been introgressed with other cisco species into a “hybrid swarm” that no longer completely resembles any one of the constituent species.

Species biology

Recent analyses of preserved museum specimens provide insight into the ecological role that the species held in relation to the other ciscoes. Using tissues obtained from formalin-preserved museum specimens, Schmidt et al. (2011) used ^{13}C and ^{15}N stable isotope analyses to determine the trophic position of nine cisco species, including Shortnose Cisco, in lakes Huron, Michigan, and Superior. The study found that the ecological niche of Shortnose Cisco overlapped only with Deepwater Cisco (*C. johannae*) in Lake Huron and was similar to that Blackfin Cisco (*C. nigripinnis*) and Deepwater Cisco in Lake Michigan.

Also using tissues obtained from formalin-preserved museum specimens, Blanke et al. (2018) used amino-acid specific nitrogen isotope analysis to determine the trophic position of seven cisco species, including Shortnose Cisco, in lakes Michigan and Superior. The study found that the ecological niche of Shortnose Cisco overlapped only with Shortjaw Cisco (*C. zenithicus*) in Lake Michigan. Note that the study erroneously provided results for Shortnose Cisco in Lake Superior, a lake in which it did not occur (Eshenroder et al. 2016; COSEWIC 2017).

Distribution, abundance and population trends

Since the publication of the federal recovery strategy, more recent sampling has been conducted in lakes Huron and Ontario that could capture Shortnose Cisco. Despite the use of appropriate sampling methods and effort, none were reported.

In Lake Huron, the annual MNRF gillnetting program caught 9122 individuals identified as “deepwater chub” in 513 of 1855 net gangs set at five locations, 2005-2017 (C. Davis, pers. comm. 2018). Individuals were not identified to species except in 2012 and 2017. In 2012, 203 ciscoes caught in deep waters (>90 m) near Tobermory were identified as Bloater (*C. hoyi*) (110), Cisco (*C. artedi*) (75), Shortjaw Cisco (17), and unidentifiable (1) (Mandrak et al. 2013). In 2017, two of 152 ciscoes caught were identified as Cisco (*C. artedi*), none as Shortnose Cisco, and the remaining specimens as hybrids (R. Eshenroder, pers. comm. 2018). Parks Canada has not sampled ciscoes since 2012 (S. Parker, pers. comm. 2018) and Chippewas of Nawash Unceded Nation does not identify ciscoes captured in their fishery to species (R. Lauzon, pers. comm. 2017).

In Lake Ontario, MNRF captured 682 ciscoes between 2005 and 2017 in their annual bottom trawl survey conducted at depths of 4-100 m; all were identified as Cisco except for one stocked Bloater (J. Hoyle, pers. comm. 2017). Between 2005 and 2017, OMNRF captured 408 ciscoes in their annual gillnetting survey conducted at depths of 7.5-140 m; all were identified as Cisco (J. Hoyle, pers. comm. 2017). Between 2005 and 2016, of the over 6.7 million fishes caught in the United States Geological Survey (USGS) and New York Department of Environmental Conservation annual bottom trawling survey conducted at a maximum depth of 225 m, the only ciscoes caught were 472 Cisco and two Bloater (B. Weidel, pers. comm. 2017).

Although members of the Ontario Commercial Fisheries Association (OCFA) fish in both lakes Huron and Ontario, no Shortnose Cisco have been reported as commercially landed since the OCFA database was inaugurated in 1997 (K. Reid, pers. comm. 2017).

Threats to survival and recovery

Hybridization

Eshenroder et al. (2016) indicated that a “hybrid swarm” of ciscoes is present in Lake Huron. Therefore, hybridization with other ciscoes appears to be an ongoing potential threat to the continued existence of Shortnose Cisco (COSEWIC 2017). The Bloater (*Coregonus hoyi*) is currently being reintroduced to Lake Ontario (OMNRF 2016) and could potentially hybridize with a remnant population of Shortnose Cisco if one still exists (COSEWIC 2017).

Predation

Native Lake Trout (*Salvelinus namaycush*), a historical predator of ciscoes, were nearly extirpated from lakes Huron and Ontario. Current stocking efforts to reestablish self-sustaining populations of this species could increase predation pressure on a remnant population of Shortnose Cisco should one exist (COSEWIC 2017).

Recovery actions completed or underway

To date, there have been no recovery efforts specifically targeting Shortnose Cisco (COSEWIC 2017) as recovery is deemed not feasible in the federal recovery strategy.

Recommended approaches to recovery

New information under the section on Threats to Survival and Recovery above is not discussed in the federal recovery strategy. Although the federal recovery strategy deemed the recovery of Shortnose Cisco not feasible, recovery actions in the federal strategy and this document would need to be implemented if any individuals are found in the future. The recovery actions outlined in the federal recovery strategy would not fully address the new threats identified in this document; therefore, consideration should be given to relevant recovery actions that would help to address these new threats when developing recovery initiatives for this species in Ontario. Additional recovery approaches have been identified in Table 1. Furthermore, DFO (2013) recommended that recovery actions for ciscoes take a multi-species approach separately for each lake.

Table 2. Approaches to the recovery of Shortnose Cisco in Ontario, specifically related to the new threats identified in this document. These approaches should only be implemented if the species is found to be still extant.

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Short-term	Research	**4.1** Confirm threats. • Conduct lab and field studies to determine threshold to, magnitude and extent of, hypothesized threats.	Threats: • Hybridization with stocked Bloater. • Predation from stocked Lake Trout. Knowledge gaps: • Magnitude and extent of threats.
Critical	Ongoing	Protection, Research, Stewardship	**4.2** Implement threat mitigation. • Conduct lab and field studies to evaluate effectiveness of potential threat mitigation actions. • Implement potentially effective threat mitigation actions. • Evaluate effectiveness of implemented threat mitigation actions.	Threats: • Hybridization with stocked Bloater. • Predation from stocked Lake Trout. Knowledge gaps: • Magnitude and extent of threats.

Area for consideration in developing a habitat regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of the Environment, Conservation and Parks on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below will be one of many sources considered by the Minister, including information that may become newly available following completion of the recovery strategy, when developing the habitat regulation for this species.

