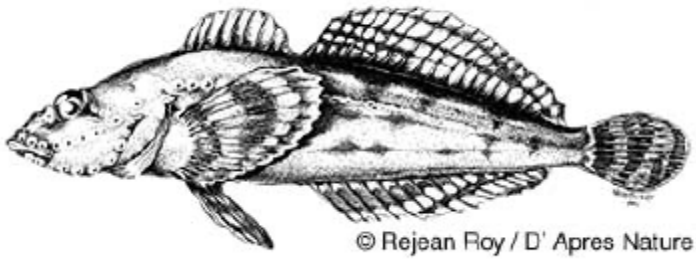
PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Cultus Pgymy Sculpin (*Cottus sp.*) in Canada

Cultus Pygmy Sculpin



February 2007

Fisheries and Oceans Canada
Pêches et Océans Canada
Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003 and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/).

Recovery Strategy for the Cultus Pygmy Sculpin (*Cottus sp.*) in Canada (PROPOSED)

February 2007

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Additional copies:

Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/)

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DECLARATION

The recovery strategy for the Cultus pygmy sculpin has been prepared in cooperation with the jurisdictions described in the Preface. Fisheries and Oceans Canada has reviewed and accepts this document as its recovery strategy for the Cultus pygmy sculpin as required under the *Species at Risk Act* (SARA). This recovery strategy also constitutes advice to other jurisdictions and organizations on the recovery goals, approaches and objectives that are recommended to protect and recover the species.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. In the spirit of the National Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans invites all Canadians to join Fisheries and Oceans Canada in supporting and implementing this strategy for the benefit of the species and Canadian society as a whole. Fisheries and Oceans Canada will support implementation of this strategy to the extent possible, given available resources and its overall responsibility for species at risk conservation. Implementation of the strategy by other participating jurisdictions and organizations is subject to their respective policies, appropriations, priorities, and budgetary constraints.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new information. The Minister of Fisheries and Oceans will report on progress within five years.

This strategy will be complemented by an action plan that will provide details on specific recovery measures to be taken to support conservation of the species. The Minister of Fisheries and Oceans will take steps to ensure that, to the extent possible, Canadians interested in or affected by these measures will be consulted.

RESPONSIBLE JURISDICTIONS

Under the Species at Risk Act, Fisheries and Oceans Canada is the responsible jurisdiction for the Cultus pygmy sculpin. The Province of British Columbia also cooperated in the production of this recovery strategy.

AUTHORS

DFO and the Province of British Columbia cooperated in the development of this recovery strategy. A recovery team was assembled to provide science-based recommendations to government with respect to the recovery of Cultus pygmy sculpin. Members of the National Recovery Team for Cultus pygmy sculpin are listed below:

Recovery Team Members
Jordan Rosenfeld, MoE, (co-chair)
Dan Sneep, DFO, (co-chair)

Todd Hatfield, Solander Ecological Research, (coordinator)
Don McPhail, UBC
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Dolph Schluter, UBC
Eric Taylor, UBC

ACKNOWLEDGMENTS

Fisheries and Oceans Canada and the Province of British Columbia are grateful to the technical experts involved in drafting this strategy, for their time and effort in attending meetings and reviewing the document. Financial support for the development of the recovery strategy was provided by the Habitat Conservation Trust Fund and the Province of British Columbia. This strategy is based on an initial draft by Sue Pollard, Ministry of Environment, Victoria.

STRATEGIC ENVIRONMENTAL ASSESSMENT

In accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*, the purpose of a Strategic Environmental Assessment (SEA) is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally-sound decision making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Cultus pygmy sculpin. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. Refer to the following sections of the document in particular: Description of the species' habitat and biological needs, ecological role, and limiting factors; Effects on other species; and the recommended approaches for recovery.

RESIDENCE

SARA defines residence as: "*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*" **[SARA S2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry:
http://www.sararegistry.gc.ca/plans/residence_e.cfm

PREFACE

The Cultus pygmy sculpin is a freshwater fish, under the jurisdiction of the federal government. The Species at Risk Act (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered or threatened species The Cultus pygmy sculpin was listed as Threatened under SARA in June 2003. Fisheries and Oceans Canada – Pacific Region and the Province of British Columbia co-led the development of this recovery strategy. The proposed strategy meets SARA requirements in terms of content and process (Sections 39-41).

EXECUTIVE SUMMARY

The Cultus pygmy sculpin was first identified in 1934 and most of what is known about it comes from a single paper, published by Ricker in 1960. It was described as a dwarf form of the coastrange sculpin, *Cottus aleuticus*. The Cultus pygmy sculpin shares many physical features of the coastrange sculpin and of sculpins in general, but there are also important differences in morphology and ecology, most importantly small body size, retention of larval features, and a limnetic existence. Observed diets of plankton corroborate the findings of limnetic life history, but other details of habitat use are not known.

There are large data gaps for this species including basic biology (e.g., life history, habitat use, reproduction), trends in abundance, and taxonomic status. The most significant data gap for Cultus pygmy sculpin is its taxonomic status, since its legal status under SARA is dependent on its status as a designatable unit. The species' status will be reviewed by COSEWIC in 2008.

A variety of factors potentially threaten Cultus pygmy sculpin, but most are poorly understood. The primary threats are introduction of exotic fish species and impacts associated with urbanization of the watershed. Current and historic data are lacking for quantity and quality of Cultus pygmy sculpin habitat, so specific trends in habitat availability are unknown. Comparisons of limnological information from 2001 with that collected in the 1930s and 1960s suggest that Cultus Lake limnetic habitat has changed little over the past 65 years, despite a considerable increase in public use of the lake and adjacent lands.

This recovery strategy focuses on the goal of ensuring the long-term viability of Cultus pygmy sculpin, and offers a variety of approaches to attain this goal. The priority actions are to clarify taxonomic status, collect information on life-history and habitat associations, fill other data gaps that inhibit conservation of the species, and to delineate critical habitat in the wild. Activities aimed at protecting and enhancing habitats of other species of fish and wildlife (notably the endangered sockeye population in Cultus Lake) may benefit Cultus pygmy sculpin.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of Assessment: November 2000
Scientific Name: *Cottus* sp.
Common Names: Cultus pygmy sculpin
COSEWIC Status: Threatened
Reason for Designation: Endemic to British Columbia, this species is restricted to one small lake, which is in an area subject to industrial and urban development. The species is also preyed on by salmonids co-existing in the lake.
Canadian Occurrence: British Columbia
COSEWIC Status History: Designated Special Concern in April 1997. Status re-examined and designated Threatened in November 2000. Last assessment based on an existing status report.

