Update
COSEWIC Status Report

on

Shortjaw Cisco
Coregonus zenithicus

prepared for

COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA

by

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EXECUTIVE SUMMARY

Species information

The shortjaw cisco, *Coregonus zenithicus*, is a member of a taxonomically complicated deepwater cisco flock that originated in the Great Lakes. The shortjaw cisco has a laterally compressed, elliptical body shape covered with large, smooth scales. Generally silver in color with little pigmentation on the paired fins, the shortjaw cisco is olive or tan dorsally shading to white ventrally. The mouth is small and toothless, and the lower jaw is generally even with the upper jaw, or shorter and included within the gape of the upper jaw. The premaxillaries generally make a distinct angle on the snout, in contrast to most other cisco species where the premaxillaries make only a very minor angle at the snout. The gill rakers on the first branchial arch generally number less than 40, and the gill rakers tend to be moderate or short in length compared to those of most other cisco species. There is considerable variation in size across the range of the species.

Distribution

The shortjaw cisco has a widespread distribution throughout central Canada. Originally described from the all the Great Lakes except Lake Ontario, the shortjaw cisco is also reported from at least 24 lakes in Canada extending from Quebec to the Northwest Territories. There are concerns about the taxonomic validity of some of these reported occurrences as most of these identifications were based on the key characteristic of low gill raker counts and could represent more than one species.

Habitat

Habitat requirements for the shortjaw cisco are poorly known outside of depth preferences. In the Great Lakes, shortjaw cisco generally inhabited waters 45 to 144 m in depth. Seasonal differences were noted in Lake Superior with movement into shallower water during spawning. It is likely that almost all shortjaw cisco inhabit coldwater, deep hypolimnion areas that experience little fluctuation in water temperature or dissolved oxygen levels.

Biology

There have been few studies investigating the biology and life history of the shortjaw cisco. Spawning occurs primarily in the fall, with eggs deposited over the lake bottom (generally clay in the Great Lakes) and left to develop without parental care for a period of three or four months, depending on water temperature. Fecundity of shortjaw cisco is likely similar to that of other deepwater cisco species. The shortjaw cisco grows quickly in their first year, reaching lengths of 90mm by age one. Shortjaw cisco primarily feed on benthic organisms such as *Mysis* and *Diporeia* which dominate their diets, with limnetic crustaceans (copepods and cladocerans) providing seasonal contributions.

The shortjaw cisco is an important native prey fish in the deep, coldwater lakes where they reside. In the Great Lakes, deepwater ciscoes, including shortjaw cisco, provided important forage for native predators such as lake trout (*Salvelinus naymaycush*) and burbot (*Lota lota*). Shortjaw cisco was one of several species that functioned in this role in the Great Lakes, but, in smaller Canadian lakes, it may be the main forage for deepwater predators.

Population sizes and trends

There is limited abundance information available for shortjaw cisco in the Great Lakes watershed (DU1). Extensive, long-term data is lacking in Lake Nipigon, though the limited data available show that the shortjaw cisco comprised 31% of the total catch of ciscoes in 1973, and only 1-4% of the cisco catch in contemporary community assessments. Shortjaw cisco made up nearly 90% of the Lake Superior deepwater cisco catch in 1920's, 34% by the late 1950's, and 2 - 25% of the catch in contemporary surveys. Similarly, shortjaw cisco abundance averaged 121 fish per net kilometre in the 1920's, and 0.6 to 5.5 fish per net kilometre in contemporary surveys. The shortjaw cisco comprised approximately 25% of the deepwater cisco community in Lake Huron in the 1920's, but the species was believed to be extirpated from Lake Huron until 2004-6, when extensive surveys around the Bruce Peninsula captured a few (<20) individuals. In

Lake Michigan, shortjaw cisco made up about 21% of the chub catch in the 1930s, dropping to 6% in the 1950s and 2% by the early 1960s, before disappearing from the lake completely in the 1970s.

The abundance of shortjaw cisco in inland lakes (DU2) is even more poorly documented. The shortjaw cisco was captured at a rate of 0.00043 fish/hour/m^2 of net in 1966 in Barrow Lake, Alberta; this compares with 0.00031 fish/hour/m^2 captured in the summer of 1996, 0.00035 fish/hour/m^2 in the summer of 1997, and 0.00078 fish/hour/m^2 from the summer of 2000.

There is a low probability of a rescue effect given the decline observed in most populations, their deepwater habitat requirements which limit migration opportunities and the genetic evidence which suggests that the shortjaw ciscois most likely of sympatric origin within a given waterbody.

Limiting factors and threats

A variety of threats to the shortjaw cisco are believed to remain throughout their range. Commercial fishing was the main factor in the initial collapse of these species, and commercial and traditional aboriginal fishing for ciscoes and other fishes still occurs on many of the lakes containing shortjaw cisco. The threat of overexploitation by either a targeted fishery or as by-catch for another fishery remains for these shortjaw cisco populations. The shortjaw cisco is also believed to be threatened by introduced species, possibly through predation, competition and food web disruption. Other, less documented threats to shortjaw cisco may include changes in ecological dynamics and food web disruption, introgressive hybridization, habitat degradation and pollution.

Special significance of the species

Shortjaw cisco comprised a significant proportion of the deepwater cisco fishery that constituted a key part of the commercial fisheries on the Great Lakes since the late 19th century. Over 1225 tons were taken annually in the early 1900's, and the smoked deepwater cisco was a highly desirable product. Deepwater ciscoes are also important because they represent unique evolutionary and ecological processes in North America. The ciscoes are one of the few species endemic to the relatively young lakes of northern North America, and are believed to be one of few examples of the incipient species flock concept in North America. The shortjaw cisco is a unique form with a distribution that is intimately tied with post-glacial hydrology, and is thus of great scientific interest.

Existing protection

No specific legal protection exists for the shortjaw cisco in Canada. The shortjaw cisco is listed on Schedule 2 of the federal *Species at Risk Act* as a species to be reassessed for consideration on Schedule 1, but it receives no protection with this designation. The shortjaw cisco is afforded the general protection all fishes receive through the federal *Fisheries Act.*

The species is considered vulnerable globally (G3) and nationally (N3). Provincially, the shortjaw cisco is considered critically imperilled (S1) in Alberta and Saskatchewan, imperilled (S2) in Ontario and vulnerable (S3) in Manitoba. In the United States, the shortjaw cisco is presumed extirpated (SX) from Illinois, New York and Pennsylvania, imperilled (S2) in Michigan and Wisconsin, and vulnerable (S3) in Minnesota. The shortjaw cisco is listed as Threatened under the new Ontario Endangered Species Act, and as vulnerable by the International Union for the Conservation of Nature.