There is virtually no information on the habitat requirements of Shortnose Cisco. Shortnose Cisco inhabited depths of 37 to 92 m in Lake Huron and 22 to 92 m in Lake Ontario in areas with its primary prey, Opossum Shrimp (*Mysis diluviana*) and a bottom-dwelling invertebrate (*Diporeia* sp.) (Eshenroder et al. 2016). Spawning occurred at depths of 52-146 m in Lake Michigan and predominantly at 73 m in Lake Ontario. Spawning depths in Lake Huron are unknown (Eshenroder et al. 2016). Eshenroder et al. (2016) provided a map of its historical distribution where it was considered to be widespread and abundant in the Great Lakes (Figure 1).

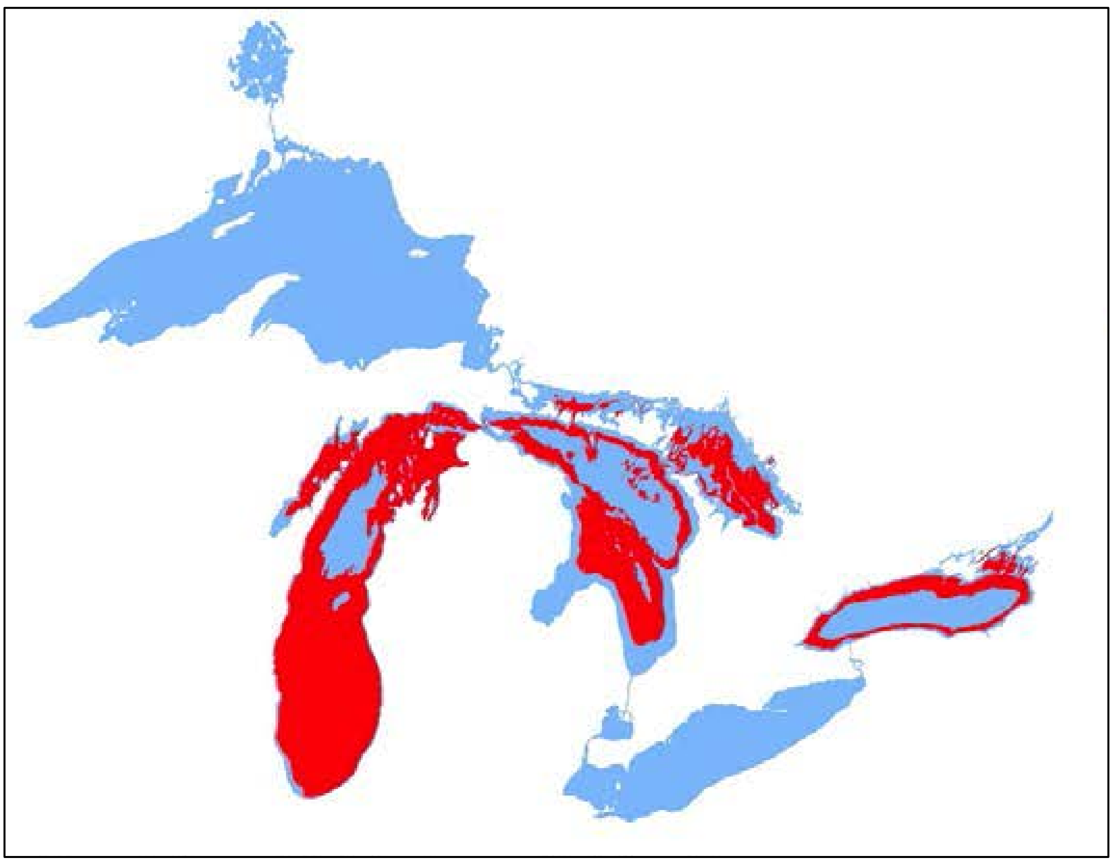

Figure 1. Historical distribution of Shortnose Cisco in the Great Lakes (from Eshenroder et al. 2016).

Despite extensive more recent sampling, the most recent record of Shortnose Cisco in Lake Ontario was from 1964 and in Lake Huron from 1985; hence, all of the known occurrences are historical. Furthermore, the federal recovery strategy considers recovery to be not feasible, and it is unlikely that the historically occupied habitat is currently suitable due to substantial ecosystem changes. Therefore, it is recommended that a habitat regulation not be developed at this time.

If, in the future, it is decided to develop a habitat regulation, the regulation could include all potential available habitat identified by Eshenroder et al. (2016) and presented in Figure 1. This map was based on a synthesis of published fishery and fishery-independent catch data and mapped at a contour scale of 20 m (Eshenroder et al. 2016) and the identified habitat corresponds to depth contours between 20 and 100 m. Both adult and spawning habitat are found within these depths. The identified habitat could be further limited to areas within these depths with sufficient densities of its historically important prey, or suitable replacement. Currently, what densities would be sufficient for Shortnose Cisco is unknown.

Glossary

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the Species at Risk Act that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. Ranks are determined by NatureServe and, in the case of Ontario's S-rank, by Ontario's Natural Heritage Information Centre. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure
NR = not yet ranked

Deepwater chub: Collective, non-technical term used for several cisco species found in, and adapted to, the deep waters (>100 m) of the Laurentian Great Lakes.

Endangered Species Act, 2007 (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Hybrid swarm: A population of hybrids that has survived beyond the initial hybrid generation, with interbreeding between hybrid individuals and backcrossing with its parent types. Such populations are highly variable with the genetic and phenotypic characteristics of individuals ranging widely between the two parent types.

Introgression (introgressed): The transfer of genetic information from one species to another as a result of hybridization between them and repeated backcrossing. Backcrossing occurs when a hybrid reproduces with one of its parent species.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

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List of abbreviations

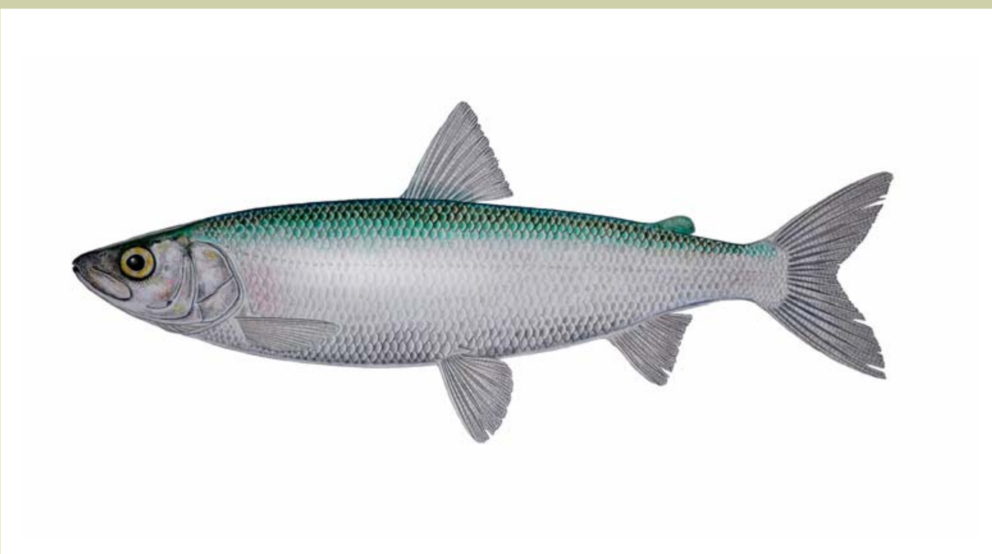
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
COSSARO: Committee on the Status of Species at Risk in Ontario
CWS: Canadian Wildlife Service
ESA: Ontario's *Endangered Species Act, 2007*
ISBN: International Standard Book Number
OMNRF: Ontario Ministry of Natural Resources and Forestry
SARA: Canada's Species at Risk Act
SARO: Species at Risk in Ontario