1. DESCRIPTION OF THE SPECIES

1.1 General Biology

Sculpins are members of the Cottidae, a family with more than 300 species (Scott and Crossman 1973; ITIS 2006). They are bottom-living, primarily marine fishes of arctic and temperate waters of the Northern Hemisphere (Scott and Crossman 1973). Sculpins are distinguished by a large head and heavy body; the body tapers from head to a relatively narrow caudal peduncle (Scott and Crossman 1973). The genus *Cottus* is widely distributed in freshwater (Scott and Crossman 1973). Species of freshwater sculpin are generally less than 18 cm in length, lack a swim bladder and are usually benthic (Heard 1965; Scott and Crossman 1973).

The Cultus pygmy sculpin (Figure 1) was first identified in 1934 and most of what we know about it comes from a single paper, published by Ricker in 1960. Ricker (1960) described this taxon as a dwarf form of the coastrange sculpin, *Cottus aleuticus*, which has pelagic larvae but adopts a benthic habit after about 32 to 35 days (Krejsa 1965 cited in McLarney 1968). The Cultus pygmy sculpin shares many physical features of the coastrange sculpin and of sculpins in general, but there are also important differences in morphology and ecology, most importantly small body size, retention of larval features, and a limnetic existence. The Cultus pygmy sculpin retains larval features (suggesting neotenic evolution), and has a number of adaptive traits characteristic of a limnetic existence, rather than the benthic habits typical of sculpins. These features include reduced bone density, enlarged head pores and an increase in subcutaneous lipids (Ricker 1960; McPhail and Carveth 1992; Cannings and Ptolemy 1998). Observed diets of plankton corroborate the findings of limnetic habits (Ricker 1960). Details of habitat use are not known.

Cultus pygmy sculpin and *C. aleuticus* differ in size, meristic traits, and overall shape (Taylor 2006). Typical length for the Cultus pygmy sculpin is 2.9 to 4.5 cm with a maximum observed length of 5 cm. This compares to a typical range of 5 to 10 cm for adult coastrange sculpin. Based on size-frequency analysis, Ricker (1960) suggests Cultus pygmy sculpin typically live a maximum of five years.

It is generally assumed that Cultus pygmy sculpin reproduce in a manner similar to *C. aleuticus*, which lay egg masses under stones that are then guarded by males. Based on frequency of

observations of gravid females, Ricker (1960) suggests that most Cultus pygmy sculpin begin to breed in their third year, with spawning beginning in late May or early June, peaking in late June through July, and tapering until early September. Spawning behaviours and habitats are not known, but spawning apparently does not occur in tributary streams or in shallow littoral areas (Ricker 1960). Some tributaries to Cultus Lake dry up in the summer and are therefore not available as spawning and incubation habitat.

The taxonomic status of Cultus pygmy sculpin is currently undetermined, a common problem with post-glacial taxa in British Columbia. The form may be derived and reproductively isolated from *C. aleuticus* and may be a distinct biological species (D. McPhail, pers. comm.). Additional studies are required to determine the taxonomic status of Cultus pygmy sculpin relative to *C. aleuticus*.

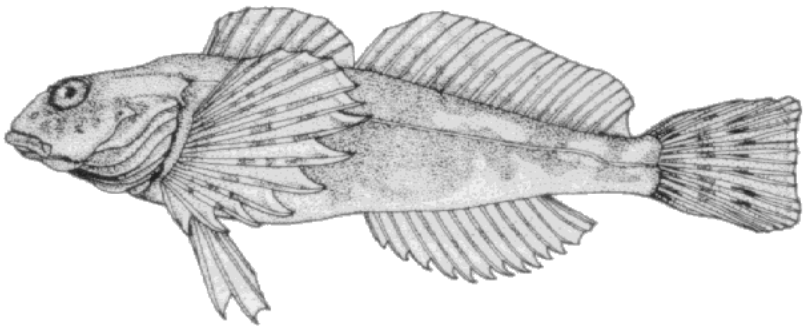

Figure 1. Drawing of coastrange sculpin, *Cottus aleuticus*, a close relative of Cultus pygmy sculpin.

1.2 Distribution

The Cultus pygmy sculpin is an extreme endemic. It is found only in Cultus Lake, British Columbia (Figure 2). Cultus Lake drains via Sweltzer Creek into Vedder River, a tributary of the Lower Fraser River mainstem approximately 112 km upstream of its confluence with the Strait of Georgia. No other populations have been documented in BC although a similar form has been observed in Lake Washington, WA (Larson and Brown 1975), and is believed to have evolved independently (D. McPhail, pers. comm.). There has been no systematic search for additional populations similar to those in Cultus and Washington lakes. However, fisheries surveys of lakes have occurred frequently in the past and would likely have detected limnetic coastrange sculpins if they were moderately widespread beyond these locations.

Distribution of Cultus pygmy sculpin within Cultus Lake is not known in detail, but the species is described as a limnetic form that lives primarily within the pelagic zone of the lake (Ricker 1960). It has been caught regularly in offshore, midwater trawls during enumeration studies of sockeye juveniles, and it is a common prey item of char in the lake, which inhabit offshore areas of the lake (DFO unpublished data; Ricker 1960). During extensive trapping and shore seining Cultus pygmy sculpin were not observed in shallow littoral areas or in tributary streams (Ricker 1960). Cultus pygmy sculpin have not been observed reproducing. Since coastrange sculpin (the species from which Cultus pygmy sculpin are assumed to have been derived) lays eggs under rocks in streams, it seems likely that Cultus pygmy sculpin also use benthic substrates for egg laying.

