

Alberta Shortjaw Cisco Recovery Plan 2013-2023



Alberta Species at Risk Recovery Plan No. 32

Alberta Shortjaw Cisco Recovery Plan 2013-2023

Prepared by:

Alberta Environment and Sustainable Resource Development

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PREFACE

Albertans are fortunate to share their province with an impressive diversity of wild species. Populations of most species of plants and animals are healthy and secure. However, a small number of species are either naturally rare or are now imperiled because of human activities. Recovery plans establish a basis for cooperation among government, industry, conservation groups, landowners and other stakeholders to ensure these species and populations are restored or maintained for future generations.

Alberta's commitment to the *Accord for the Protection of Species at Risk* and to the *National Framework for the Conservation of Species at Risk*, combined with requirements established under Alberta's *Wildlife Act* and the federal *Species at Risk Act*, has resulted in the development of a provincial recovery program. The overall goal of the recovery program is to restore species identified as *Threatened* or *Endangered* to viable, naturally self-sustaining populations within Alberta. The policy document *Alberta's Strategy for the Management of Species at Risk (2009–2014)* provides broader program context for recovery activities.

Alberta species at risk recovery plans are prepared under the supervision of the Species at Risk Program, Alberta Environment and Sustainable Resource Development. This often includes involvement of a recovery team composed of various stakeholders including conservation organizations, industry, landowners, resource users, universities, government agencies and others. Membership is by invitation from the Executive Director of the Fish and Wildlife Policy Branch and is uniquely tailored to each species and circumstance. Conservation and management of these species continues during preparation of recovery plans.

The Executive Director of the Fish and Wildlife Policy Branch provides these plans as advice to the Minister of Environment and Sustainable Resource Development. Alberta's Endangered Species Conservation Committee also reviews draft recovery plans and provides recommendations on their acceptance to the Minister. Additional opportunities for review by the public may also be provided. Plans accepted and approved for implementation by the Minister are published as a government recovery plan. Approved plans are a summary of the Ministry's commitment to work with involved stakeholders to coordinate and implement conservation actions necessary to restore or maintain these species.

Recovery plans include three main sections: background information that highlights the species' biology, population trends, and threats; a recovery section that outlines goals, objectives, and strategies to address the threats; and an action plan that profiles priority actions required to maintain or restore the *Threatened* or *Endangered* species. Each approved recovery plan undergoes regular review, and progress of implementation is evaluated. Implementation of each recovery plan is subject to the availability of resources from within and from outside government.

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EXECUTIVE SUMMARY

The shortjaw cisco (*Coregonus zenithicus*) is a freshwater fish that occurs at relatively low densities in lakes across central Canada. In July 2003, the Minister of Environment and Sustainable Resource Development approved listing the shortjaw cisco as *Threatened* in Alberta. This designation was based on the species' occurrence in only one lake in Alberta and its isolation from other populations. This species is also designated as *Threatened* in Canada, primarily due to the decline or extirpation of this species in the Great Lakes from commercial exploitation, climate change, predation, and competition with introduced species.

The specific guiding principles, goals, objectives, strategies and management actions of this updated recovery plan remain unchanged from the initial *Alberta Shortjaw Cisco Recovery Plan 2006-2011*. The goal of this plan is to maintain a self-sustaining population of shortjaw cisco in Barrow Lake, Alberta over the long-term. Key to achieving this goal will be: (1) protection of the shortjaw cisco population against direct and indirect effects of domestic fishing and sportfishing; (2) prevention of declines or losses in habitat quantity and quality associated with anthropogenic activities; (3) monitoring of the population directly using non-lethal sampling techniques or indirectly via assessment of habitat parameters; and (4) increasing public awareness about this species and its conservation requirements. Recovery strategies for the conservation and management of shortjaw cisco will focus on: (1) population conservation and management, including population monitoring and management of fishing; (2) habitat conservation and management, including managing potential threats associated with land use activities; (3) public outreach to highlight the importance of the species and its ecological and conservation requirements; (4) research to identify non-lethal sampling methods and to verify unconfirmed reports of shortjaw cisco in Alberta; (5) resource acquisition to help fund implementation of the recovery initiatives; and (6) recovery plan management and administration to evaluate the effectiveness of conservation actions. A series of specific actions in each of these areas are outlined, along with anticipated costs and lead agencies.

Since the inception of the initial recovery plan, initiatives have focused largely on population and habitat conservation and management, research, and public education and outreach. Key efforts include the placement of protective notations and a consultative notation on Barrow Lake and the Upper Slave River sub-basin, field studies to test the effectiveness of various non-lethal monitoring methods, and the production and distribution of informational materials on shortjaw cisco.

The *Alberta Shortjaw Cisco Recovery Plan 2013-2023* represents a continuation of efforts to conserve shortjaw cisco in Alberta. A variety of agencies will participate in the funding and implementation of conservation initiatives. It is expected that the ongoing implementation of activities to maintain shortjaw cisco, combined with stakeholder cooperation and commitment, will allow for the long-term persistence of this species in Alberta.

1.0 INTRODUCTION

1.1 Provincial and National Status

In July 2003, the Minister of Environment and Sustainable Resource Development (ESRD; herein the Minister) approved listing the shortjaw cisco (*Coregonus zenithicus*) as *Threatened* under Alberta's *Wildlife Act*, based on the recommendation from the Endangered Species Conservation Committee (ESCC). This designation was due to the species' occurrence at only one site in Alberta and due to its isolation, which precludes dispersal and exchange with other populations. Along with this listing, the Minister endorsed an *Initial Conservation Action Statement* which recommended the initiation of recovery planning for this species. The action statement specified that a recovery plan would be prepared within 24 months of its listing and that initial recovery efforts for this species should focus on the identification and conservation of existing populations.