Appendix 1. Recovery strategy for the Shortnose Cisco (*Coregonus reighardi*) in Canada

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Shortnose Cisco (*Coregonus reighardi*) in Canada

Shortnose Cisco



2012

Canada

Recommended citation:

Fisheries and Oceans Canada. 2012. Recovery Strategy for the Shortnose Cisco (*Coregonus reighardi*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. vi + 16 pp.

For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related documents, see the Species at Risk Public Registry (www.sararegistry.gc.ca).

Cover illustration: Paul Vecsei, 2011

Également disponible en français sous le titre
«Programme de rétablissement du cisco à museau court (*Coregonus reighardi*) au Canada [proposition]»

ISBN 978-1-100-21107-7
Catalogue no. En3-4/145-2012E-PDF

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the Species at Risk Act (S.C. 2002, c.29) (SARA) the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years.

The Minister of Fisheries and Oceans is the competent minister for the recovery of the Shortnose Cisco and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Province of Ontario.

It was determined that the recovery of the Shortnose Cisco in Canada is not technically or biologically feasible. The species still may benefit from general conservation programs in the same geographic area and will receive protection through SARA and other federal, and provincial or territorial, legislation, policies, and programs.

The feasibility determination will be re-evaluated as part of the report on implementation of the recovery strategy, or as warranted in response to changing conditions and/or knowledge.

Acknowledgments

This recovery strategy was drafted on behalf of Fisheries and Oceans Canada by Fred Hnytka with the input and assistance of Tom Pratt (DFO- Sault Ste. Marie), Nick Mandrak (DFO – Burlington), Jim Reist (DFO- Winnipeg), Dana Boyter (DFO – Burlington), P.L. Wong (DFO-Winnipeg), Scott Gibson (OMNR – Peterborough), Scott Reid (OMNR – Peterborough), Ken Cullis (OMNR – Thunder Bay) and Lloyd Mohr (OMNR – Owen Sound). We are all indebted to the numerous researchers and biologists that have endeavored to study deepwater ciscoes over the years and who have eagerly shared their knowledge and views with us.

Executive summary

In 1987, the Shortnose Cisco (*Coregonus reighardi*) was assessed as “Threatened” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In 2005, on the basis of an update status report, the species was reassessed by COSEWIC as “Endangered” and subsequently listed as such under Canada’s Species at Risk Act (SARA) in 2007. Originally endemic to three of the Laurentian Great Lakes, the species was last reported from Lake Ontario in 1964, Lake Michigan in 1982 and Lake Huron in 1985. The species is believed to be extinct although it does not yet meet the formal criteria for that designation (i.e. elapsed time since last credible record > 50 years).

The Shortnose Cisco belongs to a taxonomically complex group of closely related cisco forms representing a species flock indigenous to the Laurentian Great Lakes of North America. The Shortnose Cisco was a valuable component of the commercial “chub” fisheries which started in earnest in the mid to late 1800’s but began showing signs of depletion by the early 1900’s. Landed “chub” catches were rarely identified to individual species and few collections were made to evaluate population sizes and trends. Individual “chub” fisheries were managed as a single stock. This regime led to the sequential removal of larger species from the fisheries followed by gear size reduction to target smaller individuals thereby maintaining the fishery as a whole. Commercial chub fishing, which historically included the Shortnose Cisco, no longer occurs within the Canadian waters of lakes Huron or Ontario.

Little is known of the biology of the Shortnose Cisco. It was one of the smaller “chub” species occurring in the Great Lakes, generally ranging from 170 to 260mm (standard length). It was the only known spring-spawning cisco species in the lakes where it occurred although there is some evidence that late fall spawning might also have occurred. It occupied clear, cold, deepwater habitats of lakes Huron, Michigan and Ontario at depths ranging from 22m to 110m. Its diet consisted primarily of the crustaceans *Mysis diluviana* and *Diporeia* spp. Given its presumed extinction and the lack of historical knowledge on its life history requirements, critical habitat cannot be identified for the species.

Overexploitation, ecosystem impairment, and introgressive hybridization have all been implicated in the demise of the Shortnose Cisco. Recovery of the species has been deemed “not feasible” as there is no reproductive potential, its primary threats cannot be avoided or mitigated, and there are no recovery techniques that are applicable to its current circumstances.

Education, management and research strategies are proposed as a general conservation approach for the species. These strategies are designed to help with the identification and reporting of any new accounts for the species, focusing management decisions on protecting individual “chub” species, and developing the necessary tools and studies to help better manage and protect this, and other, deepwater cisco species where they occur.

Recovery feasibility summary

Under SARA (S.40) the competent minister must determine whether the recovery of a listed wildlife species is technically and biologically feasible. Recovery is considered technically and biologically feasible if all of the following four criteria are met (Government of Canada 2009):

1. ***Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance. NO***

There is currently no evidence of reproductive potential for the Shortnose Cisco. This species was found only in the Laurentian Great Lakes within lakes Ontario, Michigan and Huron. It was last reported from Lake Ontario in 1964, Lake Michigan in 1982 and Lake Huron in 1985 despite recent sampling. COSEWIC (2005) reported the number of extant locations in lakes Huron and Ontario as zero and indicated that there was no potential for rescue effect from Lake Michigan. The number of mature individuals and those capable of reproduction in Canada is presumed to be zero (COSEWIC 2005).