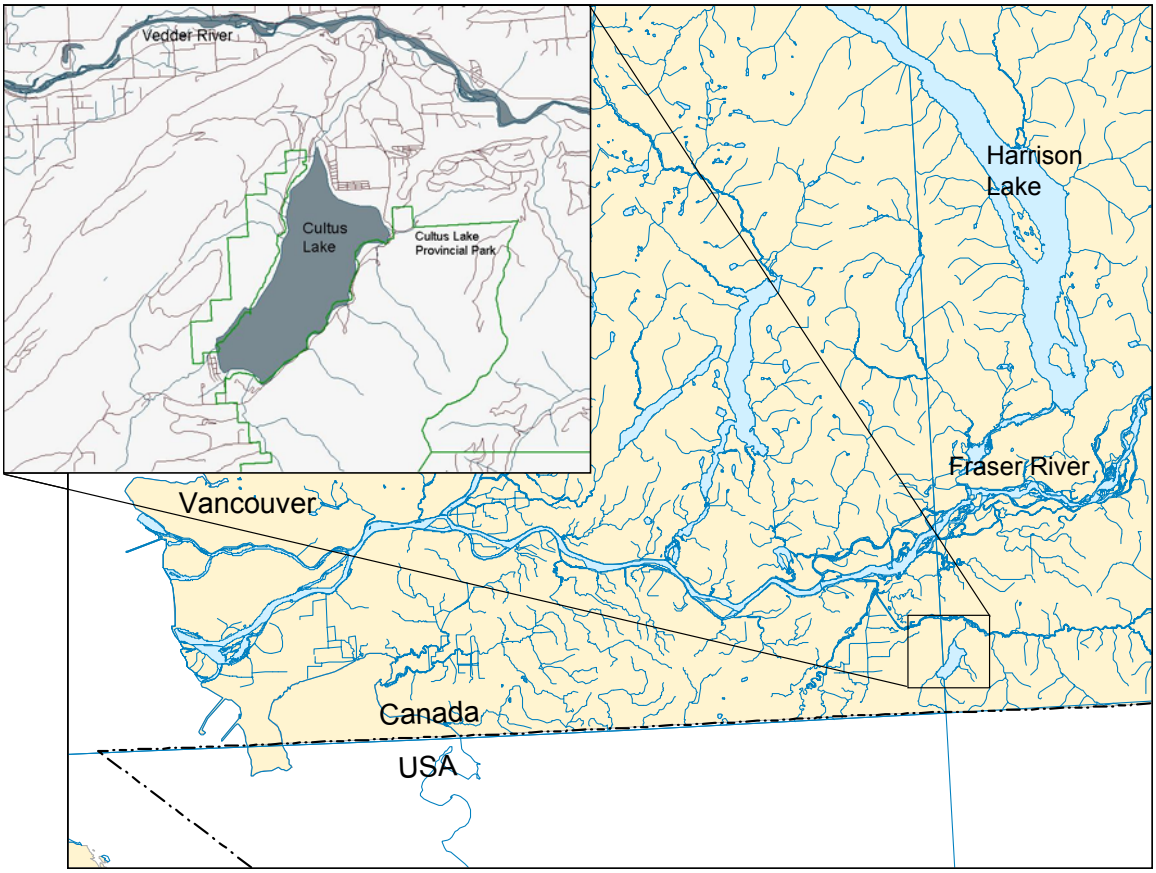

Figure 2. Distribution of Cultus pygmy sculpin. (Map base obtained from Ministry of Energy, Mines and Petroleum Resources, **http://www.em.gov.bc.ca/mining/Geolsurv/MapPlace/themeMaps.htm**). The detail map indicates roads, tributaries and parks.

1.3 Abundance

There has been little research done on Cultus pygmy sculpin, and at no time has an empirical population estimate been made. Ricker (1960) described the species as abundant in deep waters of Cultus Lake. It was regularly captured during early work and was a frequent prey item in the stomachs of char (Ricker 1960). Sampling for Cultus pygmy sculpin has generally not occurred in shallow or deep littoral areas. Cultus pygmy sculpin have been regularly caught in trawls conducted during the last 30 years to enumerate Cultus Lake sockeye. At no time have the counts of Cultus pygmy sculpin been high (usually < 100 individuals), but counts have fluctuated considerably within and among years (Taylor 2006). Available data indicate a slight downward trend in abundance, but since data come from efforts to enumerate juvenile sockeye the data are considered inappropriate for quantitative trend analysis for Cultus pygmy sculpin. In summary, no firm conclusions can be drawn with the current data.

1.4 Importance to People

The Cultus pygmy sculpin has special scientific and educational value due to its extreme endemism and unique life history. The species has no commercial value, except indirectly as prey for salmonids that contribute to recreational and commercial fisheries. Cultus pygmy sculpin is a member of the native fauna, with its own intrinsic value and ecological role.

2. DESCRIPTION OF NEEDS OF THE SPECIES

2.1 Ecological Role and Limiting Factors

Ecological Role.— After hatching, Cultus pygmy sculpin apparently exist solely as a limnetic form, foraging for zooplankton in the pelagic areas of the lake. They are common items in the diet of char, with as many as 100 Cultus pygmy sculpin occurring in the stomach of a single predator (Ricker 1960). They are a less common diet item of other fish species, but have been found in the stomachs of cutthroat trout and coho salmon (Ricker 1960).

Limiting Factors.— The environmental factors that limit abundance of Cultus pygmy sculpin have not been well-studied. We assume that populations are affected by competition, predation, habitat quantity and quality, and food availability though the relative effect of each is not known. It is evident that to persist over the long term, all species require sufficient rearing and spawning habitat, a healthy food base, and predation or exploitation rates that are less than the replacement rate of the population.

2.2 Habitat Needs

Cultus pygmy sculpin is found only in Cultus Lake, a small coastal lake that is part of the Vedder-Chilliwack drainage in the lower Fraser Valley (Figure 2). Cultus Lake has a surface area of 6.3 km^2, a drainage basin of 65 km^2, maximum depth of 41.8 m, mean depth of 32 m and elevation of 47 m (Freshwater Fisheries Society of BC 2006). The lake is steep-sided and has a littoral area (defined here as the area where sufficient light penetrates to the bottom to support photosynthesis) of only 12% of total surface area (COSEWIC 2003). Cultus Lake is monomictic, with strong thermal stratification in the warmer months, and wind- and temperature-driven vertical mixing in the cooler months. Surface temperatures exceed 20˚ C in summer, whereas temperatures below the thermocline average less than 7˚ C in the fall (COSEWIC 2003). Water clarity is fairly high, with average Secchi depths of 10 to 11 m. Lake water is alkaline, well-buffered, with high conductivity, total dissolved solids and nutrient levels (COSEWIC 2003).

Relative to other coastal lakes in British Columbia, Cultus Lake has a high primary production rate and zooplankton are abundant (COSEWIC 2003). Food levels in Cultus Lake for juvenile sockeye (a planktivore) have been described as “exceptional” (COSEWIC 2003). Numerous other fish species are present in Cultus Lake (Freshwater Fisheries Society of BC 2006) including char (bull trout and/or Dolly Varden), chinook salmon, chum salmon, coho salmon, coastal cutthroat trout, kokanee, lake whitefish, largescale sucker, longnose dace, mountain whitefish, northern pikeminnow, peamouth chub, pink salmon, prickly sculpin, rainbow trout, redside shiner, sockeye salmon, steelhead, threespine stickleback, and western brook lamprey.

