

Report on the Progress of Recovery Strategy and Action Plan Implementation for the Cultus Pygmy Sculpin (*Cottus aleuticus*) in Canada for the Period 2016 to 2021

Cultus Pygmy Sculpin



2023

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Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#) agreed to establish complementary legislation and programs that provide for the protection of species at risk throughout Canada. Under section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent minister is responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within 5 years of the date when the final recovery strategy was placed on the Species at Risk Public Registry, and in every subsequent 5 year period until its objectives have been achieved or the species' recovery is no longer feasible. Under section 55 of SARA (S.C. 2002, c.29), the competent minister must monitor the implementation of an action plan and the progress towards meeting its objectives and assess and report on its implementation and its ecological and socio-economic impacts 5 years after the plan comes into effect.

Reporting on the progress of recovery strategy and action plan implementation requires reporting on the collective efforts of the competent minister, provincial and territorial governments, and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify strategies and approaches that will provide the best chance of recovering the species at risk. Action plans provide the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. Some of the identified strategies and approaches are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a report on the progress of recovery strategy and action plan implementation (progress report).

The Minister of Fisheries and Oceans is the competent minister under SARA for the Cultus Pygmy Sculpin and has prepared this progress report.

As stated in the preamble to SARA, success in the protection and recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the recovery strategy and action plan and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. The cost of recovering and conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy and action plan for the Cultus Pygmy Sculpin for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Marlena McCabe (Fisheries and Oceans Canada; DFO) with input from Manon Morrissette (DFO), Erin Gertzen (DFO), and Ahdia Hassan (DFO). To the extent possible, this progress report has been prepared with inputs from: Dr. Daniel Selbie (DFO), Lucas Pon (DFO), Greg Wilson (British Columbia Ministry of Environment and Climate Change Strategy), Christina Toth (Fraser Basin Council; Cultus Lake Stewardship Society) and Patricia Woodruff. DFO would also like to express its appreciations to all individuals and organizations who have contributed to the recovery of the Cultus Pygmy Sculpin.

Executive summary

The Cultus Pygmy Sculpin¹ (*Cottus aleuticus*) was listed as threatened under the *Species at Risk Act* (SARA) in 2003. The “Recovery Strategy for Cultus Pygmy Sculpin (*Cottus* sp.) in Canada” ([NRTCPS 2007](#)) was finalized and published on the Species at Risk Public Registry in 2007. An “Action Plan for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada” ([DFO 2017](#)) was subsequently published in 2017. The “Report on the Progress of Recovery Strategy Implementation for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada for the Period 2007 – 2015” ([DFO 2016](#)) was published in 2016 and documented the progress toward recovery implementation during the indicated time period.

The threats identified in the recovery strategy for the Cultus Pygmy Sculpin include: exotic species, altered predation rates, water use, water quality, water-oriented recreation, land use, and climate change.

The recovery goal for Cultus Pygmy Sculpin is to ensure the long-term viability of the population in the wild. This taxon is likely to remain at an elevated risk due to the population’s extremely limited distribution.

The recovery objectives for Cultus Pygmy Sculpin are 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

The “Report on the Progress of Recovery Strategy and Action Plan Implementation for the Cultus Pygmy Sculpin (*Cottus aleuticus*) in Canada for the Period 2016 to 2021” reports on the progress made by DFO and its partners towards implementing the recovery strategy and action plan. During this time period, progress has been made toward:

- legal protection of Cultus Pygmy Sculpin’s critical habitat in January 2019 through a SARA critical habitat order
- increasing understanding of eutrophication within Cultus Lake, including its drivers, effects on Cultus Pygmy Sculpin, and abatement methods
- planning future upgrades of liquid waste facilities to reduce phosphorus and nitrogen inputs with the goal of mitigating eutrophication
- increasing understanding of the threat posed by the aquatic invasive species Smallmouth Bass (*Micropterus dolomieu*) and implementing control efforts
- continuing to support stewardship of Cultus Pygmy Sculpin and their habitat through public education

DFO remains committed to the survival and recovery of the Cultus Pygmy Sculpin. The work completed to date has built a strong foundation for continued research and management of this species over the next reporting period. Progress to date would not have been achieved without contributions from DFO Science Branch, Cultus Lake Stewardship Society, British Columbia

¹ On Schedule 1 of SARA, this species is listed as “Coastrange Sculpin – Cultus Population.” In this progress report, the common name “Cultus Pygmy Sculpin” is used to maintain consistency with the recovery strategy, the 2007-2015 progress report and the action plan (NRTCPS 2007; DFO 2016; DFO 2017).