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SPECIES INFORMATION

Name and classification

Kingdom		Animalia
Phylum		Chordata
Class		Actinopterygii
Order		Salmoniformes
Family		Salmonidae
Subfamily		Coregoninae
Genus and Species		*Coregonus zenithicus* (Jordan and Everman 1909)
Common Name	English	shortjaw cisco (Nelson *et al.* 2004)
	French	cisco à mâchoires égales (Scott and Crossman 1973)
	Other	shortjaw chub, longjaw, light-back tullibee, pale-back tullibee, short-jaw chub, Lake Superior longjaw (Scott and Crossman 1973).

Ciscoes are members of the Salmonidae family, which includes trouts, salmons and whitefishes. As members of the genus *Coregonus*, ciscoes are characterized by having a small mouth with weak or no teeth, a double nostril flap, no basiobranchial plate and no parr marks (Nelson 2006). The shortjaw cisco (*Coregonus zenithicus*) is one of the cisco species of the sub-genera *Leucichthys* identified as part of a taxonomically complicated species flock of which most species are endemic to the Laurentian Great Lakes (Koelz 1929). The species was originally described from Lake Superior at Duluth, MI (the "Zenith" city) by Jordan and Evermann (1909), and was subsequently identified as present in most of the Laurentian Great Lakes and many smaller lakes in central North America (Scott and Crossman 1973; Clarke 1973; Clarke and Todd 1980; COSEWIC 2003).

The taxonomy of *Leucichthys* remains problematic, as they show extreme morphological plasticity, and their taxonomic status remains debated. Three deepwater ciscoes from the Great Lakes identified by Koelz (1929), *C. alpenae* from lakes Erie, Michigan and Huron, *C. nigripinnis cyanopterus* from Lake Superior and *C. reighardi dymondi* from lakes Superior and Nipigon were later synonymised with the shortjaw cisco (Todd and Smith 1980; Todd et al. 1981). Clarke (1973) suggested that *C. nigripinnis prognathus* and *C. reighardi reighardi* in Lake Ontario might be synonymous with the shortjaw cisco (see also Clarke and Todd 1980). Harper and Nichols (1919) described three species, *Leucichthys entomophagus* from Tazin

River, NWT, *L. athabascae* from Lake Athabasca and *L. macrognathus* from Great Slave Lake that were synonymised with *C. zenithicus* by Dymond (1943). The Tazin River population was later reidentified as *C. artedi* (Clarke 1973). The Lake Athabasca population was confirmed as *C. zenithicus* by Clarke (1973) and Murray and Reist (2003). Clarke (1973) reidentified the Great Slave Lake population as *C. artedi*; but Todd and Steinhilber (2002) subsequently confirmed its identity as *C. zenithicus*.

The shortjaw cisco has also been reported from many inland lakes from western Quebec to Great Bear Lake (Table 1). However, comprehensive taxonomic examinations of most of these

Table 1. Waterbodies reported to contain *Coregonus zenithicus* (after COSEWIC 2003). We assessed whether the weight of scientific evidence, as designated in the likelihood column, indicated whether or not shortjaw cisco were indeed present in a given waterbody. This assessment included the four COSEWIC criteria for recognizing designatable units; whether the lake contained a named species or sub-species, showed genetic differentiation or a range disjunction, or fell in a biogeographically distinct ecological area, along with consideration of the authors' description of the putative shortjaw cisco.

Waterbody	Province / State	Source	Author's Description	COSEWIC designatable unit criteria				
				Named species or sub-species	Genetic differentiation	[a]Range Disjunction	[b]Ecozone	Likelihood
Lake Athabasca	Saskatchewan	Harper and Nichols (1919) as *Leucichthys athabascae*; Dymond and Pritchard (1930); Rawson (1947); Clarke (1973); Murray and Reist (2003)	Yes	Yes	Unknown	Yes	Western Arctic	Probable
Lake Attawapiskat	Ontario	Ryder et al. (1964)	Uncertain	No	Unknown	Yes	Southern Hudson Bay - James Bay	Unlikely
Barrow Lake	Alberta	Paterson (1969); Clarke (1973); Steinhilber (2000); Steinhilber et al. 2002; Murray and Reist (2003)	Yes	No	No[1]	Yes	Western Arctic	Probable
Basswood Lake	Ontario	Steinhilber (2000); Todd and Steinhilber (2002)	Uncertain	No	Unknown	Yes	Saskatchewan - Nelson	Possible
Big Athapapuskow	Manitoba	Clarke (1970) as *C. reighardi*; Clarke (1973); Murray and Reist (2003)	Yes	No	Unknown	Yes	Saskatchewan - Nelson	Probable
Big Trout Lake	Ontario	Ryder et al. (1964)	Uncertain	No	Unknown	Yes	Southern Hudson Bay - James Bay	Unlikely
Clearwater Lake	Manitoba	Clarke (1973); Murray and Reist (2003)	Uncertain	No	Unknown	Yes	Saskatchewan - Nelson	Possible
Deer Lake	Ontario	Ryder et al. (1964) as *C. nigripinnis*; Clarke (1973)	Uncertain	No	Unknown	Yes	Southern Hudson Bay - James Bay	Possible

Lake Erie	Michigan, Ohio, Pennsylvania, New York, Ontario	Scott and Smith (1962) as *C. alpenae*; Todd and Smith (1992) as *C. zenithicus*	Yes	Yes	Unknown	No	Great Lakes - Western St. Lawrence	Certain
George Lake	Manitoba	Gibson and Johnson (1969) as *C. hoyi*; Clarke (1973); Murray and Reist (2003)	Uncertain	No	No[1,4]	Yes	Saskatchewan - Nelson	Possible
Great Bear Lake	Northwest Territories	Randy Eshenroder, Great Lakes Fishery Commission, Ann Arbor, MI, pers. comm.; Kim Howland, Fisheries and Oceans Canada, Winnipeg, MB, pers. comm.	Uncertain	No	Unknown	Yes	Western Arctic	Possible
Great Slave Lake	Northwest Territories	Harper and Nichols (1919) as *Leucichthys macrognathus*; Dymond (1943); Rawson (1947); Clarke (1973) as *C. artedi*; Todd and Steinhilber (2002)	Yes	Yes	Unknown	Yes	Western Arctic	Probable
Lake Huron	Michigan, Ontario	Koelz (1929)	Yes	No	Unknown	No	Great Lakes - Western St. Lawrence	Certain
Lake Michigan	Illinois, Indiana, Michigan, Wisconsin	Koelz (1929)	Yes	No	Unknown	No	Great Lakes - Western St. Lawrence	Certain
Lake Mistassini	Quebec	Randy Eshenroder, Great Lakes Fishery Commission, Ann Arbor, MI, pers. comm.	Uncertain	No	Unknown	Yes	Eastern St. Lawrence	Unlikely
Lake Nipigon	Ontario	Koelz (1929) as *C. reighardi dymondi*; Todd and Smith (1981)	Yes	Yes	No[1,4,6] Yes[2]	No	Great Lakes - Western St. Lawrence	Certain
Lac Seul	Ontario	Dymond and Pritchard (1930) as *C. nipigon*; Clarke (1973)	Uncertain	No	Unknown	Yes	Saskatchewan - Nelson	Possible