Spawning habitat requirements of Cultus pygmy sculpin are not known in detail. It is assumed that the species uses deep littoral areas for spawning, but natural spawning has not been observed. With the likely exception of spawning and incubation, Cultus pygmy sculpin appear to spend the majority of time in the limnetic zone of the lake where they forage on plankton. The species likely depends on productive plankton resources, but precise habitat requirements are not known.

2.3 Residence

SARA defines residence as: “a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating” [SARA S2(1)]. The concept of residence applies readily to fish species that construct nests where eggs are deposited and fertilized, and subsequently rear to hatching. Based on the known biology of coastrange sculpin, which lay egg masses under stones that are then guarded by males, it is generally assumed that Cultus pygmy sculpin have similar reproductive behaviour. At present this is not confirmed, as reproduction has not been observed and the distribution and utilization of suitable spawning habitats within Cultus Lake is not known and requires additional study. However, it should be noted that there is reasonable likelihood that the concept of residence applies to the spawning and incubation life stage of this species.

3. THREATS

Given their extremely restricted distribution, Cultus pygmy sculpin are especially vulnerable to local threats. Much information is lacking on the general biology of the species, which makes a thorough threats assessment difficult. Nevertheless, it is possible to identify general threats, and these are discussed below. Quantifying these threats is not possible until more is known about the biology of Cultus pygmy sculpin.

Exotic Species.— Non-native species cause a range of biological impacts, from subtle to spectacular and globally are the primary driver of biotic change in freshwater systems (Sala et al. 2000). Types of biological impact include extinction, altered abundance and distribution, altered food webs, changes in community interactions through species additions and deletions, and altered evolutionary trajectories. When impacts occur to an extreme endemic, they are particularly worrisome since exotic species are exceedingly difficult to control or eradicate once they become established.

The exotic aquatic plant, Eurasian water milfoil (*Myriophyllum spicatum* L.), was first noted in Cultus Lake in 1977 and has since spread throughout the lake. By 1991 dense mats of milfoil covered 22 ha of the lake’s 74 ha littoral area (Truelson 1992). Milfoil has been identified as a significant threat to sockeye, which spawn on beaches of Cultus Lake (COSEWIC 2003). Water milfoil can also cause changes to native vegetation and macroinvertebrate communities, reduced area of shallow water habitat, depleted oxygen levels, and restricted fish swimming and forage potential (Keast 1984; Engel 1995). Milfoil beds provide shelter for juvenile northern pikeminnow (Schubert et al. 2002), a key predator in Cultus Lake.

Adult pygmy sculpin forage only in pelagic waters, and it is unclear whether milfoil has affected this habitat or altered predator-prey relationships in Cultus Lake. Cultus pygmy sculpin likely use deep littoral areas for spawning and incubation, and it is not known if they historically used littoral areas now infested with milfoil.

Other exotic species have been identified as potential concerns, notably black bullhead (*Ameiurus melas*), brown bullhead (*Ameiurus nebulosus*), pumpkinseed (*Lepomis gibbosus*), smallmouth and largemouth bass (*Micropterus salmoides* and *M. dolomieui*) and yellow perch (*Perca flavescens*). These species have affected other fish species when introduced to new waterbodies and are believed to have the potential to affect abundance and distribution of Cultus pygmy sculpin through predation or competition. These species do not currently occur in Cultus Lake, but their presence and their general spread through the area are of concern.

Altered Predation Rates.— Cultus pygmy sculpin are a key prey item for char, and potentially for other species in Cultus Lake. The majority of sculpin samples collected to date have been from gut contents of char (Ricker 1960). Other piscivorous species in the lake include coho, coastal cutthroat trout, rainbow trout and northern pikeminnow. However, these latter species tend to consume fewer Cultus pygmy sculpin than do Dolly Varden (Ricker 1960). It is assumed that the pygmy sculpin has evolved in the presence of this native predator community. However, there is a concern that predation rates could be altered through stocking or enhancement (especially of salmonids), changes in habitat, or introduction of non-native piscivorous fish species. The extent of this threat is difficult to gauge. Although Cultus Lake was stocked periodically from 1919 to 1987 with various salmonid species (Freshwater Fisheries Society of BC release records), it has not been stocked recently and stocking is not currently under consideration for most species. Future stocking could potentially result in greater predation pressure, depending on the species. As part of recovery efforts for Cultus sockeye, supplementation of fry and smolts has been occurring both in the lake and the outlet creek. Releases in the lake in 2006 exceeded 340,000 fish, but this number is still likely considerably below historic natural production.

Water Use.— A water licence query (http://www.elp.gov.bc.ca:8000/pls/wtrwhse/water_licences.input Land and Water BC 2006) lists only two water licences on Cultus Lake, with an additional 50 licences on tributaries. The licences on Cultus Lake sum to 7.14 million $m^3 \cdot yr^{-1}$. Assuming a lake area of 6.3 km^2, this translates into a little more than 1 cm of water elevation. Water licences on tributaries sum to about 10.83 million $m^3 \cdot yr^{-1}$, of which 6.81 million $m^3 \cdot yr^{-1}$ is on inflow and the remainder on outflowing tributaries. The licensed amount on inflowing tributaries translates into little more than 1 cm in lake level elevation. There are likely unlicensed water users in the Cultus watershed, though they likely consume less water than licensed users.

This brief review of water licences suggests that the majority of the annual water level fluctuation in Cultus Lake is due to evapotranspiration and variable timing of inflows and outflows. Water use associated with agriculture, industry and domestic use has impacted tributaries (COSEWIC 2003), but Cultus pygmy sculpin are a limnetic species and do not apparently use habitats in the tributaries. The threats to Cultus pygmy sculpin posed by water consumption is therefore deemed to be minor. Adding strength to this conclusion is the fact that water use was not identified as a threat to Cultus sockeye, another pelagic fish species in the lake. However, since *C. aleuticus* spawn in tributaries there is some possibility that pygmy sculpin also use tributary streams for spawning. If this is the case, flows in the tributaries may be important. This highlights the importance of identifying spawning habitat for Cultus pygmy sculpin.