Ministry of Environment and Climate Change Strategy, and graduate researchers from various academic institutions. DFO looks forward to continued collaboration and welcomes the participation of additional partners. DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Cultus Pygmy Sculpin.

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1 Introduction

The “Recovery Strategy for Cultus Pygmy Sculpin² (*Cottus* sp.) in Canada” (herein referred to as the recovery strategy; NRTCPS 2007) was published on the Species at Risk Public Registry in 2007. The “Action Plan for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada” (herein referred to as the action plan; DFO 2017) was finalized and published on the Species at Risk Public Registry in 2017.

This progress report outlines the progress made towards meeting the objectives listed in the recovery strategy and the action plan for the Cultus Pygmy Sculpin from 2016 to 2021 and should be considered as 1 in a series of documents that are linked and should be taken into consideration together, including: the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports (Coffie 1997; [COSEWIC 2000](#); [COSEWIC 2010](#); [COSEWIC 2019](#)), the science advisory report from the recovery potential assessment ([DFO 2008](#)), the recovery strategy (NRTCPS 2007), the action plan (DFO 2017), and the “Report on the Progress of Recovery Strategy Implementation for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada for the Period 2007 to 2015” (herein referred to as the 2007 to 2015 progress report; DFO 2016).

Section 2 of this progress report provides references to, or reproduces key information on, the threats to the species, recovery goal and objectives, and performance measures to assess the progress of recovery. For more details, readers should refer to the recovery strategy and the action plan. Section 3 reports on the progress of strategies identified in the recovery strategy and measures identified in the action plan to support recovery. Section 4 summarizes the progress towards achieving these objectives.

² On Schedule 1 of the *Species at Risk Act* (SARA) this species is listed as “Coastrange Sculpin – Cultus Population.” In this progress report, the common name “Cultus Pygmy Sculpin” is used to maintain consistency with the recovery strategy, the 2007 to 2015 progress report and the action plan (NRTCPS 2007; DFO 2016; DFO 2017).

2 Background

2.1 COSEWIC assessment summary and threats to the species and its critical habitat

The listing of the Cultus Pygmy Sculpin as threatened under SARA in 2003 led to the development and publication of the “Recovery Strategy for Cultus Pygmy Sculpin (*Cottus* sp.) in Canada in 2007” (NRTCPS 2007). The recovery strategy is consistent with the information provided in the COSEWIC status report (COSEWIC 2000). In 2010, COSEWIC re-examined and confirmed the status of the Cultus Pygmy Sculpin as threatened (COSEWIC 2010). In 2019, COSEWIC re-assessed and changed the status of the Cultus Pygmy Sculpin from threatened to endangered (COSEWIC 2019).

COSEWIC assessment summary – November 2019

Common name

Coastrange Sculpin - Cultus Lake population

Scientific name

Cottus aleuticus

Status

Endangered

Reason for designation

This small-bodied freshwater fish is found in a single lake that drains into the lower Fraser River, in southwestern British Columbia. This area is undergoing increasing urbanization and recreational use. Every night, this unique population migrates from the lake bottom toward the lake surface to feed. A recent introduction of an exotic predator, Smallmouth Bass, is a serious concern to the long-term persistence of the sculpin. The species is also threatened by the cumulative impacts of aquatic invasive species, water pollution (eutrophication) and climate change. These threats reduce sculpin habitat by reducing oxygen in deep waters, and reducing surface water habitat due to increased predation from Smallmouth Bass.

Occurrence

British Columbia

Status history

Designated special concern in April 1997. Status re-examined and designated threatened in November 2000 and in April 2010. Status re-examined and designated endangered in November 2019.