2. ***The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated. NO***

COSEWIC (2005) reported a stable habitat trend for the species in lakes Huron and Ontario. Although deepwater habitat itself is not physically limiting, recent ecological changes ongoing in the Great Lakes, in particular, the establishment of *Dreissena* mussels and the concurrent decline in the abundance and distribution of the benthic amphipod *Diporeia* spp. may have significant implications on existing fisheries resources as well as any potential recovery efforts for species such as the Shortnose Cisco. The degree to which this change in habitat would affect the Shortnose Cisco is unknown.

3. ***Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration. UNKNOWN***

Overexploitation, ecosystem impairment and introgressive hybridization have all been implicated in the decline and likely extinction of the Shortnose Cisco. Historically, overexploitation of Shortnose Cisco within “chub” fisheries that occurred in lakes Huron, Michigan, and Ontario, at various times dating back to the late 1800s, had a profound effect on the species abundance. As the Shortnose Cisco declined in abundance, fishing effort was re-focused on smaller co-occurring “chub” species, thereby, further depleting any residual stocks. Although impacts of overfishing on current fisheries can be mitigated through appropriate management actions, the impacts of historical overfishing of the Shortnose Cisco are not likely reversible and as such may preclude future recovery options. Although not specifically documented for the Shortnose Cisco, ecosystem changes in the Great Lakes, including the introduction of exotic species and hybridization with other co-occurring deepwater ciscoes, may have contributed to the demise of the species. These ecosystem changes can neither be avoided nor mitigated at this time.

4. ***Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe. NO***

Without individuals capable of reproduction, there is presently no recovery technique that could be applied to the Shortnose Cisco.

Given that all of the criteria in the above analysis cannot be met, and in particular, the lack of reproductive potential, recovery for the Shortnose Cisco is deemed **not feasible**.

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1. COSEWIC species assessment information

Date of Assessment: May 2005

Common Name: Shortnose Cisco

Scientific Name: *Coregonus reighardi*

COSEWIC Status: Endangered

Reason for Designation: Endemic to three of the Great Lakes, this species was last recorded in Lake Michigan in 1982, in Lake Huron in 1985, and in Lake Ontario in 1964. Although it has probably disappeared throughout its range, searches for this species have not been extensive enough to declare the species extinct. The species' apparent demise is suspected to be the result of commercial overfishing and possibly competition or predation from introduced species.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Threatened in April 1987. Status re-examined and designated Endangered in May 2005. Last assessment based on an updated status report.

2. Species status information

The Shortnose Cisco was formerly assessed as "Threatened" by COSEWIC in 1987 based on a status report by Parker (1988). In 2005, COSEWIC reassessed the species as Endangered based on an update status report (COSEWIC 2005), and the species was formally listed as such under Canada's Species at Risk Act in 2007. The species is also listed as Endangered under Ontario's Endangered Species Act, 2007. NatureServe (2009) ranks the species as Globally Historic (GH) and Nationally Historic (NH) in both Canada and the USA as well as Regionally Extirpated (SX) in Illinois, Indiana, New York, and Wisconsin, and Regionally Historic (SH) in Michigan and Ontario. The Shortnose Cisco is included on the IUCN Red List under the category of Critically Endangered (Gimenez Dixon 1996) and has been assessed as Endangered by the American Fisheries Society (Jelks et al. 2008). As there are no known extant populations throughout its historical distribution in lakes Michigan, Huron or Ontario and the last reported sighting for the species was from Lake Huron in 1985 (Webb and Todd 1995) the Shortnose Cisco is thought to be extinct (COSEWIC 2005, Jelks et al. 2008, Mandrak and Cudmore 2010).

3. Species information

3.1 Species description

The Shortnose Cisco (*Coregonus reighardi*) (Figure 1) belongs to a taxonomically complex group of closely related cisco forms representing a “species flock” (Figure 2) which was endemic to the Great Lakes of North America (Smith and Todd 1984; Todd and Smith 1992; Scott and Crossman 1998, Cudmore-Vokey and Crossman 2000). The species was typically characterized by a cylindrical body, short head, short snout with terminal mouth, small eye, black pigmentation around the snout, short paired fins and low gill raker count (typically 32-42) (Pritchard 1931, Jobes 1943, Scott and Crossman 1998). Koelz (1929) reported the occurrence of two forms of Shortnose Cisco occurring in the Great Lakes: *Coregonus reighardi reighardi* from lakes Huron, Michigan and Ontario; and, *Coregonus reighardi dymondi* from lakes Superior and Nipigon. Subsequent review of the morphological variations and systematics of the species led to *C. reighardi dymondi* being synonymized with the Shortjaw Cisco (*Coregonus zenithicus*) (Todd 1980, Todd and Smith 1980, Parker 1988). Consequently, *C. reighardi* is now regarded to have occurred only in lakes Huron, Michigan and Ontario (COSEWIC 2005). As with other deepwater ciscoes occurring in the Great Lakes, overexploitation, ecosystem impairment, and possible hybridization may have contributed to the eventual collapse and extirpation of the species (Smith 1964). Hybridization within deepwater ciscoes was suspected as early as 1960; at which time specimens collected were noted to almost defy placement within any species category and were sometimes referred to as “hybrid chubs” (Smith 1964). Confusion over its taxonomy and identification may be reflected in some of the data available for the species.

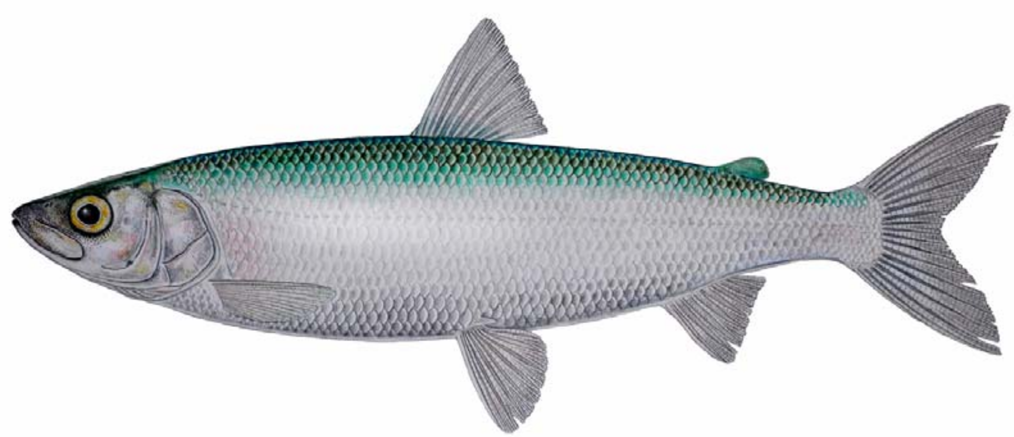

Figure 1. The Shortnose Cisco (Coregonus reighardi Koelz) (Illustration by Paul Vecsei, 2011)