Water Quality.— Water quality issues have not been raised as a severe threat to this point, although there are several concerns. Point and non-point source pollution has the capacity to affect water quality and to degrade aquatic habitat. Poorly-performing septic systems, inputs from agriculture and domestic fertilizers, sedimentation from land-based activities, and poor groundwater quality have been identified as concerns and have the potential to degrade lake water to some degree (Schubert et al. 2002). Inputs from water-oriented recreation have also been raised as a concern (see below). Water quality was assessed as excellent in 1996 (MWLAP 1996), and comparisons of recent and historic limnological information suggest that the lake's pelagic habitat has changed little over the last 65 years (COSEWIC 2003). It is unclear if existing levels of pollution negatively affect pygmy sculpin, but they are not identified as a substantial concern at this time. This threat may require additional assessment in the future as related information becomes available.

Water-oriented Recreation.— Cultus Lake is one of the most heavily used lakes in BC, particularly through the summer months. The dominant activities on the lake are power boating and swimming, but virtually all water activities are popular. The shoreline has been affected by the construction of wharves and piers, mainly in the Lindell Beach area (COSEWIC 2003). In addition, aquatic and shoreline vegetation have been removed and sand added to create a beach in the Sweltzer Creek area (COSEWIC 2003). Watercraft can be a source of pollutants, through gas and oil spills. Movement of boats among watersheds is the suspected source of introduced Eurasian milfoil (COSEWIC 2003), and is potentially a vector for other organisms, including disease organisms.

The various activities associated with water-oriented recreation have primarily altered shallow littoral areas, but it is unclear how such changes affect the pelagic habitat used by Cultus pygmy sculpin. Comparisons of recent and historic limnological information suggest that the lake's pelagic habitat has changed little over the last 65 years (COSEWIC 2003). Water-oriented recreation is not identified as a substantial threat to Cultus pygmy sculpin at this time.

Recreational fishing for any species is not common on Cultus Lake, although in recent years there have been annual derbies to cull Northern pikeminnow (COSEWIC 2003). Despite low effort, angler activity is a concern because anglers are a common vector of introduction of exotic fish. For example, Schade and Bonar (2005) found that one in four fish sampled in the 12 western US states were non-native, and the most common non-natives had been introduced for angling.

Land Use.— Some land-based activities have the capacity to alter aquatic habitat directly (e.g., impacts to riparian habitat, alteration of run-off rates or water storage capacity in headwaters) or indirectly (e.g., changes to water quality through introduction of pollutants). The Cultus Lake watershed has undergone development associated with recreational, residential, agricultural forestry, and industrial land uses. Ninety-two percent of the shoreline has been set aside for recreation purposes and occurs either within Cultus Lake Provincial Park or Cultus Lake Municipal Park, including camping and day use areas and three large swimming areas (Schubert et al. 2002). An active gravel mine is operating on Parmenter Road and a proposed expansion involving a rock quarry and gravel crushing and screening operation is planned in the vicinity of Hatchery Creek (Schubert et al. 2002). Agriculture has played a significant role in the local economy in the past, however, no agriculture occurs adjacent to the lake. Logging occurs in the upper reaches of the Frosst watershed (Schubert et al. 2002), however, no logging has occurred in the immediate vicinity of the lake since 1946 and none is planned (Balanced Environmental Services Inc. 2004). Residential development is restricted to three small areas around the lake (Schubert et al. 2002). In summary, several land-based activities have the potential to increase sediment and nutrient loads to Cultus Lake or directly affect littoral habitat, but it is unclear if specific impacts have occurred to pelagic habitats occupied by Cultus pygmy sculpin, and water quality has been assessed as excellent (see section above on water quality).

Climate Change.— Scientific evidence clearly indicates that the climate is changing and animal and plant distributions are responding to these changes (Parmesan and Yohe 2003). Since climate affects precipitation, water flow and temperature in many ways, it may also affect Cultus pygmy sculpin abundance and distribution. This threat is of concern; however, at present the topic is considered beyond the scope of this recovery strategy. The threat may be assessed and addressed at future stages of recovery planning for Cultus pygmy sculpin.

4. HABITAT TRENDS

Current and historic data are lacking for quantity and quality of Cultus pygmy sculpin habitat, so specific trends in habitat availability are unknown. Comparisons of limnological information from 2001 with that collected in the 1930s and 1960s suggest that Cultus Lake limnetic habitat has changed little over the past 65 years, despite a considerable increase in public use of the lake and adjacent lands (COSEWIC 2003). Land use practices and other human activities have likely caused some decline in habitat quantity and quality, but the magnitude of change appears to be greatest in shallow littoral areas. The impact of these changes on Cultus pygmy sculpin is not known. Below we discuss general trends in land and water use in the watershed.

Cultus Lake has been a popular recreation destination dating back to the late 1800s. The watershed is heavily developed for recreation, residential and agricultural uses, and virtually all developable shoreline is developed to some extent (Ministry of Lands, Parks & Housing 1980). The remaining shoreline is steep-sided and inaccessible by road. Cultus Lake Provincial Park was formed in 1948, and today contains 656 ha on both east and west shores of Cultus Lake. In 1969, International Ridge Recreation Area was established, totalling 2080 ha encompassing all of the land between the eastern boundary of the park and the height of land. Cultus Lake Municipal Park is located on the north shore of the lake and covers about 259 ha. The park was formed under provincial statute in 1932 and is owned and operated by the City of Chilliwack.

Cultus Lake Provincial Park is the most popular destination area in the Lower Mainland and ranks either second or third in the province for total campground visitation, depending on the weather during a given summer (Ministry of Lands, Parks & Housing 1980). Park use is heavy and sustained throughout the summer, resulting in capacity crowds each weekend and on most midweek days during fine weather (Ministry of Lands, Parks & Housing 1980). Historic park use has been proportional to population growth in the region, with approximately 1.5 million park visitors per year at present (COSEWIC 2003). Both parks are operated for intensive water and beach activities. The foreshore and upland areas of the park continue to be developed, primarily for recreation and tourism (Ministry of Lands, Parks & Housing 1980; Cultus Lake Parks Board 2006).

Activities such as hunting and forest harvest are permissible within the Recreation Area, but logging is unlikely throughout much of the watershed due to steep and unstable soils (Ministry of Lands, Parks & Housing 1980). Present forest cover on the east side of the lake is predominantly second growth Douglas fir and maple, a result of logging prior to park status. At present, logging occurs only in the headwaters of Frosst Creek in the United States (COSEWIC 2003). The impacts to Cultus Lake from forest harvesting are probably minor (COSEWIC 2003).