Section 3 of the recovery strategy provides information on the threats to species' survival and recovery. These threats include: exotic species, altered predation rates, water use, water quality, water-oriented recreation, land use, and climate change.

Critical habitat for the Cultus Pygmy Sculpin was identified, to the extent possible, in section 1.3 of the “Action Plan for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada” (DFO 2017). The action plan also provides examples of activities that are known or likely to result in degradation and/or destruction to critical habitat (that is, threats to critical

habitat). The list of activities provided in table 2 of the action plan is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the action plan. For more details on the activities likely to result in the destruction of critical habitat, consult the action plan.

2.2 Recovery

This section summarizes the information found in the recovery strategy on the recovery goal and objectives³ that are necessary for the recovery of the Cultus Pygmy Sculpin, and on performance measures that provide a way to define and measure progress toward achieving the recovery goal and objectives.

Section 7 and 8 of the recovery strategy identified the following recovery goal and objectives necessary for the recovery of the species:

Recovery goal

The recovery goal for Cultus Pygmy Sculpin is to ensure the long-term viability of the population in the wild. This taxon is likely to remain at an elevated risk due to the population's extremely limited distribution.

Recovery objectives

- 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

Performance measures

Section 9 of the recovery strategy includes the following performance measures to define and measure progress toward achieving the recovery goal and objectives:

- has a Recovery Implementation Group (RIG) or working group 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?
- has taxonomic status of Cultus pygmy sculpin been clarified?
- Are there key information gaps that inhibit conservation of Cultus pygmy sculpin?
- have threats been clarified and assessed? Are threats being mitigated?
- has critical habitat been defined for Cultus pygmy sculpin?
- 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?
- 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?

³ The recovery goal and objectives are referred to as "population and distribution objectives" within the action plan.

- have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?
- have educational materials been produced? Has public perception and awareness been affected? How many classes have received educational presentations?
- have land management criteria been developed? Is land development meeting the criteria? Have Best Management Practices (BMPs) been developed and communicated? Is there compliance with BMPs?
- have scientific investigation protocols been set and communicated? Have they been implemented?

3 Progress towards recovery

Section 9 of the recovery strategy divides the recovery effort into 11 strategies (see table 1 for list of strategies).

The action plan for the Cultus Pygmy Sculpin divides the recovery effort into 10 recovery measures that are linked but differ from the strategies outlined in the recovery strategy, grouped under 4 broad approaches (DFO 2017):

A: Protection and management

- A-1: establish and support a Recovery Implementation Group or alternative working group for Cultus Pygmy Sculpin
- A-2: develop and implement an aquatic invasive species (AIS) Total Prevention Plan with direct links to stewardship groups and local stakeholders
- A-3: develop and implement an integrated land and water use plan that strives to conserve Cultus Lake, as well as satisfy user needs

B: Monitoring and assessment

- B-1: prioritize and advance development and implementation of a long-term monitoring plan to assess population response to management activities and threats

C: Research

- C-1: prioritize and advance research to address information gaps on biology
- C-2: advance research to address information gaps on nutrient loading
- C-3: develop and implement protocols for scientific investigations
- C-4: advance research to address information gaps on mortality
- C-5: advance research to address information gaps on population limiting factors

D: Outreach and communication

- D-1: inform and educate stakeholders and the general public about the Cultus Pygmy Sculpin and the overall biodiversity value of Cultus Lake

Progress in carrying out the strategies identified in the recovery strategy, as well as the recovery measures identified in the action plan, is reported in section 3.1. Section 3.2 reports on activities identified in the schedule of studies to identify and further refine critical habitat. Section 3.3 reports on the progress made toward meeting the performance measures and other commitments (for example, critical habitat order) identified in the recovery strategy and action plan, and reports on the socio-economic impacts of implementing the action plan.

3.1 Activities supporting recovery

Table 1 provides information on the implementation of the strategies identified in the recovery strategy and the recovery measures identified in the action plan. A number of recovery activities were implemented prior to 2016 and have been documented in the “Report on the Progress of Recovery Strategy Implementation for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada for the Period 2007– 2015” (DFO 2016).