Lake of the Woods	Ontario	Hinks (1957); Clarke 1973	Uncertain	No	Unknown	Yes	Saskatchewan - Nelson	Possible
Lake Saganaga	Minnesota, Ontario	Etnier and Skelton (2003)	Yes	No	Unknown	Yes	Saskatchewan - Nelson	Probable
Lake Superior	Michigan, Minnesota, Wisconsin, Ontario	Jordan and Evermann (1909)	Yes	Yes	No[1, 3, 4, 6]	No	Great Lakes - Western St. Lawrence	Certain
Lake Winnipeg	Manitoba	Bajkov (1930); Dymond and Pritchard (1930); Clarke 1973	Yes	No	Unknown	Yes	Saskatchewan - Nelson	Probable
Loonhaunt Lake	Ontario	Royal Ontario Museum; Murray and Reist (2003).	None	No	Unknown	Yes	Saskatchewan - Nelson	Unlikely
Reindeer Lake	Saskatchewan	Dymond (1943); Clarke (1973); Murray and Reist (2003)	Yes	No	Unknown	Yes	Western Hudson Bay	Probable
Sandy Lake	Ontario	Royal Ontario Museum as *C. hoyi*; Clarke (1973).	Uncertain	No	Unknown	Yes	Southern Hudson Bay - James Bay	Possible
Sandybeach Lake	Ontario	Wain (1993)	Uncertain	No	Unknown	Yes	Southern Hudson Bay - James Bay	Possible
Tazin River	Northwest Territories	Harper and Nichols (1919) as *C. entomophagus*; Dymond (1943); Clarke (1973) as *C. artedi*.	Uncertain	Yes	Unknown	Yes	Western Arctic	Unlikely
White Partridge Lake	Ontario	Royal Ontario Museum and N.E. Mandrak, unpubl. data	Uncertain	No	No[1]	Yes	Great Lakes - Western St. Lawrence	Unlikely

[a] All populations identified outside of the Great Lakes basin were considered to be disjunctive

[b] National freshwater ecological areas were identified for COSEWIC by Mandrak (2003)

[1] Turgeon and Bernatchez (2003); [2] Turgeon et al. (1999); [3] Todd (1981); [4] Reed et al. (1998); [5] Steinhilber et al. (2002); [6] Sajdak and Phillips (1997)

populations have never been formally undertaken. Evidence for the veracity of these records varies, and we have evaluated the likelihood of each record actually being shortjaw cisco based on existing knowledge (Table 1).

Morphological description

The shortjaw cisco has a laterally compressed, elliptical body shape covered with large, smooth scales (Figure 1). Generally silver in color with little pigmentation on the paired fins, the shortjaw cisco is olive or tan dorsally shading to white ventrally. The mouth is small and toothless, and the lower jaw is generally even with the upper jaw, or shorter and included within the gape of the upper jaw (Eddy and Underhill 1978; Becker 1983). The lower jaw may occasionally extend beyond the premaxillaries in some populations. The premaxillaries generally make a distinct angle on the snout, in contrast to most other cisco species where the premaxillaries are generally in line with the slope of the head or make only a very minor angle at the snout. The gill rakers on the first branchial arch generally number less than 40, and are often in the mid-30s in contrast to most other cisco species that have counts of more than 40. In addition, the gill rakers tend to be moderate or short in length compared to those of most other cisco species (Becker 1983). Unfortunately, no single diagnostic character exists with which to identify the species, but rather an association of characters must be used, of which the single most important is gill raker number (COSEWIC 2003). Considerable variation in size exists across the range of the species, and adults of some populations (e.g., George Lake, MB and White Partridge Lake, ON) measure less than 150 mm standard length (SL) while adults of other populations reach lengths greater than 300 mm SL up to a maximum of about 467 mm (e.g., Barrow Lake, AB and Lake Nipigon, ON). Large specimens generally approach 300 g, and exceptionally large fish can reach 1.0 kg.

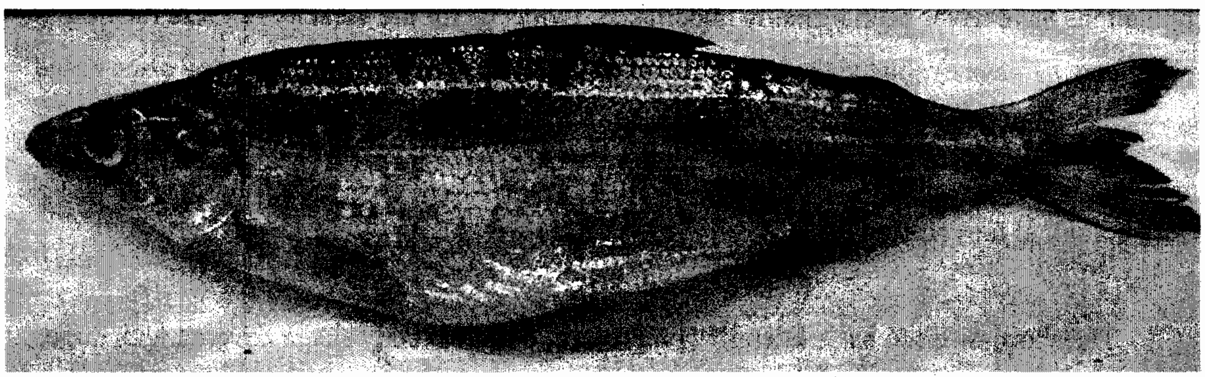

Figure 1. Photograph of a shortjaw cisco from eastern Lake Superior.

It is important to note that ciscoes, in general, are a challenging taxonomic group, exhibiting morphological variation within and among species (Todd and Smith 1992). Local adaptation, phenotypic plasticity, hybridization and parallel evolution likely interacted to produce a confounding array of forms and species in the Great Lakes and inland lakes that challenge traditional classification (Todd and Smith 1992). The shortjaw cisco exhibits morphological variability across their geographic range (Clarke 1973). Todd and Smith (1980) identified some morphological differences among sub-populations in Lake Superior, while Todd and Steinhilber (2002) found two basic morphs from across the species range. The most common form is found in large lakes, and is characterized by more and longer gill rakers than a form with smaller and fewer gill rakers that seem more typical of small lakes (Todd and Steinhilber 2002).