Permanent housing is restricted to small areas on the northeast and northwest sides of the lake and at Lindell Beach at the south. Farming occurs near the south end. Activities with direct impacts to the lake's littoral zone include the removal of aquatic and riparian vegetation, shoreline alteration and physical encroachment by wharves and piers (COSEWIC 2003). Activities that impact tributary streams include channelization and the removal of riparian vegetation (COSEWIC 2003). Of special concern is the potential degradation of the quality of the lake's surface and ground water inputs as a result of seepage from septic systems, agricultural runoff and the domestic use of fertilizers (COSEWIC 2003).

The biggest observable change in lake habitat occurred following the introduction of Eurasian milfoil (*Myriophyllum spicatum*) in the late 1970s. From 1977 to 1991, its distribution in the

littoral zone nearly doubled and shifted from mainly sparse patches to dense mats (COSEWIC 2003). By 1991, it covered 22 ha of the lake's 74 ha littoral area (Truelson 1992); subsequent distributions have not been monitored. It is not known if Cultus pygmy sculpin historically used littoral areas now infested with milfoil.

5. HABITAT PROTECTION

There are no habitat protection provisions specifically for Cultus pygmy sculpin, however, the species likely benefits from existing legislation (*Fisheries Act*) that protects fish habitat generally. Approximately 92% of the shoreline of Cultus Lake is within Cultus Lake Provincial Park and Cultus Lake Municipal Park. These parks extend to upland areas (Figure 2).

6. CRITICAL HABITAT

Identification and protection of "critical habitat" is vital for management of species at risk. While defining critical habitat is one of the most challenging aspects of species management, it is vital to ensuring a species' long-term survival. This rationale is central to endangered species legislation in general, and specifically to the *Species at Risk Act* (SARA), where critical habitat is defined as:

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

The need to designate and protect critical habitat is clearly recognized by scientists, resource managers, and the general public. Despite its complexity, the core issue is the same for all species: to determine the role of habitat in population limitation, and to answer the question, "How much of the different habitats is required to maintain viable populations of the species?"

6.1 Identification of the Species' Critical Habitat

At this point, it is possible to indicate some habitats that are likely important. For example, if it is true that Cultus pygmy sculpin nest in the deep benthic areas of Cultus Lake, some or all of this habitat could qualify as critical. Cultus pygmy sculpin use the limnetic areas of the lake during the majority of their life and likewise some or all of this habitat could qualify as critical. Clearly, these habitats, or portions of them, will feature in the definition of the species' critical habitat. However, due to a number of information gaps, we are unable to provide a defensible demarcation of critical habitat at this time.

6.2 Schedule of Studies

Very little is known about Cultus pygmy sculpin. to the following schedule of studies should allow delineation in the wild of critical habitat for Cultus pygmy sculpin. A more detailed description of each task will be developed in the Action Plan.

Habitat Use.— The first task is to develop a better understanding of habitat use by different life stages of Cultus pygmy sculpin. A description of the basic habitat associations for each life stage is a core information need for defining critical habitat (Rosenfeld and Hatfield 2006), in particular spawning habitat of Cultus pygmy sculpin. There is a general understanding of habitat types used by Cultus pygmy sculpin, but a more precise understanding is essential.

Where possible, habitat requirements will be defined in terms of microhabitat components such as depth, substrate type and condition, physical water characteristics, etc.

Habitat Availability.— The second task is to review historic and current habitat availability. Information on the extent and distribution of different habitat types available to a species is also a key component of critical habitat delineation. Studies are required that describe abundance and distribution of different habitats in the wild. Where possible, historic habitat availability should be explored to help provide context for the present condition and the final delineation of critical habitat.

Population Abundance.— Clearly defined population recovery targets for each life stage are integral to the identification of critical habitat because the quantity of habitat designated as critical must be related to a population benchmark (Rosenfeld and Hatfield 2006). This task is to review historic and current population abundance, as part of the process of setting recovery targets. Both the current and historic population abundance provide meaningful context for the recovery target, though we recognize that historic abundance may be difficult to ascertain with accuracy. It may only be possible to qualitatively assess historic abundance of Cultus pygmy sculpin.

Recovery Targets.— Setting recovery targets may require several steps and the collection of several pieces of information. Recovery targets may be based on rules of thumb (e.g., Thomas 1990; IUCN 2001; Reed et al. 2003), numeric analyses such as population viability analysis (PVA; Morris and Doak 2002), or a combination of techniques. For organisms such as Cultus pygmy sculpin, where relatively little information exists and additional information takes a long time to collect, it may be beneficial to use targets based on rules of thumb. However, it is nevertheless valuable to examine such targets by assessing key population parameters (e.g., survival and fecundity) and to undertake specific population modeling (e.g., elasticity analysis, see Gross et al. 2002) to explore which life stages are most limiting to sculpin abundance. It will be necessary to set targets for each major life stage (Rosenfeld and Hatfield 2006).

Relationship Between Habitat and Abundance.— Designation of critical habitat requires quantitative relationships between habitat and abundance because these relationships are needed to establish the amount of habitat required to achieve a population recovery target (Rosenfeld and Hatfield 2006). Developing such a relationship is not a straightforward task and may need to rely, at least in part, on expert judgement.

Define Critical Habitat.— The final step in delineating critical habitat is to use population targets and relationships between habitat types and abundance to determine how much of the different habitats are required to maintain a viable population of Cultus pygmy sculpin, and to then identify the specific locations of these habitats in the wild.

6.3 Examples of Activities That Are Likely to Result in Destruction of Critical Habitat

Until critical habitat is formally delineated it is not possible to provide specific guidance on which activities are most likely to destroy critical habitat, other than in very general terms. For example, activities that threaten deep littoral areas or those that alter the productivity of limnetic areas may have negative impacts on Cultus pygmy sculpin. The more general threats to some of the important habitat types for Cultus pygmy sculpin are discussed in Section 3.

RECOVERY

7. RECOVERY GOAL

The recovery goal for Cultus pygmy sculpin is to ensure their long-term viability of the population in the wild by protecting individuals and their habitats. It is highly likely that Cultus pygmy sculpin will remain at some risk due to its extremely limited distribution.

8. RECOVERY OBJECTIVES

Recovery objectives are stated as follows:

1. Foster awareness of Cultus pygmy sculpin and its conservation status. Encourage active local involvement in stewardship and habitat protection.
2. Maintain, and where possible enhance, the ecological integrity of habitat for Cultus pygmy sculpin.
3. Increase scientific understanding of Cultus pygmy sculpin through additional investigation of its natural history, critical habitat and threats to its persistence.