Little is known of the biology of the Shortnose Cisco (Parker 1988; Scott and Crossman 1998; COSEWIC 2005). It was one of the smaller deepwater cisco or "chub" species indigenous to the Great Lakes. Todd (1980) reported adult size generally ranging 170-260mm standard length (SL), although fish of at least 356mm SL and weights of 539g were reported from Lake Ontario (Scott and Crossman 1998). It was the only known spring-spawning cisco species in the lakes where it occurred. Spawning reportedly occurred between April and May in Lake Ontario and between May and June in lakes Huron and Michigan at depths of 52m - 146m (COSEWIC 2005). There was some evidence that late fall spawning might also have occurred (Koelz 1929; Smith 1964), potentially allowing for hybridization with other fall spawning species (Scott and Crossman 1998). Information on fecundity, embryological development and early life history is unknown (Parker 1988).

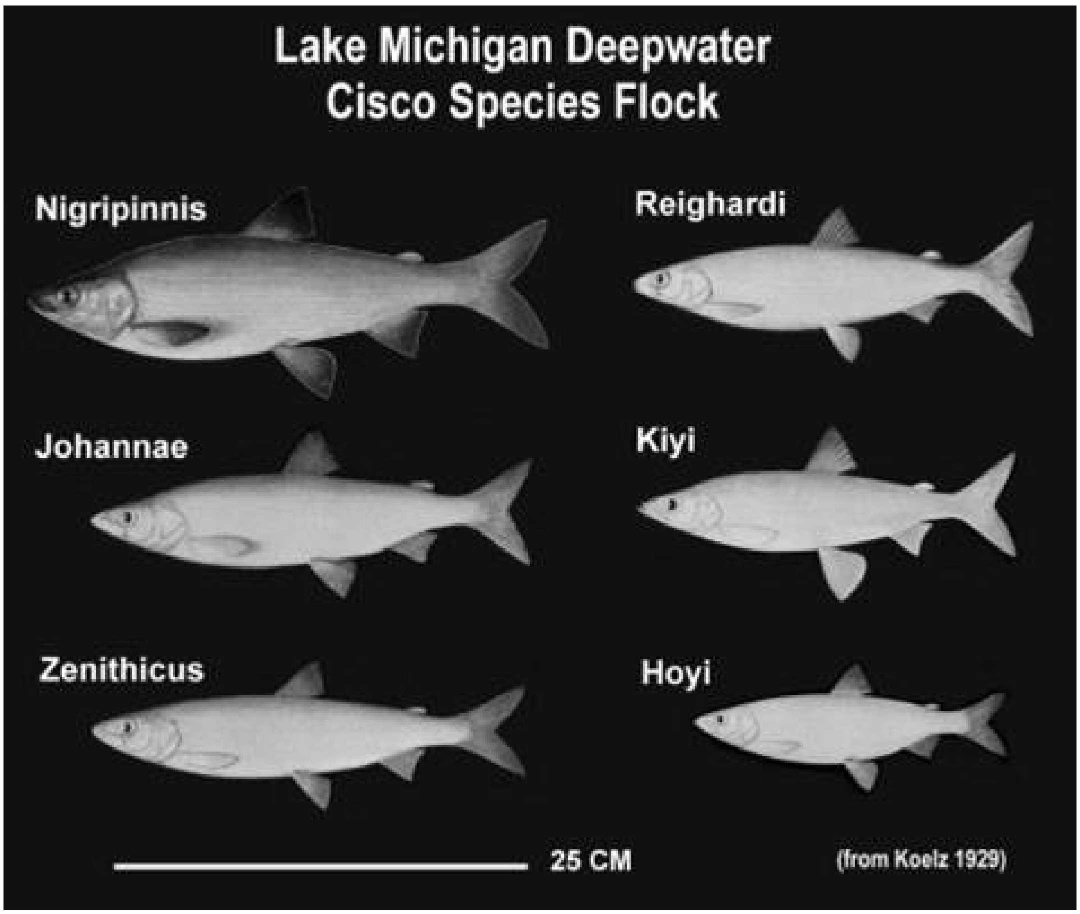

Figure 2. Lake Michigan deepwater cisco species flock including the Shortnose Cisco. From Koelz (1929)

3.2 Population and distribution

Shortnose Cisco occurred only in the Great Lakes within lakes Michigan, Huron, and Ontario (Figure 3). The species was last reported from: Lake Ontario in 1964; Lake Michigan in 1982; and, the Georgian Bay area of Lake Huron in 1985 (COSEWIC

2005). The species has not been reported since then despite significant fishing and sampling efforts. Although the occurrence of any remnant populations cannot be ruled out, it is very unlikely (Webb and Todd 1995, COSEWIC 2005, Mandrak and Cudmore 2010).