Table 1. Details of strategies and recovery measures supporting the recovery of the Cultus Pygmy Sculpin from 2016 to 2021. Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all activities have specific participants or recovery measures identified.

#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
1	Establish and support a Recovery Implementation Group (RIG) or alternative working group for Cultus Pygmy Sculpin.	A-1	A RIG has not been established for Cultus Pygmy Sculpin; however, Cultus Lake Stewardship Society (CLASS ⁵) (established in 2007, chaired by the Fraser Basin Council [FBC]) is involved in stewardship within the Cultus Lake Watershed. From 2016 to 2021, CLASS has assisted with recovery of Cultus Pygmy Sculpin (refer to table 1 row 4).	CLASS , FBC, Fisheries and Oceans Canada (DFO), Fraser Valley Watershed Coalition
2	Assess taxonomic status of Cultus Pygmy Sculpin.	N/A	No taxonomic studies have been completed within this reporting period.	N/A

⁴ The coding for recovery measures is defined in section 3 of this progress report.

⁵ CLASS (formerly called the Cultus Lake Aquatic Stewardship Strategy) is a network that includes local residents, volunteer scientists, representatives from non-government organizations, industry, First Nations, regional and municipal government, British Columbia Ministry of Environment and Climate Change Strategy and DFO.

#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
3	Address information gaps that inhibit conservation of Cultus Pygmy Sculpin.	C-1, C-2, C-4, C-5	<p>Since 2008, DFO Lakes Research Program has used science-based research activities and published recommendations to address lake management and conservation of species at risk. Ongoing research has helped to advance information gaps on biology, mortality, population limiting factors for Cultus Pygmy Sculpin, and on nutrient loading in the lake.</p> <p>Research conducted on atmospheric nutrient deposition across the Fraser Valley (Putt et al. 2019) suggests the airshed is a primary source of nutrients driving critical habitat degradation. This study suggests</p> <ul style="list-style-type: none"> • agricultural deposition of nutrients (predominantly from phosphorus entrapment in aerosols) needs to be reduced to protect Cultus Lake from eutrophication • best management practices for agriculture could be instrumental in species at risk recovery both for Cultus Pygmy Sculpin and Cultus Lake Sockeye Salmon (<i>Oncorhynchus nerka</i>) <p>Seining was completed in 2019 to confirm whether sculpin found in shoreline areas are Cultus Pygmy Sculpin or typical Coastrange Sculpin. Laboratory analyses are needed to confirm species of shoreline sculpin; these analyses are pending (Pon pers. comm. 2021).</p> <p>Hypoxia tolerance testing of Cultus Pygmy Sculpin was conducted to understand physiological and behavioural responses to low oxygen tolerance in changing lake conditions (Selbie pers. comm. 2021).</p> <p>Ongoing sediment sampling research will be used to determine redox sensitive toxicants that could threaten Cultus Pygmy Sculpin in deep water habitat (Putt et al. 2019; Loudon 2020; Selbie pers. comm. 2021).</p>	DFO, Academia