The observed morphological plasticity and absence of strong genetic differentiation between sympatric ciscoes has resulted in some questioning whether all ciscoes are, in fact, a single species with multiple ecophenotypes (Turgeon and Bernatchez 2003). For example, a recent morphological re-examination of ciscoes from Little Lake Athapapushkow, MB, led the authors to suggest that the low-raker form previously ascribed to *C. zenithicus* and may actually be a conspecific morph of *C. artedi* (Aoki and Bodaly 2003). However, most populations of shortjaw cisco across the range share a similar morphology, and are believed to represent a single, widely distributed species (Todd and Steinhilber 2002).

Genetic description

Genetic analyses on ciscoes have generally not been successful in helping confirm observed morphometric differences among species (e.g. Todd 1981; Reed et al. 1998; Turgeon and Bernatchez 2001; Steinhilber et al. 2002; Turgeon and Bernatchez 2003). Early genetic efforts found no differences in allelic frequencies among *C. zenithicus*, *C. hoyi*, *C. kiyi* or *C. artedi* from Lake Superior (Todd 1981). Similar results, i.e. high similarity within and among species, were obtained using the mitochondrial DNA control sequence from ciscoes from Lake Superior and Lake Nipigon (Sajdak and Phillips 1997; Reed et al. 1998). Genetic differentiation is absent even in populations in lakes with fewer cisco species. Mitochondrial DNA control sequence data suggest no genetic discrimination between *C. zenithicus* and *C. artedi*, the only sympatric ciscoes in three lakes (Barrow Lake, AB, George Lake, MB, and White Partridge Lake, ON) from across the species range (Reed et al. 1998; Steinhilber et al. 2002). Broader genetic analysis of the phylogeographic origins of coregonines has also resulted in researchers determining that cisco species within lakes are genetically indistinguishable (Reist et al. 1998; Turgeon and Bernatchez 2001; 2003).

In contrast, microsatellite DNA analysis demonstrated that shortjaw cisco are genetically distinct within and among lakes. Turgeon et al. (1999) found slight differentiation of shortjaw cisco from sympatric *C. artedi*, *C. hoyi* and *C. nigripinnis* in Lake Nipigon, although no species-specific marker was detected. Steinhilber (2000) also found that shortjaw cisco in Barrow Lake was genetically distinct from sympatric *C. artedi*. However, Turgeon and Bernatchez (2003) argued that shortjaw cisco were more genetically similar to sympatric ciscoes than other shortjaw cisco populations. This evidence led Turgeon and Bernatchez (2003) to recognize only a single cisco taxon outside the Great Lakes basin, *C. artedi* (*sensu lato*), as they argued that observed genetic variation in ciscoes reflected geography as opposed to morphology and that the observed shortjaw cisco forms evolved in sympatry. This suggestion has not gained wide acceptance by others in the field and, at the time of preparing this update status report, the troubling taxonomy of this species remains unresolved and the taxonomy of Koelz (1929) is accepted by Nelson et al. (2004).

Designatable units

The formal taxonomic description of only the Great Lakes and Lake Nipigon populations (Koelz 1929), the contention that shortjaw cisco populations outside the Great Lakes basin likely have sympatric origins (Turgeon and Bernatchez 2003), the identification of separate Laurentian Great Lakes/large lakes and inland lake/small lakes morphometric forms (Todd and Steinhilber 2002), and the presence of shortjaw cisco in several freshwater ecozones (COSEWIC 2006), provide a basis for the separation of shortjaw cisco into designatable units.

The shortjaw cisco populations of the Laurentian Great Lakes and Lake Nipigon were described by Koelz (1929) but were not divided into sub-species. A number of other species and sub-species, originally described by Koelz (1929), were later synonomized with *C. zenithicus* (*C. alpenae*, *C. nigripinnis cyanopterus* and *C. reighardi dymondi*). Therefore, the populations in the Great Lakes, including Lake Nipigon, constitute a single designatable unit.

Based on our evaluation of the likelihood of inland lake records actually being shortjaw cisco (Table 1), we recommend that the inland lakes with records considered to be probable shortjaw cisco form a second designatable unit. Inland lakes with records considered possible or unlikely should not be considered further until the additional studies are undertaken to determine the identify of the species.

DISTRIBUTION

Global range

The subfamily Coregoninae is present throughout the northern hemisphere with many endemic species present in North America and Eurasia. The shortjaw cisco is only found in the Laurentian Great Lakes and smaller lakes north-westward throughout central Canada to Great Bear Lake.

Canadian range

Shortjaw cisco has a widespread distribution throughout central Canada (Figure 2). Originally described from the all the Great Lakes except Lake Ontario, the shortjaw cisco was last verified in Lake Michigan in 1975 (COSEWIC 2003). The species was believed to be extirpated in Lake Huron in 1982 (Todd 1985), until recent surveys around the Bruce Peninsula located a few (<20) individuals (N.E. Mandrak, unpubl. data). The shortjaw cisco has also been reported from at least 24 lakes in Canada extending from Quebec to the Northwest Territories (Table 1; Clarke 1973; Murray and Reist 2003; COSEWIC 2003). Most of these identifications were based on the key characteristic of low gill raker counts (especially when sympatric pairs of forms were present) and could represent more than one species (Clarke 1973; COSEWIC 2003). There are concerns about the taxonomic validity of some of these reported occurrences; therefore, we assessed whether the weight of scientific evidence, based primarily on the work of Murray and Reist (2003), indicated whether or not shortjaw cisco were indeed present in a given waterbody. This assessment included whether the lake contained a named species or sub-species, showed genetic differentiation, and an assessment of the authors' description of the putative shortjaw cisco (Table 1).