The national status of the shortjaw cisco was evaluated in April 1987 as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004). This status was reconfirmed by COSEWIC in May 2003, and was based primarily on the decline or extirpation of this species in the Great Lakes (COSEWIC 2004). Factors implicated in the decline of this species include a combination of commercial exploitation (e.g., fishing), climate change, predation, and competition with introduced species (Houston 1987; COSEWIC 2003; Todd 2003). At the time of original plan preparation, the federal government was considering adding shortjaw cisco to Schedule 1 of the federal *Species at Risk Act* (SARA). However, the species was referred back to COSEWIC for a reassessment in April 2006. To date, the shortjaw cisco is not listed under SARA. A national shortjaw cisco recovery team, which is coordinated by Fisheries and Oceans Canada, was formed in 2003. Alberta is a member of the national recovery team.

1.2 Recovery Team

At the direction of the Minister, the Alberta Shortjaw Cisco Recovery Team was initiated in 2005 by the Director of Wildlife Management. Led by a species lead from ESRD, the team's primary responsibility was to provide recommendations for recovery of the shortjaw cisco, by outlining recovery strategies and actions in the *Alberta Shortjaw Cisco Recovery Plan* (hereafter referred to as the Plan). ESRD oversaw implementation of the Plan by facilitating and encouraging involvement of appropriate and interested parties, including members of the team.

ESRD oversaw implementation of the Plan by facilitating and encouraging involvement of appropriate and interested parties, including members of the team. The team lead was responsible for updating the Plan and evaluating and reporting on the progress of recovery actions. The original team included representation from the following: Alberta Environment and Sustainable Resource Development (Fish and Wildlife Policy Branch and the Public Lands Policy Branch), Royal Alberta Museum, Mikisew Sport Fishing, and First Nations representation from the Métis Association, Mikisew Cree First Nation, and the Athabasca Chipewyan First Nation.

2.0 SPECIES BIOLOGY

2.1 Life History

Ciscoes (*Coregonus* spp.) exhibit morphological variation among populations which combined with their overall similarity in appearance makes species identification difficult. Ciscoes tend to have a trout-like appearance with slender bodies, abdominal pelvic fins, and an adipose fin, but have larger scales than trout and lack teeth on their jaw bones. Ciscoes are generally silver in colour with darker backs and lighter undersides (Scott and Crossman 1973).

Two species of ciscoes occur in Alberta; the shortjaw cisco (*C. zenithicus*) and the cisco (or lake herring; *C. artedi*¹). In contrast to the shortjaw cisco which is confined to one lake (Barrow Lake) in Alberta, the cisco is abundant and widespread in northeastern Alberta. In Barrow Lake, the two species are sympatric (occur together), and because they are similar in appearance, they are difficult to distinguish. Genetic analyses have generally been unable to distinguish between them, and considerable uncertainty surrounds the taxonomic identity of the shortjaw cisco (Todd 1981; Philips *et al.* 1996; Reed *et al.* 1998; Turgeon *et al.* 1999; Steinhilber *et al.* 2002; Turgeon and Bernatchez 2003). Shortjaw cisco is most reliably distinguished from cisco based on the number of gill rakers - the slender, bony protuberances on the gill arches that filter plankton (i.e., food) (Paterson 1969; Steinhilber 2000; Steinhilber *et al.* 2002). Shortjaw cisco usually have 30-46 gill rakers, but most have 44 or less (Scott and Crossman 1973; Steinhilber 2000; Steinhilber *et al.* 2002). In contrast, cisco usually have 38-64 gill rakers (Scott and Crossman 1973), but most Alberta specimens have 42-59 (Steinhilber 2002). In addition to fewer gill rakers, shortjaw cisco in Alberta can be further distinguished from cisco by their shorter gill rakers, larger overall size, shallower head, and smaller eye (Steinhilber 2000). Throughout their North American range, shortjaw cisco also tend to have longer snouts, longer upper jaw, a lower jaw that does not extend beyond the upper jaw, and a more vertical upper jaw tip than cisco (Todd and Smith 1980).

Across their range, shortjaw cisco spawn between late September and early December (Koelz 1929; Scott and Crossman 1973). In Alberta, spawning is assumed to occur in late October or November (Steinhilber 2002). Shortjaw cisco are broadcast spawners, depositing eggs indiscriminately over the lake bottom (Berlin *et al.* 1977). Ciscoes do not construct nests or provide parental care, and eggs develop over the winter and hatch in the spring (Berlin *et al.* 1977). The number of eggs produced by female shortjaw cisco is assumed to be similar to that produced by a related species of cisco, the bloater (*C. hoyi*), that produces between 3 000 and 18 000 eggs depending on female size (Emery and Brown 1978). Spawning behaviour of ciscoes is promiscuous and males are not aggressive toward other males (Svärdson 1965).

The diet of shortjaw cisco in Barrow Lake is dominated by the crustacean, *Mysis relicta*, which tends to occur near the bottom of the lake. Zooplankton (copepods and cladocerans) comprise a smaller portion of its diet (Steinhilber 2000, 2002).

¹ There are several common names for *C. artedi*, including cisco, tullibee, and lake herring. In this document, “cisco” refers to *C. artedi*, “shortjaw cisco” refers to *C. zenithicus*, and “ciscoes” refers to *Coregonus* spp. in general.

Shortjaw cisco grow rapidly during their first year (Van Oosten 1937; Moyle and Cech 1988; Steinhilber 2000). Rapid growth early in life may provide protection from predators such as northern pike (*Esox lucius*), walleye (*Sander vitreus*), and burbot (*Lota lota*) that appear to prefer smaller prey than adult shortjaw cisco (Steinhilber 2002). Shortjaw cisco in Alberta grow to a larger size than any other known North American population (Koelz 1929; Clarke 1973; Steinhilber 2000). Males and females are similar in morphology and appearance, but females may be slightly larger and heavier than males (Van Oosten 1937; Clarke 1973; Steinhilber 2000, 2004). In Alberta, females mature at two years of age (ca. 250 mm standard length (SL)), whereas males mature at three years of age (ca. 220 to 270 mm SL) (Steinhilber 2002). Other North American populations of shortjaw cisco typically mature by four or five years of age (Bajkov 1930; Van Oosten 1937). Although lifespans of shortjaw cisco are not well documented, individuals estimated to be 13 years of age have been captured in Alberta (Steinhilber 2000, 2002).