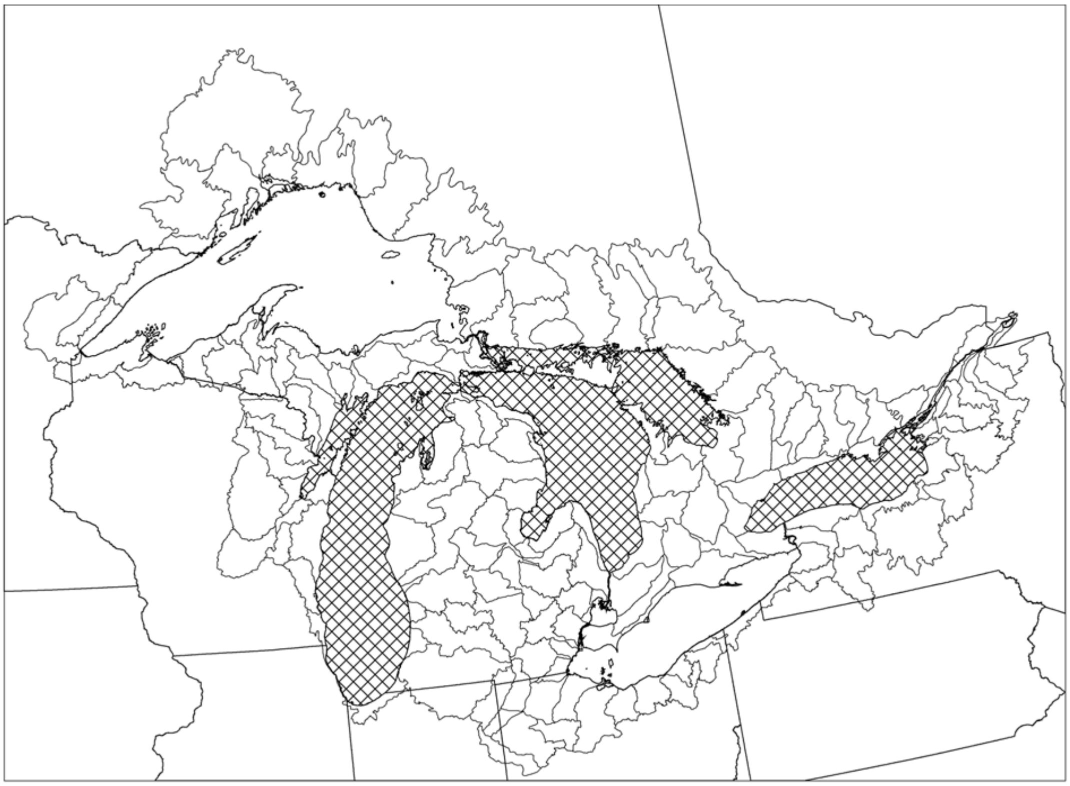

Figure 3. Global historic distribution of Shortnose Cisco (*Coregonus reighardi*). From COSEWIC 2005.

The species was once a valuable component to the commercial "chub" fisheries which started in earnest in the mid to late 1800's but began showing signs of depletion by the early 1900's (Koelz 1926, Jobes 1943). Landed "chub" catches were rarely identified to individual species and few collections were made to evaluate population sizes and trends. Only 324 specimens were documented from Lake Huron with a single specimen collected in 1919 and the balance collected between 1956 and 1985 (Webb and Todd 1995). Misrepresentation of the Shortjaw Cisco as the Shortnose Cisco in lakes Superior and Nipigon prior to 1980 may have obscured the critical status of the species elsewhere in the Great Lakes.

Although distribution data for the species are lacking, deepwater habitats within lakes Huron and Ontario were abundant. Based on a suitable depth stratum of 35m to 100m, roughly 47% of the total area of Lake Huron (60,166 km^2) and 26% of the total area of Lake Ontario (24,157 km^2) would have been suitable habitat for the Shortnose Cisco (COSEWIC 2005).

3.3 Needs of the Shortnose Cisco

The Shortnose Cisco occurred in clear, cold, deepwater habitats in lakes Huron, Michigan and Ontario ranging in depths from 22m to 110m (COSEWIC 2005). Its diet consisted primarily of the freshwater crustaceans *Mysis diluviana* (formerly *Mysis relicta*) and *Diporeia* spp. along with small numbers of copepods, aquatic insect larvae, and fingernail clams (Scott and Crossman, 1998). Spawning was believed to occur primarily during April through June at depths in excess of 52m (COSEWIC 2005).

4. Threats

4.1 Threat assessment

Table 1. Threat assessment table

Threat/Attributes	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Ecosystem Impairment						
Invasive Species, Habitat changes	High	Widespread	Historic/ Current	Continuous	Unknown	Unknown
Hybridization						
Introgressive hybridization	High	Unknown	Unknown	Unknown	Unknown	Unknown
Overexploitation (Historic threat only – contributed to decline but no longer affecting the species)						
Commercial "chub" fisheries	High	Widespread	Historic	Continuous	High	High

[1] *Level of Concern: signifies that should the species still exist managing the threat and/or its effects is of (high, medium or low) concern for the recovery of the species. This criterion considers the assessment of all the information in the table.*

[2] *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

[3] *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

4.2 Description of threats

Overexploitation, ecosystem impairment, and introgressive hybridization have all been implicated in the demise of the Shortnose Cisco (Smith 1964, 1967, Berst and Spangler 1973, Todd and Stedman 1989, Parker 1988, COSEWIC 2005).

Overexploitation:

As the Shortnose Cisco is believed to be extinct and thus no viable population exists, the overexploitation threat from the commercial fishery that contributed to the decline is no longer affecting the species. The overexploitation threat is an historic threat only but could become a current threat if a commercial chub fishery becomes active in the future.

Among the threats identified, overexploitation by the commercial chub fishery probably had the most immediate and profound effect on the Shortnose Cisco (Smith 1968, Christie 1973, Wells and McLain 1973, Parker 1988, COSEWIC 2005). In Lake Ontario, the species was abundant in the 1880s (Pritchard 1931) but, by the 1930s, that fishery had all but collapsed (Gray 1979). The last reported sighting for Lake Ontario was in 1964 (Gray 1979, Parker 1988, COSEWIC 2005). A similar pattern of overexploitation was observed in lakes Michigan and Huron with last reported sightings of the species at these locations in 1974 and 1985, respectively (Webb and Todd 1995). The overexploitation and eventual collapse of the Shortnose Cisco populations followed the same pattern as the collapse of other deepwater cisco populations in the Great Lakes including the Deepwater Cisco (*C. johannae*), Shortjaw Cisco (*C. zenithicus*), Blackfin Cisco (*C. nigripinnis*), Kiyi (*C. kiyi*), and Bloater (*C. hoyi*) (Smith 1968, Wells and McLain 1972, Todd and Smith 1992).

Commercial chub fishing, which historically included the Shortnose Cisco, no longer occurs within the Canadian waters of lakes Huron or Ontario (L. Mohr, pers.comm.). Level of concern associated with overexploitation was rated as high based on the historical fishery and would remain such if viable populations and chub fisheries existed. When active, the extent of commercial fishing had been widespread. The frequency of commercial fishing was continuous since at least the mid-1800s with its greatest impact prior to the 1970s. Severity of impact was historically high with a high degree of causal certainty (Stone 1944, Smith 1964, Wells and McLain 1972, Berst and Spangler 1973, Parker 1988, Webb and Todd 1995, COSEWIC 2005). One of the significant issues with the commercial chub fishery was that it was not managed based on individual species. After the larger species were selectively removed, gear size was reduced in order to target smaller individuals thereby maintaining the chub fishery as a whole (Stone 1944, Smith 1964). This led to the sequential removal of the smaller species from the fishery, and in some cases, the eventual collapse of the fishery as a whole (Smith 1964, Smith 1968, Wells and McLain 1972, Parker 1988).