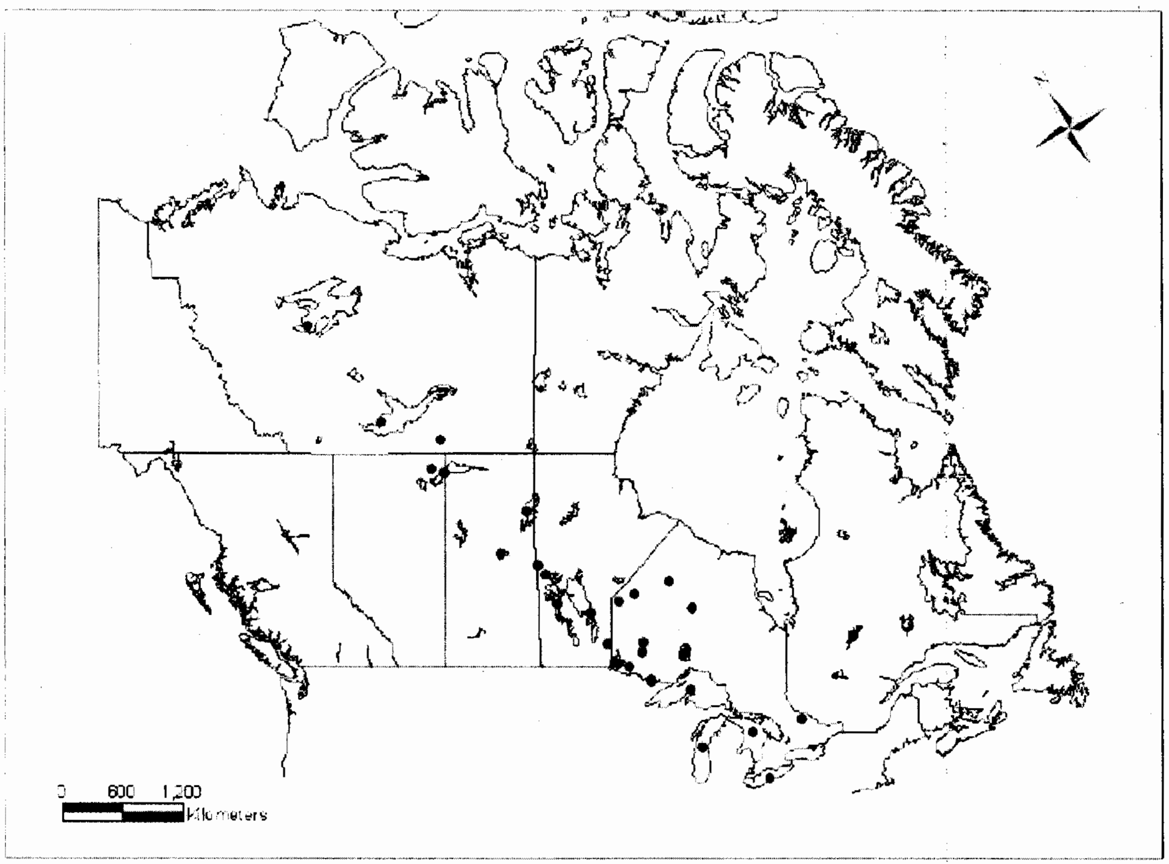

Figure 2. World-wide distribution of shortjaw cisco populations.

HABITAT

Habitat requirements

Habitat requirements for the shortjaw cisco are poorly known outside of depth preferences. In the Great Lakes, shortjaw cisco generally inhabited waters 45 to 144m in depth, though they have been recorded from as deep as 183m and occasionally in shallower water (Scott and Crossman 1973; COSEWIC 2003; Pratt and Mandrak 2007). Seasonal differences were noted in Lake Superior with movement into shallower water during spawning, as the fish inhabited 110-114m in spring, 55-71m in summer, and 73-90m in winter (Dryer 1966). Hoff and Todd (2004) noted during 1999-2001 that shortjaw cisco captured in American waters of Lake Superior were most abundant at the maximum depths at which they were collected in the 1920s, suggesting a shift to deeper water in the intervening decades. Recent surveys in Canadian waters of Lake Superior found that shortjaw cisco were most abundant in 66 to 104m depths (Pratt and Mandrak 2007). In Lake Nipigon, shortjaw cisco inhabit depths between 10-60 m, although the occasional individual has been captured deeper than 60m (Turgeon et al. 1999).

Depth preferences appear to be more variable in inland lakes. Shortjaw cisco in George Lake, Manitoba, were caught in the very deepest stratum of the lake, occurring mostly in gillnets set at 45-47 m, and were not found in sets shallower than 42m (Murray and Reist 2003). Likewise, shortjaw cisco were found to inhabit the deepest portions of Sandybeach Lake, Ontario, at depths ranging 22-38 m, along with sympatric cisoc (*C. artedi*) (Wain 1993). In contrast, shortjaw cisco were found quite shallow, at depths of 2-16 m, in Barrow Lake, Alberta (maximum depth=24 m; Steinhilber et al. 2002). It is likely that all shortjaw cisco, with the exception of those captured in Barrow Lake, inhabit coldwater, deep hypolimnion areas that experience little fluctuation in water temperature or dissolved oxygen levels.

Habitat trends

Little is known about the habitat trends for shortjaw cisco, although it is unlikely that the preferred deepwater physical habitat has changed much over time.

Habitat protection/ownership

All lakes known to contain shortjaw cisco are publicly owned, and all fish habitat within the lakes are protected by the Federal *Fisheries Act*.

BIOLOGY

General

There have been few studies investigating the biology and life history of shortjaw cisco. Maximum size for Lake Superior fish was recorded at 368 mm total length and 292g (VanOosten 1936). Lake Nipigon shortjaw cisco exhibit larger sizes, and have been recorded at weights of 500g to 1.0kg and up to 400mm total length (R. Salmon, Ontario Ministry of Natural Resources, Lake Nipigon Assessment Unit, pers. comm.). A few inland populations of shortjaw cisco, including White Partridge Lake, Ontario, and George Lake, Manitoba, mature at much smaller sizes. For example, adult fish in George Lake, averaged only 158mm (127-173mm) standard length (Tom Todd, USGS Great Lakes Science Center, unpublished data).

Spawning and Reproduction

Spawning occurs primarily in the fall, although there are populations in Lake Superior that were observed spawning in the spring (Koelz 1929). Spring spawning was considered unusual, however, as shortjaw cisco in lakes Michigan, Huron and Erie spawned solely in the fall (Koelz 1929; Scott and Smith 1962). This led Koelz (1929) and VanOosten (1936) to conclude that shortjaw cisco was a fall spawner. More recently, Todd and Smith (1980) reported a more extensive occurrence of spring spawning in this species. Almost nothing is known about the spawning behaviour of shortjaw cisco. Eggs are deposited over the lake bottom (generally clay in the Great Lakes) and left to develop without parental care for a period of three or four months, depending on water temperature (Berlin et al. 1977). Fecundity of shortjaw cisco is likely similar to that of other deepwater cisco species such as *C. hoyi*, ranging from 3,230 eggs for a fish 241mm total length, to 18,768 for a fish 305mm total length (Emery and Brown 1978).

Growth and age-at-maturity

As in most fishes, shortjaw cisco grow quickly in their first year of life, reaching lengths of 90mm by age one (Pratt and Mandrak 2007). While the sexes have been found to have similar growth in length, females gain weight more quickly than males growing an average of about 30g a year in mature fish with an annual length increase of about 25mm (VanOosten 1936). Maturity occurred in about the fifth year and resulted in additional growth in weight, primarily due to gonadal development. Nearly 60% of potential maximum weight gain occurred after age five compared to growth in length that reached about 80% of its potential maximum value at age five and increased only slowly thereafter (VanOosten 1936).