<p>4</p>	<p>Clarify and address threats to Cultus Pygmy Sculpin.</p>	<p>A-3, C-1, C-2</p>	<p>CLASS has been working to address Cultus Pygmy Sculpin threats by:</p> <ul style="list-style-type: none"> • completing weekly water quality sampling throughout the summer • removing invasive riparian plant species • contributing information to the advisory committee and regional district to support the development of a new wastewater treatment system to divert nitrogen and phosphorus from entering Cultus Lake • working with local landfills to have waste piles covered to prevent Glaucous-winged Gulls (<i>Larus glaucescens</i>) from transporting plastics to Cultus Lake and across the Fraser Valley (Toth pers. comm. 2021) <p>An aquatic invasive species Total Prevention Plan has not been developed. However, the British Columbia (BC) government has produced 2 regulatory documents which provide the provincial framework for invasive species management: Invasive Species Strategy for British Columbia: 2018-2022 (Invasive Species Council of British Columbia 2017) and the BC Government Invasive Species Strategic Plan (British Columbia Inter-Ministry Invasive Species Working Group 2014).</p> <p>In 2019, the BC Ministry of Environment and Climate Change Strategy (BC ENV) secured funding to mitigate the impacts of Smallmouth Bass⁶ (<i>Micropterus dolomieu</i>) in Cultus Lake:</p> <ul style="list-style-type: none"> • between 2019 to 2021, suppression of Smallmouth Bass (a newly introduced invasive predator to native species of fish in Cultus Lake) was initiated (Margetts pers. comm. 2021) <p>Putt et al. 2019 published findings from a watershed nutrient budget modelling study which helped to clarify threats and information gaps related to:</p> <ul style="list-style-type: none"> • lake oxygen depletion (caused by climate change and eutrophication) impacting Cultus Pygmy Sculpin • identifying potential regional and local mitigation actions to stop or reduce eutrophication and preserve species at risk, including: <ul style="list-style-type: none"> ○ reducing atmospheric and local phosphorus inputs within the Cultus Lake regional airshed and watershed, respectively ○ utilizing best management practices for agriculture, lowering septic inputs, and lessening avian guano impacts <p>Many threats to Cultus Lake Sockeye Salmon (DFO 2020; Selbie et al. 2018) also threaten Cultus Pygmy Sculpin, especially critical habitat degradation linked to hypolimnetic⁷ oxygen depletion (Kerker 2020; Putt et al. 2019). Recovery efforts for</p>	<p>BC ENV, DFO, Academia, British Columbia Inter-Ministry Invasive Species Working Group, CLASS, Cultus Lake Parks Board, FBC, Fraser Valley Regional District (FVRD), Invasive Species Council of British Columbia</p>
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#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
			<p>Cultus Lake Sockeye Salmon will likely also benefit Cultus Pygmy Sculpin (FBC 2020; Selbie et al. 2018).</p> <p>DFO Lakes Research Program and their partners have reconstructed the long-term water quality data and drivers of habitat degradation imperilling species at risk in Cultus Lake (Gauthier et al. 2020).</p> <p>Refer to table 1 row 3 for information on atmospheric nutrient deposition.</p>	
5	Conduct studies to help define critical habitat for Cultus Pygmy Sculpin.	N/A	Refer to section 3.2 of this progress report.	DFO, Academia
6	Develop and implement a long-term monitoring program.	B-1	<p>DFO Lakes Research Program initiated a non-lethal trapping program targeting Cultus Pygmy Sculpin in 2012. Minnow traps are baited and left overnight along 5 transect lines set at depths between 0 and 40 metres. A total of 10 sampling events have taken place between 2012 and 2021. Initial catch-per-unit-effort results suggest that Cultus Pygmy Sculpin show variation in spatial and temporal residence use (Loudon 2022).</p> <p>A formal, long-term monitoring program specifically targeting Cultus Pygmy Sculpin has not been developed or implemented; however, DFO Lakes Research Program and their partners have:</p> <ul style="list-style-type: none"> • collected incidental bycatch data on Cultus Pygmy Sculpin during Cultus Lake Sockeye Salmon trawls • monitored spatiotemporal changes in critical habitat, including its biophysical functions, features, and attributes (Selbie pers. comm. 2021) • established a continuous long-term environmental monitoring program for Cultus Lake focusing on the lake, atmosphere, and climate (Selbie pers. comm. 2021) 	DFO, Academia

⁶ Smallmouth Bass were first discovered in Cultus Lake in May 2018.

⁷ Hypolimnion is the cold water layer at the bottom of a stratified lake.