Ecosystem Impairment:

Ecosystem impairment is the result of multiple stressors including changes in coastal and aquatic habitats, invasive species, contamination, changes in biotic communities, resource utilization, land use/cover, and climate change. The most important of these to the Shortnose Cisco was probably the introduction of invasive species (Brown et al. 1987). Currently, more than 185 aquatic invasive species are known to persist in the

Great Lakes with new introductions likely to occur in the future (Environment Canada and US Environmental Protection Agency 2009).

Predation by the Sea Lamprey (*Petromyzon marinus*) is suspected of having contributed to the collapse of various fish populations including the Shortnose Cisco (Smith 1968, Berst and Spangler 1973). Competition with, or predation by, other invasive species including the Alewife (*Alosa pseudoharengus*) and Rainbow Smelt (*Osmerus mordax*) may have further contributed to the population decline or, at least, prevented its re-establishment (Berst and Spangler 1972, Wells and McLain, Parker 1989). The recent establishment of *Dreissena* mussels into the Great Lakes and the concurrent decline in the benthic amphipod *Diporeia* spp. may also have significant implications on the biotic communities of the Great Lakes (Dermot and Kerec 1997, Nalepa et al. 1998, Lozano et al. 2001, Mills et al 2003, Dobiesz et al. 2005, Nalepa et al. 2006, NOAA 2006, Riley et al. 2008, Environment Canada and US Environmental Protection Agency 2009). The degree to which this might affect deepwater cisco species, which depend on *Diporeia* as an important food source, is unknown. Habitat changes including eutrophication, pollution and habitat degradation have also been suggested as potentially limiting re-establishment of deepwater cisco populations (Wells and McLain 1972, Colby et al. 1972, Christie 1973, Parker 1988). Little is known about the effects of the other ecosystem stressors listed above on the Shortnose Cisco. The level of concern assigned to ecosystem impairment is rated as high as it would likely preclude, or have precluded, the recovery of the Shortnose Cisco even if the principal threat of overexploitation was removed or mitigated. The extent of ecosystem impairment is described as widespread throughout lakes Ontario, Michigan and Huron where the Shortnose Cisco occurred. The occurrence of ecosystem impairment is both historic and current, and its frequency would be continuous. Severity and causal certainty are listed as unknown as most populations of Shortnose Cisco were already in serious decline due to overexploitation and there have been no studies dedicated to looking at specific ecosystem impacts on the Shortnose Cisco.

Hybridization:

Introgressive hybridization between Shortnose Cisco and other deepwater ciscoes has been suggested as potentially hastening the extirpation of the species (Smith 1964, Todd and Stedman 1989, Webb and Todd 1995). Smith (1964) reported the apparent increase in different and unique forms of chubs in Lake Michigan as noted by local fishermen and suggested that future forms of cisco stocks might be different than those recognized in the past. The lack of genetic markers between cisco species makes it difficult to validate this threat. As such, other than the level of concern which is rated as “High” based on the historical references, all other attributes for this threat are deemed to be “Unknown”.

5. Critical habitat

5.1 Identification of the species' critical habitat

Under SARA, habitat for aquatic species is defined as:

> "…spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be introduced" [s.2(1) SARA]

Critical habitat under SARA is defined as"

> "… the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or action plan for the species" [s.2(1) SARA]

Little is known about the habitat requirements of the Shortnose Cisco other than that the species occupied moderately deep waters of lakes Ontario (22m to 92m), Michigan (37m to 110m) and Huron (37m to 92m) (COSEWIC 2005). Based on its diet, it must have occurred where it was able to feed on the freshwater crustaceans *Mysis diluviana* and *Diporiea* spp. (Parker 1988, COSEWIC 2005). Naumann and Crawford (2009) found that the identification of critical habitat for rare and taxonomically uncertain fish species, such as the closely related Shortjaw Cisco in Lake Huron, was not feasible due to rarity of occurrence and the need to consider other important physical and biological habitat factors other than water depth alone. The lack of species-specific information on the biology and life history requirements of the Shortnose Cisco would of itself preclude the identification of critical habitat at this time. Furthermore, the presumed extinction of the Shortnose Cisco suggests that the survival or recovery of the species is not possible and, consequently, critical habitat, as defined by SARA, is not an applicable concept.

6. Conservation approach

Conservation or recovery of the Shortnose Cisco, as assessed by COSEWIC, is not feasible as it has not been observed in over 25 years from the lakes where it once occurred. However, the collection of a single specimen from any of these locations or from any new location would provide new hope for the species. As such, any conservation efforts for the species should be directed first at confirming its current status through the utilization of education, management and, research strategies.

Education:

Despite significant fishing and sampling efforts, the last Shortnose Cisco was reported from Lake Huron in1985. Even prior to this date, observations of Shortnose Cisco were rare usually consisting of only a few specimens per year (Webb and Todd 1995, COSEWIC 2005). Given its historical rarity and the duration since last reported, the species is most likely extinct. Nonetheless, efforts should be continued to document any occurrences of the species. Anyone fishing for deepwater ciscoes, including commercial fishermen and research/assessment crews, should be made aware of the remote possibility of encountering the Shortnose Cisco and should be provided with basic information and an identification guide to help distinguish it from other co-occurring cisco species. Appropriate protocols and scientific authorities should be identified in advance to assist with sample identification, reporting of information, and archiving of samples, in the event that the species is encountered again.

Management:

Overfishing precipitated the collapse and likely prevented the recovery of Shortnose Cisco populations in the Great Lakes through non-specific management and targeting by the chub fishery. As such, any conservation efforts for the Shortnose Cisco would likely have to be directed at the chub fishery as a whole. Until its existence is confirmed, no management actions are recommended specifically for the Shortnose Cisco at this time. However, given that the Shortnose Cisco is only one of a number of deepwater ciscoes deemed to be “at risk” by COSEWIC in the Great Lakes including the Deepwater Cisco (Extinct), the Shortjaw Cisco (Threatened), Blackfin Cisco (Threatened)[1], and Kiyi (Special Concern), it would be prudent to develop management plans geared towards the conservation of the cisco species complex as a whole. Periodic monitoring of commercial chub catches would help to confirm the status of the Shortnose Cisco.

Research:

Difficulties in distinguishing individual species within the Great Lakes deepwater cisco flock, and the consequent lack of knowledge of their life history and habitat requirements, have severely hampered efforts to effectively manage and protect these species. Therefore, further research to resolve taxonomic uncertainties surrounding the identification of individual species, including the Shortnose Cisco, should be continued. New technologies and innovative approaches, especially in the field of genetics, have the potential to help overcome some of the barriers to species identification using conventional taxonomic approaches.