9. APPROACHES TO MEETING RECOVERY OBJECTIVES

The general approach recommended in this recovery strategy includes:

- establish and support stewardship initiatives,
- undertake specific research activities to fill knowledge gaps and clarify threats,
- delineate and protect key habitats,
- minimize impacts from land and water use, and
- design and implement sound monitoring programs.

A description of the recommended approaches and actions is presented in Table 1. These actions will be further detailed in the Action Plan,with the participation of a Recovery Implementation Group (RIG). Further plans and decisions may require involvement of stakeholders and participants including government agencies, First Nations, private land owners, industry and local stewardship groups.

Table 1. Prioritized strategies and recommended actions for the recovery of Cultus pygmy sculpin.

Priority[1]	Strategy	Actions	Performance Measure [2]
Necessary	Establish and support a Recovery Implementation Group (RIG) for Cultus pygmy sculpin.	1. Invite stakeholders and interested parties to participate in a RIG. 2. Encourage local governments to have membership or representation on RIGs to facilitate Recovery Action Plan communication and implementation. 3. Establish the RIG leadership (chair, facilitator, etc.), develop terms of reference, and obtain necessary funding to support RIG activities. 4. Participate in the development of an Action Plan, which is to be guided by the Recovery Strategy.	Has a RIG been established? Is the RIG adequately supported with funding and technical expertise? Has an Action Plan been developed? Is the RIG achieving the goals outlined in the Recovery Strategy?
Necessary	Assess taxonomic status of Cultus pygmy sculpin.	Undertake phylogenetic studies to clarify taxonomic status relative to *C. aleuticus*.	Has taxonomic status of Cultus pygmy sculpin been clarified?
Necessary	Address information gaps that inhibit conservation of Cultus pygmy sculpin.	Address key information gaps including: 1. habitat use and requirements, in particular spawning habitat. 2. life history information, in particular differences with *C. aleuticus*. 3. causes of mortality (e.g., temperature, pollutants, predation, siltation of incubation habitat, etc.). 4. limiting factors to population growth. 5. adult diets.	Are there key information gaps that inhibit conservation of Cultus pygmy sculpin?
Primary	Clarify threats to Cultus pygmy sculpin.	Undertake appropriate research to clarify threats, including: 1. Assess effects of land and water use. 2. Exercise caution (in favour of conservation) when planning/regulating/enforcing land development, water use and fisheries regulations.	Have threats been clarified and assessed? Are threats being mitigated?

[1] Priority has been assigned based on professional judgement into one of three groups, from highest to lowest: necessary, primary, secondary.
[2] Performance measures plot the progress toward meeting the stated objectives. The performance measures are presented here as questions, the answers to which can be plotted in time to monitor progress.

Priority[1]	Strategy	Actions	Performance Measure [2]
Primary	Conduct studies to help define critical habitat for Cultus pygmy sculpin.	Undertake necessary research to define critical habitat and to delineate it in the wild. See Section 6.2 for a list of necessary research activities.	Has critical habitat been defined for Cultus pygmy sculpin?
Primary	Develop a watershed-scale land use plan that identifies and protects key areas, and ensures that cumulative impacts of development in the watershed do not adversely impact key habitats.	RIG will work with stakeholders to ensure that watershed development plans for the drainage protect key habitats. This may include establishment of covenants on private lands, direct purchase of priority properties, and zoning to restrict development in key areas.	Have key areas in the watershed (i.e., those that are disproportionately important for maintaining habitat) been identified? Has a watershed plan that recognizes these habitats as important been developed? Have key habitats been effectively protected?
Primary	Develop and implement a long-term monitoring program.	Recovery Team and RIG to develop a monitoring program to assess population response to management activities or threats. Monitoring may include: • trends in abundance of Cultus pygmy sculpin and its prey species, • trends in habitat quantity and quality, • water quality, • land use, and • water use. Exercise care to ensure that census methods do not impact the population.	Have monitoring programs been implemented? How long has a monitoring program been in place? Is it effective? Is it a benign activity for the population? Is funding secure for the long term?
Primary	Establish water quality and water use objectives for Cultus Lake.	1. Current provincial water quality standards for the protection of aquatic life are likely appropriate guidelines for basic parameters of water quality (see http://srmwww.gov.bc.ca/risc/pubs/aquatic/interp/index.htm). 2. Assess the need for species-specific water quality objectives. 3. Communicate objectives to appropriate authorities and stakeholders 4. Assess the need for a comprehensive water management plan for Cultus Lake.	Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?

Priority[1]	Strategy	Actions	Performance Measure [2]
Secondary	Develop and implement an information and education plan that includes the following elements: 1. public education material regarding the species and the threats to its persistence, 2. presentation materials for public schools, and 3. educational signage for appropriate placement.	RIG to work with government agencies and educators to develop 1. educational material (e.g., an educational brochure, web-based material) to explain the general biology of the species, its biodiversity values and threats to its persistence. Consider developing material for project WILD < http://www.hctf.ca/wild/about.htm>. 2. educational material for use in public schools, particularly schools in the vicinity of Cultus Lake. 3. educational signage for placement at specific locations (e.g., road crossings, habitat enhancement projects, etc.). Obtain funding for sign construction and maintenance.	Have educational materials been produced? Has public perception and awareness been affected? How many classes have received educational presentations?
Secondary	Jointly develop land management strategies for crown and private lands.	Develop criteria for assessing effects of land developments on aquatic habitats and develop guidelines for good stewardship. For private lands, work with land owners to encourage good stewardship. Develop and implement Best Management Practices (BMP), as needed. Develop and use conservation covenants where useful.	Have land management criteria been developed? Is land development meeting the criteria? Have BMPs been developed and communicated? Is there compliance with BMPs?
Secondary	Develop sound protocols for scientific investigations (e.g., limit number of fish collected each year, etc.)	Recovery Team to work with government agencies to set boundaries for experimental work and collection activities. Note: SARA permits are required to legally collect and undertake research on a listed wildlife species.	Have scientific investigation protocols been set and communicated? Have they been implemented?

10. ANTICIPATED CONFLICTS OR CHALLENGES

Cultus pygmy sculpin are currently of little or no economic value, and this is unlikely to change. By contrast there are other public, private and commercial interests in the Cultus watershed. These interests include water extraction, roads, and recreation, residential and commercial property development. It is possible that mitigating threats to Cultus pygmy sculpin will conflict with some development pressures. Recovery of the species will therefore require continuous stewardship, effective decision-making, and specific research over the long-term. It is important to understand that many of the threats to Cultus pygmy sculpin can be reduced but not eliminated.