#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
7	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.	A-3	<p>A watershed-scale land use plan has not been developed.</p> <p>A watershed nutrient budget modelling study was completed and provides information on watershed and airshed management in Cultus Lake (Putt et al. 2019) (refer to table 1 row 4).</p> <p>Critical habitat was defined as the whole of Cultus Lake up to its wetted boundaries in the 2017 action plan (DFO 2017; Chiang et al. 2015). A critical habitat order was made on January 9, 2019 prohibiting the destruction of critical habitat.</p>	DFO, Academia
8	Establish water quality and water use objectives for Cultus Lake.	N/A	<p>No formal water quality and water use objectives have been established for the entirety of Cultus Lake; however, water quality and use objectives have been developed for specific purposes:</p> <ul style="list-style-type: none"> • “Plan Cultus” establishes water quality objectives (section 2.3.2 of this progress report) for Cultus Lake Park (Cultus Lake Park Board 2016) (refer to table 1 row 10). • Research and monitoring from the DFO Lakes Research Program on Cultus Lake has informed water quality and water use objectives related to liquid waste management (Putt et al. 2019). These water quality and water use objectives have been communicated to the relevant stakeholders and are now part of the provincially regulated liquid waste management plan which can help reduce nutrient loading (FVRD 2020; Chan 2018; Selbie pers. comm. 2021). 	DFO

#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
9	Inform and educate stakeholders and the general public about the species and general biodiversity values.	D-1	<p>CLASS has been actively educating stakeholders and the general public on Cultus Pygmy Sculpin and other restoration initiatives related to Cultus Lake (Toth pers. comm. 2021); for example:</p> <ul style="list-style-type: none"> • setting up information booths at Cultus Lake days⁸, fishing events and Northern Pikeminnow (<i>Ptychocheilus oregonensis</i>) derbies • maintaining and updating the CLASS website to provide up to date information on threats to Cultus Lake and Cultus Pygmy Sculpin (Toth pers. comm. 2021) <p>A total of 13 research presentations and lectures have been delivered by DFO and academia at conferences, workshops or focus groups since 2016 on Cultus Lake eutrophication, species at risk, and Cultus Pygmy Sculpin critical habitat (Selbie pers. comm. 2021). These presentations have contributed to the recovery objectives of increasing scientific understanding and fostering awareness of the Cultus Pygmy Sculpin (Selbie pers. comm. 2021).</p>	CLASS, DFO, Academia
10	Jointly develop land management strategies for crown and private lands.	A-3	<p>An evaluation of Cultus Lake environmental services suggests that inaction related to nutrient management could have large socioeconomic implications for Cultus Lake, largely impacting user needs and lake use (Janmaat and Cebry 2018). Developing and implementing an integrated land, water and airshed use plan could provide ecosystem benefits beyond the recovery of the Cultus Pygmy Sculpin. Research has helped to better understand the link between land, water and airshed management (refer to table 1 row 3).</p> <p>“Plan Cultus” was adopted as a bylaw⁹ by the Cultus Lake Park Board in 2016 (Cultus Lake Park Board 2016). This plan is used to guide any potential land management and development within Cultus Lake Park (Cultus Lake Park Board 2019). It also outlines goals and priorities for protecting foreshore areas and lake water quality, and details overall environmental goals to preserve Cultus Lake Park and its biodiversity, including supporting the recovery of Cultus Pygmy Sculpin (Cultus Lake Park Board 2019).</p> <p>Refer to table 1 row 7 for information related to watershed-scale land use plans.</p>	FVRD, Cultus Lake Park Board, DFO

⁸ An annual festival held at Cultus Lake.

⁹ Cultus Lake Park Plan Bylaw No. 1080 also referred to as “Plan Cultus.”

#	Strategy	Recovery measure(s) ⁴	Descriptions and results	Participants
11	Develop sound protocols for scientific investigations (e.g. limit number of fish collected each year, etc.).	C-3	<p>No new sampling protocols have been developed since those outlined in Harvey and Brown (2013a, 2013b).</p> <p>Diet studies conducted in 2016 have confirmed that non-lethal gastric lavage is an effective protocol for studying diet in Cultus Pygmy Sculpin (Pon pers. comm. 2021).</p>	DFO

3.2 Activities supporting the identification of critical habitat

Critical habitat for the Cultus Pygmy Sculpin was identified, to the extent possible, in section 1.3 of the “Action Plan for the Cultus Pygmy Sculpin (*Cottus aleuticus*, Cultus Population) in Canada” (DFO 2017). Further research may help refine the understanding of the functions, features and attributes of the currently identified critical habitat.