2.2 Habitat

The shortjaw cisco is a freshwater species found in deep, cold, well-oxygenated lakes (Scott and Crossman 1973). Shortjaw cisco typically occur at depths ranging from 18 m to 183 m (Van Oosten 1937). They usually spawn in shallow waters (Dryer 1966) although Van Oosten (1937) believed that Lake Superior populations spawned at depths of up to 73 m over a clay bottom.

In Alberta, shortjaw cisco occur only in Barrow Lake, a small lake (3.81 km²) north of Lake Athabasca (Paterson 1969; Steinhilber 2002). Habitat use by shortjaw cisco in Barrow Lake is not well understood. In this lake, shortjaw cisco occur at relatively shallow depths. Paterson (1969) captured shortjaw cisco in Barrow Lake at depths of 2 to 5 m. Similarly, Steinhilber (2000) captured shortjaw cisco at depths of 5 to 16 m. It is uncertain where this species spawns in Barrow Lake. Paterson (1969) speculated that gravel shoals in shallow water (3 m depth) were potential spawning sites. However, he acknowledged that relatively little of this habitat was found in the lake. Substrate sampling conducted in 1996 and 1997 revealed a thick layer of sand and silt overlying cobbles and small boulders in shallower areas of the lake. In deeper regions, the substrate shifted to predominantly silt. No gravel shoals were located (M. Steinhilber, pers. comm.).

It is unknown what, if any, physical or chemical characteristics of Barrow Lake make it uniquely suitable for shortjaw cisco (M. Steinhilber, pers. comm.). A cursory analysis of basin morphometry and water chemistry did not reveal any unique characteristics about Barrow Lake when compared to other lakes in the immediate vicinity. As such, it is not possible at this time to identify specific essential habitat elements for the Alberta population of this species. A more in-depth factor analysis, such as that conducted by Clarke (1973), may reveal habitat elements that can be linked to the occurrence of shortjaw cisco in Barrow Lake. More likely, this is a glacial relict that has persisted at this site due primarily to stochastic processes.

2.3 Population Size, Distribution, and Trends in Alberta

In Canada, the shortjaw cisco is distributed from the Northwest Territories to the Great Lakes. The shortjaw cisco was first reported in Barrow Lake, Alberta in 1969 (Paterson 1969). This remains the only verified population of shortjaw cisco in the province (Figure 1). There have been unconfirmed reports of shortjaw cisco in Gregoire Lake (Tripp and Tsui 1980), Cold Lake (Clarke 1973), and on the Alberta side of Lake Athabasca (Dymond and Pritchard 1930). Several surveys have been conducted in an attempt to identify new populations of shortjaw cisco and to verify these unconfirmed reports (Steinhilber 2000, 2004; Steinhilber and Rhude 2001; Rhude 2005). In total, 19 lakes in northeastern Alberta have been surveyed since 1996 (Figure 1). No additional populations of shortjaw cisco have been identified. One of 100 specimens collected at Cold Lake was suspected to be shortjaw cisco based on a low gill raker count (Steinhilber 2004). Further surveys are needed to establish whether a population of shortjaw cisco occurs in Cold Lake. A survey of the Alberta side of Lake Athabasca failed to identify shortjaw cisco, possibly due to little suitable habitat on this side of the lake (Steinhilber 2004). However, shortjaw cisco occur on the Saskatchewan side of the lake, and it is possible that the species occurs on the Alberta side. All ciscoes captured incidentally during a recent survey of walleye in Gregoire Lake appeared to be cisco rather than shortjaw cisco (Rhude 2005).

Population trends of this species are not well documented. However, surveys on Barrow Lake in 1996, 1997, and 2000 have provided data on the abundance of shortjaw cisco relative to co-occurring cisco, and on catch-per-unit-effort (CPUE), a measure of abundance using standardized sampling effort (Table 1). These data appear to indicate that the Alberta population of shortjaw cisco is stable. In addition, 57% of shortjaw cisco collected in 2000 were immature, suggesting high reproductive success in 1998 and 1999 (Steinhilber and Rhude 2001). A comparison of these recent estimates of relative abundance and CPUE of shortjaw cisco with those estimated from data collected during the earliest surveys on Barrow Lake suggests that the population has been relatively stable over the last 30 years (Table 1) (Steinhilber and Rhude 2001).

Table 1. Shortjaw cisco relative abundance and catch-per-unit-effort (CPUE) in Barrow Lake.

Year	Relative abundance (% shortjaw cisco in total catch of all ciscoes)	CPUE (shortjaw cisco/hr/m ² of net)
1969	7.8 ¹	0.00043 ¹
1996	4.6	0.00031
1997 (July)	5.7	0.00035
1997 (Oct)	4.2	0.00013
2000	11.6	0.00078

¹These values are estimates provided in Steinhilber and Rhude (2001) based on data from Turner (1967) and Paterson (1969).