Stewardship – The present model for managing most species at risk relies on establishing community-based stewardship groups that will be responsible for implementing recovery actions in one or more watersheds. This model assumes that there is, over the long term, a pool of willing volunteers, sufficient funding to support the necessary management activities, and available technical expertise to support participants in the stewardship groups. The validity of these assumptions is not known.

Research – There are three areas that require immediate targeted research to overcome specific challenges: clarifying the taxonomic status of Cultus pygmy sculpin, defining critical habitat, and clarifying threats to aquatic habitat. A description of these needs is provided in Sections 6 and 13.

10.1 Potential Management Impacts for Other Species

Although Cultus pygmy sculpin are found only in a single watershed, the introduction of this species into other watersheds has not been put forward as a recommendation. It is also unclear whether introduction elsewhere is even possible, given that the specific habitat conditions for evolution of a pelagic sculpin appear to have occurred only twice (i.e., in Cultus Lake and Lake Washington).

It is unlikely that recovery efforts aimed at Cultus pygmy sculpin will have a negative effect on other fish or wildlife species indigenous to Cultus Lake. For example, the impact of Cultus pygmy sculpin on the abundance of resident and anadromous fish species is not known, but is not believed to be substantial. Numeric enhancement of the species is not being recommended, and protection of Cultus pygmy sculpin habitats will likely benefit other species too.

11. RECOVERY FEASIBILITY

The RENEW Recovery Handbook (National Recovery Working Group 2004) states that the recovery of a species has been achieved when a self-sustaining population can withstand stochastic events of a non-catastrophic nature. A species' recovery should be considered *feasible* if its long-term persistence in the wild can be practicably achieved.

Cultus pygmy sculpin are found only in Cultus Lake and there is no plan to purposely transplant them elsewhere in BC. Thus, their population will continue to be limited to a small area. Indeed, it is this extreme endemism that supports its current status and it is unlikely that this species will ever be downlisted. Recovery actions will be aimed at maintaining current habitat

conditions, monitoring the population, and undertaking specific research tasks. With the support of local governments, local industry and the public, recovery is deemed to be feasible.

As part of the SARA process, the competent minister must determine the feasibility of recovery for each species at risk. To help standardize these determinations current draft policy (Government of Canada 2005) poses four questions, which are to be addressed in each recovery strategy. These questions are posed and answered here.

1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?

Yes. Cultus pygmy sculpin naturally have a very restricted distribution. The population is believed to be self-supporting at present, although population status is unknown. Regardless of population abundance and trends the species will continue to be at risk due to limited geographic range.

2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?

Yes. Sufficient suitable habitat exists in Cultus Lake.

3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?

Yes. Controlling threats to Cultus pygmy sculpin is feasible, but rests more on social than technical considerations. For example, the primary threats are urban expansion, water management and general land use. Most threats, such as those from excessive water use and land development, can be managed with existing regulations, but may require consultation with stakeholders.

4. Do the necessary recovery techniques exist and are they demonstrated to be effective?

Yes. Special recovery techniques are not required for recovery of Cultus pygmy sculpin. What is required is effective management of current and future threats, which is believed to be entirely feasible. It should be stressed, however, that Cultus pygmy sculpin will likely always be very restricted in their distribution. As a result, they are unlikely to be downlisted to a lower risk category. Recovery efforts are best concentrated on controlling threats. There are no significant technical challenges in this regard.

12. RECOMMENDED APPROACH / SCALE FOR RECOVERY

This recovery strategy recommends the use of a single species approach (rather than an ecosystem approach) because it addresses a single taxonomic unit. However, recovery efforts for Cultus pygmy sculpin should be coordinated with those for Cultus sockeye, a salmonid stock listed as endangered (COSEWIC 2003). Juvenile sockeye are planktivores and occupy the same habitat as Cultus pygmy sculpin, so protection of limnetic habitats is likely to benefit both species.

Every effort should be made to provide input to management planning initiatives, actions, or policies, particularly land use planning for the local parks. Development must be approached such that cumulative impacts do not lead to significant changes in the ecology of Cultus Lake, which requires planning at the watershed scale and compliance with existing regulations and best management practices. It will be necessary to identify specific sites for protection or special management within the watershed.

13. KNOWLEDGE GAPS

Little is known about the ecology of Cultus pygmy sculpin, the environmental factors that affect abundance and distribution, and the threats to this species. Meeting conservation goals will require addressing several knowledge gaps. The gaps fall into three main categories, as outlined below.

Basic Biology

- Taxonomic status and phylogenetic relationships,
- Habitat use and requirements by life stage (e.g., population distribution within the drainage; differential use of particular tributaries), and in particular spawning habitat and how it differs from *C. aleuticus*.
- Which habitats are most likely to be limiting for different life stages,
- Life history information,
- Diets,
- Causes of mortality (e.g., temperature, pollutants, predation, siltation of incubation habitat, etc.),
- Factors limiting population growth.

Threat Clarification

- Status of key habitats and potential threats to these habitats,
- Effect of present and future human activities and prioritization of threats.

Population Abundance and Dynamics

- Current population abundance of Cultus pygmy sculpin,
- Natural population fluctuations of Cultus pygmy sculpin,
- Current and historic trends in abundance.

Basic knowledge of the natural history of this species is severely limited. Significant gaps exist with respect to taxonomic status relative to *C. aleuticus*, population demographics, critical habitat, and tolerance to changes in physical habitat.

14. ACTIONS ALREADY COMPLETED AND/OR UNDERWAY

Several recovery actions have been completed or initiated.

1. COSEWIC assessment and listing for the Cultus pygmy sculpin was completed in 2000.
2. COSEWIC re-assessment is currently underway.
3. Cultus pygmy sculpin are listed under SARA as threatened.
4. A National Recovery Team for Non-game Freshwater Fish Species was established in 2003, and the team developed a draft Recovery Strategy for Cultus pygmy sculpin in 2006.

5. Taxonomic investigations, including some molecular genetics work has been initiated.

15. Statement of When Action Plans Will be Completed

Within two years of the approval of the recovery strategy, a Cultus pygmy sculpin Action Plan will be developed. This plan should include descriptions of programs, plus a timeline of programs with estimated budgets. The plan should encompass a timeframe of at least five years.

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