Table 2 provides information on the implementation of the schedule of studies to identify critical habitat, found in the recovery strategy (NRTCPS 2007). Each study has been assigned 1 of 4 statuses:

- 1) completed: the study has been carried out and concluded
- 2) in progress: the planned study is underway and has not concluded
- 3) not started: the study has been planned but has yet to start
- 4) cancelled: the planned study will not be started or completed

Table 2. Status and details of the implementation of the schedule of studies outlined in the recovery strategy for Cultus Pygmy Sculpin. Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all activities have specific participants identified.

#	Study	Status	Descriptions and results	Participants
1	Habitat Use	Critical habitat identification: completed Critical habitat further refinement: in progress	Critical habitat was identified in section 1.3 of the action plan. It is described in terms of biophysical functions, features, and attributes (DFO 2017). Ongoing research on habitat use (refer to table 1 row 3) may help further refine critical habitat features, functions and attributes.	Academia , Fisheries and Oceans Canada (DFO)

#	Study	Status	Descriptions and results	Participants
2	Habitat Availability	<p>Critical habitat identification: completed</p> <p>Critical habitat further refinement: in progress</p>	<p>Critical habitat was identified in section 1.3 of the action plan. It is described in terms of biophysical functions, features, and attributes (DFO 2017).</p> <p>Habitat availability was further detailed by the following studies:</p> <ul style="list-style-type: none"> • Loudon (2020) compiled data from Cultus Pygmy Sculpin trapping events with water quality data. Results suggest a seasonal degradation of critical habitat (specifically, the attribute of adequate oxic benthic conditions which supports functions of spawning, rearing, and feeding) leading to potentially lethal hypoxic/anoxic zones • Sumka (2017) examined thermal dynamics in Cultus Lake as they relate to climate change. Field data was compiled across 3 time periods from 1920 to 2016 and used to model thermal dynamics of Cultus Lake. Modelling results suggest the potential for substantial changes to the thermal dynamics of Cultus Lake could continue to worsen water quality if eutrophication continues unabated. These changes could negatively impact critical habitat for Cultus Pygmy Sculpin (Sumka 2017) • Kerker (2020) conducted research on the implications of temperature and oxygen levels on habitat for Pacific salmonids and Cultus Pygmy Sculpin. Data from 2009 to 2018 was modelled to simulate lake thermal structure given 2 climate change scenarios (Kerker 2020). Results suggest that without decreasing nutrient inputs to Cultus Lake, it is likely that habitat for both Cultus Pygmy Sculpin and Cultus Lake Sockeye Salmon will become unsuitable if microbial decomposition of organic matter is exacerbated by climate change (Kerker 2020) 	Academia, DFO
3	Population Abundance	Cancelled	No work was completed during this reporting period. Population abundance was not required for critical habitat identification, as described in the 2017 action plan.	N/A
4	Recovery Targets	Cancelled	No work was completed during this reporting period. Recovery targets were not required for critical habitat identification, as described in the 2017 action plan.	N/A
5	Relationship Between Habitat and Abundance	Cancelled	No work was completed during this reporting period. An understanding of the relationship between habitat and abundance was not required for critical habitat identification, as described in the 2017 action plan.	N/A

#	Study	Status	Descriptions and results	Participants
6	Define Critical Habitat	<p>completed</p> <p>Critical habitat further refinement: in progress</p>	<p>Critical habitat was identified in section 1.3 of the action plan. Protection of Cultus Pygmy Sculpin's critical habitat from destruction was accomplished in 2019 through a <i>Species at Risk Act</i> (SARA) critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat.</p> <p>DFO Lakes Research program and their partners have monitored spatiotemporal changes in critical habitat, including its biophysical functions, features, and attributes (Selbie pers. comm. 2021). This research could help to refine Cultus Pygmy Sculpin critical habitat by providing further information on temperature, oxygenation and nutrient change requirements.</p>	DFO, Academia

3.3 Summary of progress towards recovery

3.3.1 Status of performance measures

Table 3 provides a summary of the progress made toward meeting the performance measures outlined in table 1 of the recovery strategy. Each measure has been assigned 1 of 4 statuses:

- 1) not met: the performance measure has not been met, and little to no progress has been made
- 2) partially met, underway: moderate to significant progress has been made toward meeting 1 or more elements of the performance measure, and further work is ongoing or planned
- 3) met: the performance measure has been met and no further action is required
- 4) met, ongoing: the performance measure has been met, but efforts will continue as needed to achieve the objectives outlined in the recovery strategy and/or action plan

Table 3. Summary of progress made toward meeting the performance measures outlined in the recovery strategy for Cultus Pygmy Sculpin.