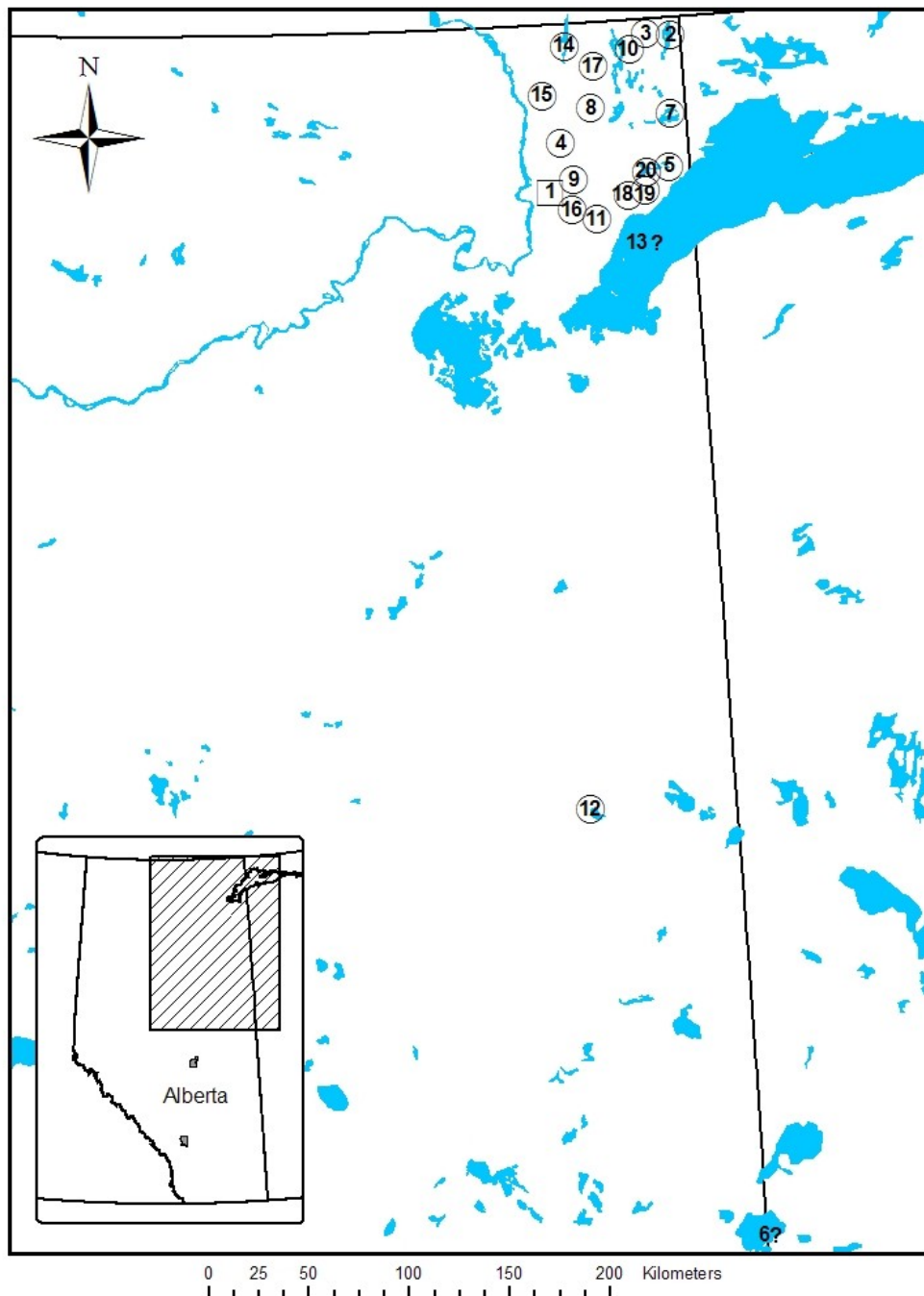


Figure 1. The distribution of shortjaw cisco in Alberta, based on surveys conducted between 1996 and 2005. The open square indicates the only confirmed population of shortjaw cisco in Alberta (Barrow Lake). Open circles indicate lakes that were surveyed but where no shortjaw cisco were recorded. Question marks indicate lakes that may contain shortjaw cisco, but require further verification. See Appendix 1 for the identity of lakes corresponding to the numbers on the map.

3.0 THREATS AND LIMITING FACTORS

None of the factors that contributed to declines of shortjaw cisco in the Great Lakes are considered immediate threats to the Alberta population. However, several of these factors have the potential to threaten the Alberta population in the future. Addressing some of these potential threats (e.g., climate change) is beyond the scope of this recovery plan and as such, have no associated recovery actions.

3.1 Sport, Domestic, and Commercial Fishing

Shortjaw cisco are relatively large, making them susceptible to incidental capture in gillnets used for commercial or domestic fishing of large game species (e.g., northern pike, walleye) (Steinhilber and Rhude 2001). Most shortjaw cisco do not survive capture and handling (M. Steinhilber, pers. comm.). Given the low abundance of shortjaw cisco in Barrow Lake and the small size of the lake, even low levels of gillnetting could threaten the Alberta shortjaw cisco population (Steinhilber and Rhude 2001; Steinhilber 2002). Hence, commercial and domestic fishing on Barrow Lake are not compatible with the conservation and management of this species. There are no historical records of commercial fishing on Barrow Lake, and current regulations prohibit this activity on the lake (L. Rhude, pers. comm.). Domestic fishing permits have not been issued on Barrow Lake since at least 1981 (K. Bodden, pers. comm.). Population monitoring studies using gillnetting could also impact the shortjaw cisco population, particularly if conducted frequently.

Sportfishing is limited on Barrow Lake, probably owing to its remote location. One fishing lodge is situated on the lake. The lake is also a likely destination for fly-in anglers, but angling pressure on Barrow Lake has been low. Six years of data collected between 1988 and 1998 indicate a total of 80 angler days on the lake, ranging from 0 to 20 angler days across years (Hansen 1988, 1989, 1990, 1991, 1996, and 1998). Harvest of game species during four of the six years when anglers used the lake was correspondingly low, with a mean of 38 walleye and 52 northern pike kept in each year. Recent data indicate that angling pressure has remained low, with only eight anglers (comprising 40 angler days) using the lake in 2004 (T. Gillies, pers. comm.). It is very unlikely that ciscoes were the target of sportfishing effort. Regardless, capture of ciscoes by angling is extremely rare (Steinhilber 2002; D. Park, pers. comm.), current sportfishing regulations in Alberta prohibit harvest of cisco in Barrow Lake (Alberta Environment and Sustainable Resource Development 2013).