Diet

Coregonines are opportunistic, particulate feeders that generally ingest prey one item at a time. Because shortjaw cisco primarily live in the deeper parts of lakes, terrestrial input is limited, and benthic organisms such as *Mysis* and *Diporeia* dominate their diets, with limnetic crustacea (copepods and cladocerans) providing seasonal contributions (Koelz 1929; Bersamin 1948; Anderson and Smith 1971; Wain 1993; Turgeon et al. 1999; Hoff and Todd 2004; Pinkerton and Moerke 2006). Such prey has been found to dominate even the diet of shortjaw cisco found in shallower habitats, such as in Barrow Lake, Alberta (Steinhilber et al. 2002). The dominance of larger, benthic organisms in their diet is likely why shortjaw cisco have shorter, thicker gill rakers than *c. artedi*, which feed primarily on zooplankton.

Movements / Migration

There are little data available on the movements of shortjaw cisco. As mentioned in the Habitat section, seasonal movements were observed in Lake Superior with fish inhabiting depths of 110-114m in spring, 55-71m in summer, and 73-90m in winter (Dryer 1966). No other information on the movements or migration behaviour of shortjaw cisco are available.

Interspecific interactions

The shortjaw cisco is an important native prey fish in the deep, coldwater lakes where they reside. In the Great Lakes, deepwater ciscoes, including shortjaw cisco, provided important forage for native predators such as lake trout (*Salvelinus naymaycush*) and burbot (*Lota lota*). Shortjaw cisco was one of several species that functioned in this role in the Great Lakes but, in smaller Canadian lakes, it may be the main forage for deepwater predators. It is also likely that the species became vulnerable to predation from sea lampreys in the Great Lakes as larger prey fishes became depleted.

Adaptability

The dramatic decline of deepwater ciscoes from the Laurentian Great Lakes has primarily been attributed to overfishing followed by negative interactions with exotic species (Christie 1972; Lawrie and Rahrer 1972), and the absence of recovery in the intervening years when the fishing effort declined suggests that shortjaw cisco do not adapt well to human disturbance. It is important to note that the intensity of exploitation during the first half of the 20th century was severe, and shortjaw cisco may adapt better to more moderate levels of human intervention. There is no information available on how shortjaw cisco would adapt to environmental change or degradation such as water temperature changes or water level fluctuations, but their ability to thrive outside of their current deepwater habitats is likely quite limited.

POPULATION SIZES AND TRENDS

Abundance

There is limited abundance information available for shortjaw cisco despite their importance in the food fishery of the Great Lakes (DU1), and there is almost no abundance information available from any of the inland lake populations (DU2). In the Great Lakes, shortjaw cisco have been an important commercial species since the mid-nineteenth century

(Koelz 1929). Unfortunately, commercial fisheries lumped all deepwater ciscoes as 'chubs', and ciscoes were not identified to species.

Designatable Unit 1

In Lake Nipigon, the shortjaw cisco continues to coexist with *C. artedi*, *C. hoyi*, and *C. nigripinnis regalis*. Extensive, long-term data are lacking, although periodic population assessments have been made since the 1970s. Examination of commercial catches (large-mesh nets) and experimental sets in 1973 revealed that shortjaw cisco comprised 31% of the total catch of ciscoes (United States Geological Survey, Great Lakes Science Center, unpublished data). More recent data from graded mesh gillnets fished as part of a community assessment by the Ontario Ministry of Natural Resources found that shortjaw cisco made up only 1-4% of the cisco community annually (R. Salmon, Ontario Ministry of Natural Resources, Lake Nipigon Assessment Unit, personal communication).

Shortjaw cisco made up nearly 90% of the Lake Superior deepwater cisco catch in the Koelz (1929) surveys; these surveys were the first large-scale coreginine assessments on the Great Lakes. By the late 1950s, shortjaw cisco made up 34% of the deepwater cisco community in eastern Lake Superior (E. H. Brown Jr., unpublished data, cited in Hoff and Todd 2004). In the 1970s, shortjaw cisco comprised 6% of the ciscoes captured by the commercial fishery around the Keweenaw Peninsula and 11% of the commercial catch sampled at Marquette (Peck 1977). Contemporary surveys have found that shortjaw cisco continue to make up a similar or greater proportion of the deepwater cisco catch in Lake Superior, contributing 5 to 11% of the cisco catch in Whitefish Bay and Grand Marais in 1997 (United States Geological Survey, unpublished data, cited in Hoff and Todd 2004), 5% of the catch along the south shore of Lake Superior (Hoff and Todd 2004), 2% of the deepwater ciscoes in eastern Lake Superior in 2000 (Petzold 2002), 11% of catch in the Rossport area in 2004 (Pratt and Mandrak 2007), and >25% of the catch along the north shore of Lake Superior in 2006 (T.C. Pratt, unpubl. data). It is important to note that the use of proportions provides only a relative measure of abundance, and important trends can be misinterpreted using proportion data.

Lake Superior was the only Great Lake were catch numbers were reported by Koelz (1929); in the remaining lakes only proportions were identified. This provides a longer abundance record for shortjaw cisco in Lake Superior than the remaining lakes. Shortjaw cisco abundance was high in the Koelz (1929) surveys, with an average of 121 shortjaw cisco per net kilometre reported across the entire lake. In contrast, Hoff and Todd (2004) averaged 0.6 shortjaw cisco per net kilometre along the south shore, Petzold (2002) averaged 1.2 shortjaw cisco per net kilometre in eastern waters, Pratt and Mandrak (2007) found 5.5 shortjaw cisco per net kilometre in the Rossport area, while 1.2 shortjaw cisco per net kilometre were captured along the north shore in 2006 (T. Pratt, unpubl. data)

In Lake Huron proper, shortjaw cisco (including the synonymised *C. alpenae*) comprised approximately 25% of the deepwater cisco community in the Koelz (1929) survey, but were relatively uncommon in Georgian Bay waters of Lake Huron. Similarly, collections in United States waters of Lake Huron in 1956 revealed that shortjaw cisco comprised 19% of the total deepwater cisco catch (United States Geological Survey, Great Lakes Science Center, unpublished data). Only individual specimens were taken in the 1970s, and a lone individual was taken in Lake Huron in 1982 off Ausable Pt., Michigan (Todd 1985). Shortjaw cisco were believed to be extirpated from Lake Huron until 2004-6, when extensive surveys around the Bruce Peninsula captured a few (<20) individuals identified as shortjaw cisco (N.M. Mandrak, unpublished data).

In Lake Michigan, shortjaw cisco, including fish identified as *C. alpenae*, followed a similar pattern to Lake Huron. Shortjaw cisco made up about 21% of the chub catch in the 1930s, dropping to 6% in the 1950s and 2% by the early 1960s, before disappearing from the lake completely in the 1970s (Smith 1964, Todd 1985). Over the same timeframe, catches of shortjaw cisco fell in the northern end of Lake Michigan from 15.8 fish per gillnet kilometre in the 1930s to ~ 1 fish per gillnet kilometre by the 1950s. Catches of 86 fish per gillnet kilometre in the 1930s, 37 fish per gillnet kilometre in the mid-1950s, and 6.3 fish per gillnet kilometre in the early 1960s were reported in the south end of Lake Michigan.