As for any potential “new” occurrences of Shortnose Cisco, some recent research using stable isotope analysis on archived specimens from Lake Superior (Schmidt et al. 2009) indicated that there are discernable differences in trophic niche partitioning between what were formerly called Shortnose Cisco and the Shortjaw Cisco. The previously identified “Shortnose Cisco” from Lake Superior and Lake Nipigon were synonymized with Shortjaw Cisco in the 1980s (Todd 1980, Todd and Smith 1980). Although the stable isotope analysis is not definitive, it does suggest that the status of Shortnose

[1] COSEWIC 1988 assessment (current status under Schedule 2 of SARA.) - COSEWIC 2007 assessment “data deficient”.

Cisco in Lake Superior warrants further investigation. Further stable isotope analysis and genetic testing of Shortjaw Cisco from Lake Superior may help resolve whether these populations include, or may have included, the Shortnose Cisco.

In support of the actions identified in this section, continued examination of cisco collections by ongoing U.S. Geological Surveys, Ontario Ministry of Natural Resources, and Fisheries and Oceans Canada monitoring programs for Shortnose Cisco, and other co-occurring deepwater cisco species, in Lakes Huron and Superior is recommended.

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8. Personal communications

Mohr, Lloyd., pers. comm. 2011. Ontario Ministry of Natural Resources, Owen Sound ON

Appendix A: Effects on the environment and other species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

As recovery is not feasible for the Shortnose Cisco, this recovery strategy does not propose any specific recovery actions or activities that would adversely affect the environment or other species. General conservation approaches detailed in Section 4 of this report including education, management, and research strategies are directed at improving our fundamental knowledge of the deepwater cisco species and ultimately improving the ability to manage them as a whole. Other deepwater cisco species under consideration by COSEWIC (i.e. Shortjaw Cisco) or currently listed under SARA (i.e. Kiyi) can only benefit from an improved understanding of the species complex.

Appendix B: Record of cooperation and consultation

During consultations on the proposed listing of the Shortnose Cisco, DFO published notices in 12 local newspapers inviting comment and an expression of interest in the species. These Newspapers included:

Sarnia Observer
Sault Star
Goderich Signal Star
Port Elgin Shoreline Beacon
Collingwood-Wasage Connection
Midland Penetagnuishene Mirrror
Parry Sound North Star
Le Gout de Vivre
Kincardine News
Lucknow Sentinel
Wiarton Echo
Grand Bend Lakeshore Advance

In addition, 38 Aboriginal communities and organizations were directly contacted and provided with information packages on the Shortnose Cisco inviting comment and an expression of interest. These communities/organizations included:

Chippewas – Kettle and Stony Point
Walpole Island
Chippewas – Thames River First Nation (FN)
Aamjiwaang FN
Mississaugas of the Credit
Six Nations – Grand River
Chippewas-Georgina Island
Mississauga of Scugog Island FN
Curve Lake
Hiawatha FN
Alderville (Sugar Island)
Mohawks – Bay of Quinte
Batchewana FN
Grand River FN
Thessalon
Mississauga
Serpent River
Sagamok Anishnawbek
Whitefish River
Whitefish Lake
Wikwemikong
Henvey Inlet FN
Magnetawan
Shawanaga FN
Dokis
Beausoleil
Moose Deer Point
Chippewas of Mnijkaning FN
Wahta Mohawk
Chippewas of Nawash FN
Saugeen
Audeck-Omni-Kaning
Sheguiandah
M’Chigeeng FN
Sheshegwaning
Zhibaahaasing FN
Mohawks of Akwesasne
Anishnabek/Ontario Fisheries Resource Centre

Similarly, information packages were sent to 28 non-aboriginal organizations including:

Algoma Manitoulin Commercial Fishermen’s Association
Bait Association of Ontario
Canadian Council of Professional Fish Harvesters
Canadian Environmental Network
Canadian Federation of Agriculture
Canadian Nature Federation
Canadian Parks/Recreation Association
Canadian Port and Harbour Association
Canadian Society of Environmental Biologists

Great Lakes Fishery Commission
Lake Superior Advisory Committee
Lake Superior Binational Forum
Northern Ontario Charter Boat Operators Association
Northern Ontario Tourism Outfitters
Northwestern Ontario Sportsmen's Alliance
Northwestern Ontario Tourism Association
Ontario Commercial Fisheries Association
Ontario Environmental Network
Ontario Federation of Anglers and Hunters
Ontario Hydro One
Ontario Power Generation
World Wildlife Fund – Canada
Lake Huron Fishing Club
Municipality of Huron-Kinross
Municipality of Kincardine
Municipality of Arran-Elderslie
Municipality of Saugeen Shores
Lake Huron Charter Boat Association

A total of nine replies were received in response to the general and direct notifications; three from First Nation Communities, two from environmental organizations, one from industry, and three from private individuals. Comments received ranged from supporting the listing (4) to being neutral (neither supporting nor opposing the listing). A draft recovery strategy was forwarded to all nine respondents identified.

The Shortnose Cisco Recovery Strategy was prepared by DFO in consultation with various researchers, biologists and managers knowledgeable of the deepwater cisco in the Great Lakes. A formal recovery team was not convened for the species given the lack of knowledge on the species, its presumed extinction and the fact that recovery was deemed non-feasible. Individuals consulted or participating during the development of the recovery strategy included:

Tom Pratt, Department of Fisheries and Oceans, Sault Ste. Marie, ON
Nick Mandrak, Department of Fisheries and Oceans, Burlington, ON
Jim Reist, Department of Fisheries and Oceans, Winnipeg, MB
Dana Boyter, Department of Fisheries and Oceans, Burlington, ON
Pooi-Leng Wong, Department of Fisheries and Oceans, Winnipeg, MB
Ken Cullis, Ontario Ministry of Natural Resources, Thunder Bay, ON
Lloyd Mohr, Ontario Ministry of Natural Resources, Owen Sound, ON
Scott Reid, Ontario Ministry of Natural Resources, Peterborough, ON
Scott Gibson, Ontario Ministry of Natural Resources, Peterborough, ON

Ontario Ministry of Natural Resources participated throughout the development and review of this recovery strategy and once completed it will contribute to meeting their requirements for a recovery strategy under Ontario's Endangered Species Act 2007. The U.S. Fish and Wildlife Service – Division of Endangered Species also provided comments indicating general concurrence with the approach proposed in this recovery strategy.