3.2 Ecological Integrity

The presence of old, large individuals of predatory fish species are important for maintaining ecological balance within lakes and ensuring sustainable fish populations (Berkeley *et al.* 2004, Mike Sullivan, pers. comm.). Factors that reduce the number of these individuals, such as overharvesting, can disrupt the ecological balance of a lake. For example, large game species in Barrow Lake appear to preferentially prey upon adult cisco, which are smaller than mature shortjaw cisco. Overharvesting these game species could lead to an increase in the cisco

population, which could allow the abundant cisco to outcompete the much less common shortjaw cisco. Increasing the disparity in population sizes of these two species could also lead to hybridization between cisco and shortjaw cisco (i.e., the larger population “swamps” the smaller population), jeopardizing the shortjaw cisco gene pool (Svårdson 1965). Currently, there is no evidence of hybridization between shortjaw cisco and cisco in Barrow Lake (M. Steinhilber, pers. comm.).

Declines in population sizes of predatory species can cause changes in water quality through the subsequent increase in prey populations (e.g., minnows) that feed on zooplankton in lakes. Zooplankton consume algae in waterbodies, and their decimation by the overpopulation of minnows and other prey species could reduce water quality from increased algae abundance, producing a condition known as “green lake” (Carpenter and Kitchell 1993). This type of effect, known as trophic cascade, has been postulated in several northern Alberta waterbodies, including Lac La Biche and Baptiste Lake (M. Sullivan, pers. comm.). Furthermore, increases in minnow populations associated with declines in predator populations could also lead to reductions in food availability for shortjaw cisco, which also consume zooplankton.

3.3 Land Use and Other Anthropogenic Activities

Land use activities (e.g., forestry, petroleum exploration and development, mining, and hydroelectric development) have the potential to impact the shortjaw cisco population and its habitat. Potential threats from land use activities include habitat loss, and reduced habitat quality from acidification, sedimentation, and nutrient loading of the lake. Increased access from land use developments could also increase angling pressure on Barrow Lake. Land use activities are currently limited in the northeast corner of Alberta. However, it is possible that these activities could increase in the area. Uranium exploration and mining have increased near Lake Athabasca, and could increase in other areas of northeast Alberta. Other potential threats from anthropogenic activities include pollution of Barrow Lake or adjacent habitat from fuel spills or other contaminants. As noted above, one fishing lodge is situated on the lake and clients are flown into the site. The Public Lands Policy Branch, ESRD, regulates how fuel is stored adjacent to waterbodies, and can conduct inspections to ensure that regulations are followed. Barrow Lake also has the potential to be targeted as a water source or base for regional forest protection activities. Concerns related to this type of activity include site or water contamination and fishing activity by fire crews.

3.4 Climate

Natural climatic events or human-induced changes in climate could lead to a loss of habitat or a reduction in quality of habitat for shortjaw cisco. Effects of climate change have not been noted at Barrow Lake, however, they could manifest in several ways. For example, periods of drought could reduce the water level in Barrow Lake, potentially reducing habitat available to shortjaw cisco (Steinhilber 2002). Acid rain could lead to reductions in water quality that could affect the ability of the species to persist in the lake. Climate change can have a variety of impacts on aquatic ecosystems (United States Environmental Protection Agency 1995). For example,

increased water temperature associated with global warming could be particularly detrimental to shortjaw cisco, a species that prefers cold, well-oxygenated lakes. Increased waterbody temperature can also increase metabolic rates and food requirements of fish (McDonald *et al.* 1996). Particularly when food is limiting, such changes could lead to losses or declines of fish populations.

4.0 KNOWLEDGE GAPS AND RESEARCH PRIORITIES

Many aspects of the ecology of shortjaw cisco in Barrow Lake are poorly understood, including timing and location of spawning, reproductive success, recruitment, and habitat use. However, given that shortjaw cisco are known to occur in only one lake in Alberta, immediate research on the life history of this species is unlikely to be required to manage current and potential threats to the species and its habitat. Research efforts should focus on monitoring the population using direct, non-lethal techniques as well as indirect methods (e.g., water quality, sportfishing harvests) combined with an evaluation of the effectiveness of conservation efforts.

Several secondary research objectives may be important to the long-term management of this species. In particular, continued research is required to identify non-lethal methods of directly monitoring shortjaw cisco populations. Currently, gillnetting represents the best available tool for directly monitoring shortjaw cisco populations, but this method commonly results in mortality of captured fish. Trapping, trawling, or other non-lethal methods should first be tested on species such as cisco and lake whitefish to assess applicability of these methods for monitoring shortjaw cisco. If future reductions in the population size of shortjaw cisco are anticipated, baseline data should be collected in the short term to facilitate assessment of future population trends. Further, non-lethal sampling methods will ensure that monitoring efforts do not further impact the population. Research is also needed to verify whether a population of shortjaw cisco occurs in Cold Lake, where a possible specimen was previously recovered. This survey would establish whether conservation and management efforts need to be implemented at this location. Surveys of other lakes with unconfirmed reports of shortjaw cisco (i.e., Gregoire Lake and the Alberta side of Lake Athabasca) have failed to document this species occurrence and thus are of lower priority for future survey efforts.

Other research needs include further studies on the taxonomy of shortjaw cisco and studies to evaluate whether shortjaw cisco and cisco are hybridizing. Studies on hybridization should be undertaken if it is suspected that the cisco population is increasing in Barrow Lake as a result of declines in predatory fish populations. Currently, there is no evidence for hybridization between these species in Barrow Lake (M. Steinhilber, pers. comm.). Genetic studies of shortjaw cisco could influence how it is managed in the future. To date, molecular analyses have provided little consensus on the taxonomic relationship of the shortjaw cisco to other ciscoes. Morphological studies conducted in Alberta suggest that the shortjaw cisco is distinct from co-occurring cisco (Steinhilber *et al.* 2002).