Only a few individuals, originally identified as *C. alpenae*, were ever collected from Lake Erie. Approximately 40 fish were first identified out of commercial catches in the 1940s, and the last was collected in 1957 (Scott and Smith 1962). No subsequent specimens have ever been collected in this lake.

Designatable Unit 2

The abundance of shortjaw cisco in inland lakes is even more poorly documented. In Great Slave Lake, ciscoes were considered abundant by Rawson (1947; 1951), comprising the largest number of fishes captured in experimental gillnets. As per the Great Lakes, however, the three species of ciscoes purported to reside in Great Slave Lake were not identified to species in these surveys. Similarly, ciscoes were apparently abundant, but all ciscoes were lumped together as by-catch with the development of a commercial fishery on Great Slave Lake (Keleher 1972). Recent efforts to capture shortjaw cisco in Great Slave Lake have met with varying success; no shortjaw cisco were captured in the Hay River and Simpson Islands regions of the lake, but putative shortjaw cisco were captured Lutsel'Ke area in 2002 (Murray and Reist 2003).

Rawson (1947) considered ciscoes, which were not identified to species but included shortjaw cisco, to be moderately abundant in Lake Athabasca in the 1945, comprising 15% of the gillnet catch. Contemporary surveys have identified a shortjaw-like morph on the Saskatchewan side of the lake, but no abundance data is available (Murray and Reist 2003).

Steinhilber (2002) calculated a catch rate of 0.00043 fish/hour/m^2 of net from shortjaw cisco captured in 1966 and, subsequently, used in the taxonomic assessment published by Paterson (1969). This compares with 0.00031 fish/hour/m^2 captured in the summer of 1996, 0.00035 fish/hour/m^2 in the summer of 1997, and 0.00078 fish/hour/m^2 from the summer of 2000 (Steinhilber 2002). Over a 24h period, these catches would range from 7.4 – 18.2 fish per gillnet kilometre.

Both Clarke (1973) and Murray and Reist (2003) believed that the shortjaw cisco populations of Lake Athapapskow, Reindeer Lake were abundant, but no catch data are available. No abundance information is available for the remaining inland lake populations.

Fluctuations and trends

While there are not large amounts of quantifiable data available, it is apparent that shortjaw cisco have declined precipitously in Designatable Unit 1. They are extirpated from lakes Erie and Michigan, nearly extirpated from Lake Huron, reduced from an average of ~121 fish per gillnet kilometre in the 1920's to ~ 1 fish per gillnet kilometre in recent surveys in Lake Superior, and their relative proportion of the cisco catch in Lake Nipigon appears to be declining. Trend data from Designatable Unit 2 are absent except for Barrow Lake, where abundance appears to be stable since the first collections made in the 1960s (Steinhilber 2002). Etnier and Skelton (2003) stated that shortjaw cisco in Lake Saganaga were declining, but present no abundance data.

Rescue effect

There is likely an extremely low probability of a rescue effect given the decline observed in most populations and deepwater habitat requirements that limit migration opportunities in the Great Lakes, and isolated nature of, and genetic evidence indicating sympatric origin within, inland lakes.

LIMITING FACTORS AND THREATS

A number of factors have likely contributed to the decline of shortjaw cisco, and a variety of threats to the species remain throughout their range. Commercial fishing targeting larger deepwater ciscoes was the main factor in the initial collapse of these species (Smith 1964; Lawrie and Rahrer 1972; Jensen 1999), and commercial and traditional aboriginal fishing for ciscoes still occur on many of the lakes containing shortjaw cisco. The threat of overexploitation by either a targeted fishery or as by-catch for another fishery remains for these shortjaw cisco populations.

Shortjaw cisco is also believed to be threatened by introduced species, possibly through predation, competition and food web disruption. Sea lampreys (*Petromyzon marinus*) prey on coreginines in the Great Lakes, and a large-bodied cisco like the shortjaw cisco would likely be targeted by this parasite. Smallmouth bass (*Micropterus dolomieu*) have been introduced to many of the inland lakes that support shortjaw cisco (Sandy Beach L., Loonhaunt L., Saganaga L., Lake of the Woods, Lac Seul, Basswood L. and Athapapuskow L.), and it is possible that predation may occur on younger life stages (Shortjaw Cisco Recovery Team 2005). Rainbow smelt (*Osmerus mordax*) prey upon *C. artedi* eggs and young and compete with the adults for food and habitat (Berst and Spangler 1972; Wells and McLain 1972; Stedman and Argyle 1985), and may similarly influence shortjaw cisco. Interactions with rainbow smelt have been attributed to the decline of shortjaw cisco in Lake Saganaga and Sandybeach Lake (Wain 1993; Etnier and

Skelton 2003). Rainbow smelt have also been introduced to Lake of the Woods, Lac Seul and Lake Winnipeg; the effects of these introductions on deepwater cisco populations are unknown, but of particular concern in Lake Winnipeg (Franzin et al. 1994).

Other, less documented threats to shortjaw cisco may include changes in ecological dynamics and food web disruption, introgressive hybridization, habitat degradation and pollution (Shortjaw Cisco Recovery Team 2005). For example, the foodweb in Lake Erie has lost its deepwater, oligotrophic community with the onset of eutrophication (Hartman 1972; COSEWIC 2003), and recent increases in siscowet (a form of deepwater lake trout) abundance may further threaten deepwater ciscoes in Lake Superior (Petzold 2002). There are also concerns that decreasing shortjaw cisco populations increases the risk of introgressive hybridization with other closely related ciscoes (ref). Habitat degradation associated with water regulation, shoreline development, landscape changes and climate change may also threaten shortjaw cisco populations, but the deepwater habitats preferred by this species mean that it is likely less easily impacted by habitat degradation than most other fishes. In addition, both point source and non-point source pollution were considered as minor threats to shortjaw cisco in many lakes (Shortjaw Cisco Recovery Team 2005).