5.0 RECENT RECOVERY AND CONSERVATION EFFORTS

Prior to the preparation of the initial plan, several initiatives had been undertaken that indirectly or directly support conservation and management of shortjaw cisco. In particular, 19 lakes in northeast Alberta had been surveyed for shortjaw cisco occurrence since 1996. These surveys supported the known distribution of shortjaw cisco in only one lake in Alberta, but provided some evidence for a possible population in Cold Lake (Steinhilber 2000, 2004; Steinhilber and Rhude 2001; Rhude 2005). Furthermore, morphological studies were successful in establishing characteristics to reliably distinguish shortjaw cisco from cisco (Steinhilber 2000; Todd and Steinhilber 2002). These studies were also important for assessing abundance of shortjaw cisco in Barrow Lake. Finally, changes to sportfishing regulations, first implemented in 2004, prevent harvesting of cisco in Barrow Lake (ASRD 2005, 2011). These changes essentially eliminate the potential for harvest of shortjaw cisco. The current sportfishing regulations also include a reduction in the walleye and pike catch limit; this reduction was implemented to reduce harvest pressure on predatory fish in order to maintain the predator/prey balance and the ecological integrity of Barrow Lake (D. Latty, pers. comm.).

An information session was conducted by members of the core team in Ft. Chipewyan in February 2005. Community leaders and stakeholders were invited to attend to learn more about the challenges faced by shortjaw cisco in Alberta.

In June 2009, research into non-lethal sampling methods was initiated by staff from ESRD and the Royal Alberta Museum with a project utilizing underwater video cameras. It was anticipated that video recordings would provide confirmation of the presence of the species and perhaps an estimate of shortjaw cisco relative abundance in Barrow Lake. Unfortunately, over a period of 5 days and 40+ hours of observations, no shortjaw cisco were detected using random deployment of cameras that covered all depth strata, time strata, and habitat types. Lack of detection was attributed to low visibility (camera's field of view ~4 ft.), the species' pelagic nature, and possible behavioural response (i.e., camera avoidance) (S. Bumstead, D. Latty, and M. Steinhilber, pers. comm.).

Subsequently, in August 2009, an alternative non-lethal sampling technique was explored. To avoid capture stress and handling of the fish but allow for close range visibility with the camera, researchers tested the use of modified trap nets in conjunction with video cameras. This method was first evaluated at Moose Lake, Alberta; a lake with a cisco density similar to that of Barrow Lake. Although no ciscoes were captured after approximately 18 hours of soak time (M. Steinhilber, pers. comm.), modifications to the trap are being considered, as is the use of scuba to deploy and monitor traps more effectively.

To protect and maintain the integrity of shortjaw cisco habitat, a protective notation was put on Barrow Lake. Additionally, a protective notation and a consultative notation were put on the Upper Slave River sub-basin to ensure that land use activities are compatible with the conservation of shortjaw cisco and its habitat (D. Latty, pers. comm.).

In 2010, informational materials on the shortjaw cisco, including its ecological requirements and the importance for its conservation, were produced to educate the public and promote the

stewardship of this unique species. Informational brochures are available at local ESRD offices, the Royal Alberta Museum, and Mikisew Sport Fishing.

6.0 RECOVERY STRATEGY

6.1 Biological and Technical Feasibility of Recovery

It is the belief of the recovery team that conservation of shortjaw cisco is biologically and technically feasible. Although only one population has been documented in Alberta, it appears stable. Shortjaw cisco also exhibit characteristics that may buffer population decreases, including early age of maturation, high fecundity, and rapid growth rates. There are currently few immediate threats to the Alberta population of shortjaw cisco. Careful management and stakeholder involvement should ensure that future impacts are minimized or mitigated.

One potential factor that could impede conservation or management efforts is the fact that only one population of shortjaw cisco occurs in Alberta and this population is ecologically isolated from adjacent populations in Saskatchewan and the Northwest Territories by lotic habitats. Consequently, there is an extremely low possibility of a 'rescue effect' from other populations. In addition, Barrow Lake is a small lake (3.81 km²) and likely has limited capacity to buffer potential changes from anthropogenic activities (e.g., site pollution). Another potential limitation is the lack of available, non-lethal methods to directly monitor the shortjaw cisco population. In particular, if future declines are suspected, no methods are currently available to directly measure the extent of the declines without incurring further losses.

6.2 Guiding Principles

The conservation and management of shortjaw cisco in Alberta will be guided by the following principles:

- Recovery team members believe that conservation of shortjaw cisco is desirable and feasible, and are committed to this endeavour.
- This recovery plan is based on the assumption that all appropriate land users and managers, including all affected branches of government, share responsibility for maintaining shortjaw cisco in Alberta. Commitment and action by all of these parties will be important to the conservation of this species.
- A cooperative approach with land managers, industry, and other agencies is essential to the success of this plan. This includes shared stewardship, compatible land use, and local commitment to management initiatives.
- The loss of habitat and individuals of shortjaw cisco is undesirable and preventable.
- Conservation actions will adopt an ecosystem based approach to management.
- This recovery plan will employ the precautionary principle to risk management where the lack of information or scientific certainty should not impede implementation of actions believed to be necessary to achieve the goals of this plan.

- This plan will be guided by the concept of adaptive management, whereby specific actions are implemented, evaluated, and adjusted as necessary, to ultimately improve the outcome.

6.3 Recovery Goal

The *Alberta Shortjaw Cisco Recovery Plan* will serve for a period of ten years (2013-2023). The goal of this plan is to maintain a self-sustaining population of shortjaw cisco in Barrow Lake, Alberta over the long-term.

6.4 Recovery Objectives

The objectives necessary to achieve this goal are as follows:

- Protect the shortjaw cisco population from direct and indirect effects of domestic fishing and sportfishing.
- Prevent decline or loss of habitat quantity or quality from anthropogenic activities.
- Monitor the shortjaw cisco population using indirect methods until a non-lethal direct protocol can be established.
- Increase public awareness about shortjaw cisco, its ecological requirements, and the need to conserve the species and its habitat.

6.5 Strategies for Recovery

Recovery actions for the shortjaw cisco are organized under the following strategic approaches, which will be pursued concurrently over a ten-year period:

Population Conservation and Management - activities related to monitoring population size and distribution, reducing human-caused mortality, and ensuring appropriate policies and regulations are in place to protect shortjaw cisco.

Habitat Conservation and Management - actions related to maintaining and conserving habitat for shortjaw cisco. This includes management to limit land use activities on or near Barrow Lake.

Information and Outreach - actions related to providing education and awareness to the public, sportfishermen, and any other relevant stakeholders about the conservation and management of shortjaw cisco in Alberta.

Research - all actions related to the collection, analysis, and reporting of scientific data to inform the management and recovery of shortjaw cisco in Alberta.

Resourcing - actions related to securing funding and other resources needed to deliver identified actions detailed in this plan.

Plan Management and Administration - activities related to the operation of the Alberta Shortjaw Cisco Recovery Team and implementation of the Alberta *Shortjaw Cisco Recovery Plan 2013-2023*.

7.0 ACTION PLAN

7.1 Population Conservation and Management

1. The Royal Alberta Museum and ESRD will work to develop and refine non-lethal direct sampling techniques for shortjaw cisco.
2. ESRD will continue to work with the owners of the sportfishing lodge on Barrow Lake to monitor annual angling pressure on Barrow Lake as a means of indirectly monitoring the shortjaw cisco population and potential threats to the population.
3. ESRD will identify appropriate thresholds associated with angling pressure and ensure they are not exceeded.
4. ESRD will perpetually support the policy of no domestic fishing on Barrow Lake due to the potential for by-catch mortalities of shortjaw cisco from gillnetting.
5. As required, ESRD will develop or amend existing policies and regulations to provide additional protection to shortjaw cisco from sportfishing on Barrow Lake.
6. ESRD will regularly review the sportfishing limits for Barrow Lake (i.e., one walleye over 43 cm; one northern pike over 63 cm), and adjust timing of the sportfishing season if required, to ensure that the ecological integrity of Barrow Lake is maintained.
7. Fish and Wildlife Enforcement Officers will enforce sportfishing regulations on Barrow Lake to ensure that catch limits are not exceeded.
8. The recovery team will continue to investigate the feasibility of surrogate monitoring methods (e.g., water quality parameters, predator/prey balance) to indirectly or remotely monitor the shortjaw cisco population and potential threats to the population.

7.2 Habitat Conservation and Management

1. ESRD, Fish and Wildlife Operations Branch will be identified as contacts in the industrial referral process for notification of potential land use activities that may occur on or near Barrow Lake.
2. Appropriate Branches within ESRD will work together to develop a strategy or policy to avoid using Barrow Lake as a water source or base for regional forest protection activities,

whenever possible. This policy should only be enforced when human health or welfare are not at risk.

7.3 Information and Outreach

1. ESRD will continue to provide informational materials on shortjaw cisco, its ecological requirements, the need to conserve this species and its habitat in Alberta, and address questions and issues related to the conservation of this species as required.
2. ESRD will continue to make the brochure on shortjaw cisco available to clients at the sportfishing lodge on Barrow Lake and to the communities of Fort Chipewyan and Fort Smith. This brochure will include a survey that encourages anglers to report their catches to ESRD.
3. The Fish and Wildlife Operations Branch will communicate with other Branches within ESRD, and other agencies as appropriate, to inform these agencies of any conservation actions that will be implemented.
4. ESRD, in cooperation with other agencies and researchers, will enter all accumulated data on shortjaw cisco and habitat quality (e.g., water quality) into the Fisheries and Wildlife Management Information System (FWMIS) or other centralized databases.

7.4 Research

1. ESRD and the Royal Alberta Museum will support research to develop non-lethal sampling methods for directly monitoring shortjaw cisco populations.
2. Within the first five years of this plan, researchers from government agencies, non-government organizations, or universities will conduct surveys at Cold Lake to assess the occurrence of shortjaw cisco in the lake.
3. Samples of ciscoes obtained opportunistically from Cold Lake will be forwarded to the Royal Alberta Museum for taxonomic assessment.
4. If it is suspected that the cisco population in Barrow Lake is increasing, researchers from government agencies, non-government organizations, or universities will conduct research on hybridization between shortjaw cisco and cisco, resource permitting.
5. ESRD and the Royal Alberta Museum will support ongoing research to understand the taxonomy of shortjaw cisco, as opportunities arise. Support may include provision of information or specimens for these initiatives.

7.5 Resourcing

1. Cooperating organizations and researchers will periodically approach government agencies, non-government organizations, industry, and universities to participate in, or fund, conservation initiatives for shortjaw cisco.
2. Individuals and organizations supporting conservation actions will be acknowledged on printed materials, websites, presentations, and press releases, on an ongoing basis.

7.6 Plan Management and Administration

1. ESRD may reconvene members of the Alberta Shortjaw Cisco Recovery Team as an advisory group on an as-needed basis. Activities may include reviewing implementation of the Plan, monitoring the effectiveness of recovery actions, and possibly developing new recovery actions, as required.
2. The provincial recovery team lead will communicate with the National Shortjaw Cisco Recovery Team to ensure that recovery actions for shortjaw cisco complement, where appropriate, those outlined in the draft national recovery strategy for shortjaw cisco.

8.0 TIMETABLE FOR IMPLEMENTATION AND SCHEDULE OF COSTS

The following table provides a timeline for implementation of activities identified by the recovery team as being important to the conservation and management of shortjaw cisco in Alberta, and provides the estimated costs associated with their implementation. It is anticipated that a variety of agencies will participate in the funding and implementation of these activities. Estimated costs include in-kind and funding needed to implement conservation actions. Costs are not provided for activities that are part of the daily operations of the identified agencies.

Table 2. Implementation schedule for the action plan for shortjaw cisco.