SPECIAL SIGNIFICANCE OF THE SPECIES

The shortjaw cisco comprised a significant proportion of the deepwater cisco fishery that constituted a key part of the commercial fisheries on the Great Lakes since the late 19th century (Chiarappa 2005). Over 1225 tons were taken annually in the early 1900's (Lawrie and Rahrer 1972), and the smoked deepwater cisco was a highly desirable product. Deepwater ciscoes are also important because they represent unique evolutionary and ecological processes in North America. The ciscoes are one of the few species endemic to the relatively young lakes of northern North America, and are believed to be one of few examples of the incipient species flock concept in North America (Smith and Todd 1984). The shortjaw cisco is a unique form with a distribution that is intimately tied with post-glacial hydrology, and is thus of great scientific interest.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

No specific legal protection exists for the shortjaw cisco in Canada. The shortjaw cisco is listed on Schedule 2 of the federal *Species at Risk Act* as a species to be reassessed for consideration on Schedule 1, but it receives no protection with this designation. The shortjaw cisco is afforded the general protection all fishes receive through the federal *Fisheries Act.*

The species is considered vulnerable globally (G3) and nationally (N3) (NatureServe 2004). Provincially, the shortjaw cisco is considered critically imperilled (S1) in Alberta and Saskatchewan, imperilled (S2) in Ontario and vulnerable (S3) in Manitoba (NatureServe 2004). In the United States, the shortjaw cisco is presumed extirpated (SX) from Illinois, New York and Pennsylvania, imperilled (S2) in Michigan and Wisconsin, and vulnerable (S3) in Minnesota (NatureServe 2004). The shortjaw cisco is listed as Threatened under the new Ontario Endangered Species Act, and as vulnerable by the International Union for the Conservation of Nature (International Union for the Conservation of Nature 1990).

TECHNICAL SUMMARY

Coregonus zenithicus

Shortjaw cisco — cisco à mâchoires égales

Range of Occurrence in Canada: NT, AB, SK, MB, ON

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Approximate spatial area covered by lakes with residency; COSEWIC 2003	>1 x 10^6 km^2
• *Specify trend in EO*	Declining
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Approximate surface area of in lakes; COSEWIC 2003	>175,000 km km^2
• *Specify trend in AO*	Declining
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	12-25
• *Specify trend in #*	Declining
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Stable

Population Information	
• *Generation time (average age of parents in the population)*	5 years
• *Number of mature individuals*	Unknown
• *Total population trend:*	Declining
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Unknown
• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	1 Stable – Barrow Lake 6 Declining – Lake Erie, Lake Huron, Lake Michigan, Lake Superior, Lake Nipigon, Lake Saganaga
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: Unknown	

Threats (actual or imminent threats to populations or habitats)
Exploitation Invasive Species Changes in ecological dynamics Food web disruption Introgressive hybridization Habitat degradation Pollution

Rescue Effect (immigration from an outside source)

• *Status of outside population(s)?* **USA: Extinct, Endangered or Threatened**	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	N/A
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• ***Is rescue from outside populations likely?***	**No**

Quantitative Analysis	None available

Current Status

COSEWIC: Threatened, 2003

Nature Conservancy Ranks (Naturserve 2004)

- Global - G3
  - National
    - US - N3
    - Canada - N3
  - Regional
    - US
      - IL - SX
      - NY - SX
      - PN - SX
      - MI - S2
      - WI - S2
      - MN - S3
    - Canada -
      - ON - S2
      - MB - S3
      - SK - S1
      - AB - S1
      - NT - SNR

International Union for the Conservation of Nature - VU

Author of Technical Summary: Thomas C. Pratt, July 2007

Coregonus zenithicus

Shortjaw cisco — cisco à mâchoires égales

Designatable Unit 1

Range of Occurrence in DU1: ON

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Approximate watershed area covered by Great Lakes; U.S. E.P.A.	521,000 km^2
• *Specify trend in EO*	Declining
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Approximate surface area of lakes with historic residency; U.S. E.P.A.	231,000 km^2
• *Specify trend in AO*	Declining
• *Are there extreme fluctuations in AO?*	No

• *Number of known or inferred current locations*	5
• *Specify trend in #*	Declining
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Declining

Population Information	
• *Generation time (average age of parents in the population)*	5 years
• *Number of mature individuals*	Unknown
• *Total population trend:*	Declining
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Unknown
• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	5 Declining – Lake Erie, Lake Huron, Lake Michigan, Lake Superior, Lake Nipigon,
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: Unknown	

Threats (actual or imminent threats to populations or habitats)
Exploitation Invasive Species Changes in ecological dynamics Food web disruption Introgressive hybridization Habitat degradation Pollution

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: Extinct, Endangered or Threatened**	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	N/A
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• ***Is rescue from outside populations likely?***	**No**

Quantitative Analysis	None available

Current Status
COSEWIC: Threatened, 2003

Nature Conservancy Ranks (Naturserve 2004)
Global - G3
National
US - N3
Canada - N3
Regional
US
IL - SX
NY - SX
PN - SX
MI - S2
WI - S2
MN - S3
Canada -
ON - S2
MB - S3
SK - S1
AB - S1
NT - SNR
International Union for the Conservation of Nature - VU

Coregonus zenithicus

Shortjaw cisco — cisco à mâchoires égales

Designatable Unit 2

Designatable Unit 2: NT, AB, SK, MB, ON

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Approximate spatial area covered by lakes with residency; COSEWIC 2003	>1 x 10^6 km^2
• *Specify trend in EO*	Unknown
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Approximate area of deepwater habitat in lakes; COSEWIC 2003	>175,000 km km²
• *Specify trend in AO*	Unknown
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	7-20
• *Specify trend in #*	Stable
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Stable

Population Information	
• *Generation time (average age of parents in the population)*	5 years
• *Number of mature individuals*	Unknown
• *Total population trend:*	Unknown
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Unknown

• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	1 Stable – Barrow Lake 1 Declining –Lake Saganaga
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: Unknown	

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Threats (actual or imminent threats to populations or habitats)
Exploitation Invasive Species Changes in ecological dynamics Food web disruption Introgressive hybridization Habitat degradation Pollution

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: Extinct, Endangered or Threatened**	
• *Is immigration known or possible?*	No
• *Would immigrants be adapted to survive in Canada?*	N/A
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• ***Is rescue from outside populations likely?***	**No**

Quantitative Analysis	None available

Current Status

COSEWIC: Threatened, 2003

Nature Conservancy Ranks (Naturserve 2004)
- Global - G3
  - National
    - US - N3
    - Canada - N3
  - Regional
    - US
      - IL - SX
      - NY - SX
      - PN - SX
      - MI - S2
      - WI - S2
      - MN - S3
    - Canada -
      - ON - S2
      - MB - S3
      - SK - S1
      - AB - S1
      - NT - SNR

International Union for the Conservation of Nature - VU

Recommended Status and Reasons for Designation

[This table is to be completed in the Interim Report by the SSC;
COSEWIC will approve or modify the text in this section for the Final Report]

<table>
<tr><td>Recommended Status:</td><td>Alpha-numeric code:</td></tr>
<tr><td colspan="2">Reasons for Designation: [Note especially if it is a Canadian endemic with 100% of its distribution in Canada]</td></tr>
<tr><td colspan="2"><u>Applicability of Criteria</u>

Criterion A (Declining Total Population):

Criterion B (Small Distribution, and Decline or Fluctuation):

Criterion C (Small Total Population Size and Decline):

Criterion D (Very Small Population or Restricted Distribution):

Criterion E (Quantitative Analysis):</td></tr>
</table>

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COLLECTIONS EXAMINED

No collections were examined in the preparation of this status report.