Recovery Plan Section	Action	Lead Agency ¹	Cost (thousands/year)										Total
			2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	
7.1	Population Conservation and Management												
1	Develop and refine non-lethal direct sampling methods for shortjaw cisco.	RAM, ESRD	1.5	1.5	5								8
2	Monitor angling pressure on Barrow Lake	ESRD											
3	Support policy of no domestic fishing on Barrow Lake	ESRD											
4	Regularly review sportfishing regulations for Barrow Lake	ESRD											
5	Enforce sportfishing regulations on Barrow Lake (1 visit to lake/year)	FWEB	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	21
6	Identify monitoring surrogates and thresholds	RT											
	Total		3.6	3.6	7.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	29
7.2	Habitat Conservation and Management												
1	Identify FWOB as the contact in the PLOB industrial referral process for Barrow Lake area	ESRD											
2	Develop strategy/policy to avoid use of Barrow Lake during forest protection activities	ESRD											
	Total												0
7.3	Information and Outreach												
1, 2	Update and distribute information and outreach material as needed	ESRD	0.5			0.5			0.5				1.5
3	Communicate with involved agencies about planned implementation activities	ESRD											
4	Capture monitoring and other data in a centralized database	ESRD, RAM											
	Total		0.5			0.5			0.5				1.5

Recovery Plan Section	Action	Lead Agency ¹	Cost (thousands/year)										Total
			2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	
7.4	Research												
1	Opportunistically support research to develop non-lethal sampling methods	ESRD, RAM	5.0										5.0
2	Survey Cold Lake for shortjaw cisco	ESRD, RAM	2.0										2.0
3	Conduct taxonomic assessment on ciscoes from Cold Lake	RAM, ESRD											
4	Conduct research on shortjaw cisco - cisco hybridization, if cisco population appears to be increasing	ESRD	Costs will be estimated if/when this threat becomes apparent										
5	Opportunistically support research on taxonomy of shortjaw cisco	ESRD, RAM											
	Total		7.0										7.0
7.5	Resourcing												
1	Fundraising to support shortjaw cisco conservation activities	ESRD, RAM											
2	Acknowledge organizations that support shortjaw cisco conservation activities	ESRD											
	Total												0
7.6	Plan Management and Administration												
1	Periodic recovery team meetings and evaluation of recovery progress	ESRD											
2	Continued involvement with national recovery planning for shortjaw cisco	ESRD, RAM											
	Total												0
	TOTAL		11.1	3.6	7.1	2.6	2.1	2.1	2.6	2.1	2.1	2.1	37.5

¹ESRD – Alberta Environment and Sustainable Resource Development; FWOB – Fish and Wildlife Operations Branch; FWEB – Fish and Wildlife Enforcement Branch, Solicitor General and Public Security; PLOB – Public Lands Operation Branch; RAM – Royal Alberta Museum; RT – Recovery Team

9.0 SOCIO-ECONOMIC CONSIDERATIONS

Given that shortjaw cisco occur only in Barrow Lake and that land use activities are limited in the area, implementation of conservation actions for this species are expected to have limited social and economic impacts. Changes to sportfishing regulations could reduce recreational fishing opportunities. These changes also may pose an economic cost to the sportfishing lodge on the lake, if clients deem these regulations as excessively restrictive and patronage at the lodge declines. Similarly, restrictions on domestic fishing on Barrow Lake could impact traditional use of the lake. However, domestic fishing on the lake appears to have been limited, with no recorded domestic use in the past 30 years. Potential costs associated with industrial development may include restrictions on land use activities surrounding Barrow Lake. Finally, changes to policies regarding use of Barrow Lake as a potential water source or base for forest protection activities could pose logistical or economic constraints on these activities. This policy is not intended to pose a risk to human health or welfare as this policy should only be enforced when human health and welfare are not at risk.

10.0 PLAN EVALUATION AND AMENDMENT

The life of this plan is ten years. During this time, the recovery team or advisory group may be invited to conduct periodic reviews of the Plan to monitor its implementation and to determine the effectiveness of conservation actions. Progress reports will be made available through various means (e.g., annual recovery implementation updates, Species at Risk project reports as appropriate, etc.). At the end of ten years, the Plan will be revisited and revised as needed, or if major changes are needed a team or advisory group may be reconvened to assist with a rewrite of the Plan. Recovery plans are considered “living” documents and can be amended during reviews or at any time it is deemed necessary.

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12.0 APPENDIX 1

The following table outlines lakes surveyed for the presence of shortjaw cisco, their location, and whether or not the species has been confirmed on the lake. Question marks indicate that the species may exist in the lake, but requires further verification. Map numbers correspond to numbers on Figure 1. Data are from Steinhilber (2000), Steinhilber and Rhude (2001), Steinhilber (2004), Rhude (2005), and M. Steinhilber, unpubl. data.

Map Number	Lake	Latitude (N)	Longitude (W)	Confirmed Occurrence
1	Barrow	59° 15′	111° 14′	Y
2	Andrew	59° 55′	110° 5′	N
3	Bayonet	59° 56′	110° 18′	N
4	Bocquene	59° 28′	111° 7′	N
5	Burstall	59° 20′	110° 11′	N
6	Cold	54° 32′	110° 2′	?
7	Colin	59° 34′	110° 8′	N
8	Daly	59° 37′	110° 50′	N
9	Darwin	59° 18′	111° 1′	N
10	Dawson	59° 52′	110° 27′	N
11	Fletcher	59° 7′	110° 50′	N
12	Gregoire	56° 29′	111° 11′	N
13	Lake Athabasca	59° 15′	110° 30′	?
14	Leland	59° 54′	111° 2′	N
15	Myers	59° 41′	111° 15′	N
16	Ryan	59° 10′	111° 3′	N
17	Unnamed 1	59° 48′	110° 47′	N
18	Unnamed 2	59° 13′	110° 33′	N
19	Winnifred	59° 14′	110° 24′	N
20	Wylie	59° 19′	110° 23′	N