#	Performance measure	Status	Details
1	Has a recovery implementation group (RIG) or working group 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?	Partially met, underway	<p>A recovery implementation group has not been established for Cultus Pygmy Sculpin. However, other groups and actions have served to partially address this performance measure. These are detailed here.</p> <p>The Cultus Lake Stewardship Society (CLASS; formerly known as the Cultus Lake Aquatic Stewardship Society prior to 2021) is a non-profit, volunteer-run society, whose overarching goal is to provide stewardship for the Cultus Lake Watershed, predominantly through sharing information throughout the community, supporting agencies with their communications within the Cultus Lake area, and providing volunteers to support stewardship activities (CLASS 2021; Toth pers. comm. 2021). Their work has assisted with recovery implementation for Cultus Pygmy Sculpin.</p> <p>In 2019, Fisheries and Oceans Canada (DFO) Lakes Research Program established a regional leadership committee to participate in a Cultus Lake Summit. This summit was developed to further address threats to the survival and recovery of the Cultus Pygmy Sculpin by targeting broad threats such as eutrophication. The summit was cancelled due to COVID 19 and planning is underway to re-establish the committee.</p> <p>An action plan was published in 2017 and outlines critical habitat and key recovery actions to be taken to support recovery of Cultus Pygmy Sculpin (DFO 2017).</p> <p>Significant work has been completed to support recovery of Cultus Pygmy Sculpin since 2016, as documented in tables 1 and 2.</p>

#	Performance measure	Status	Details
2	Has taxonomic status of Cultus Pygmy Sculpin been clarified?	Partially met, underway	<p>The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2019 status report notes that Cultus Pygmy Sculpin are genetically unique from other populations of Coastrange Sculpin within the Cultus Lake watershed. Cultus Pygmy Sculpin are also likely significantly different from other Coastrange Sculpin both behaviourally and morphologically (COSEWIC 2019). COSEWIC therefore suggests that Cultus Pygmy Sculpin is an independent designatable unit within the species of <i>Cottus aleuticus</i> (Coastrange Sculpin) (COSEWIC 2019).</p> <p>Analyses are underway to determine whether sculpin found in shoreline areas of Cultus Lake are Cultus Pygmy Sculpin or typical Coastrange Sculpin (Pon pers. comm. 2021; refer to table 1 row 3).</p>
3	Are there key information gaps that inhibit conservation of Cultus Pygmy Sculpin?	Partially met, underway	<p>The 2007 to 2015 progress report outlined several additional information gaps that could inhibit conservation of Cultus Pygmy Sculpin (DFO 2016). These information gaps included: population abundance dynamics, general biology, water quality impacts, eutrophication, and overlap with Cultus Lake Sockeye Salmon recovery efforts (DFO 2016).</p> <p>From 2016 to 2021, studies were conducted on information gaps related to eutrophication/water quality (Kerker 2020; Putt et al. 2019; Sumka 2017) and overlap with Cultus Lake Sockeye Salmon (Fraser Basin Council (FBC) 2020).</p> <p>Ongoing studies relating to hypoxia tolerance of Cultus Pygmy Sculpin, sediment/water chemistry, and physiological/behavioural responses (refer to table 1 row 3) could help to address additional information gaps. This data could help to identify when deep water habitats that regularly become hypoxic/anoxic in the summer and fall become inhabitable for Cultus Pygmy Sculpin (Pon pers. comm. 2021).</p>
4	Have threats been clarified and assessed? Are threats being mitigated?	Met, ongoing	<p>Ongoing and completed activities outlined throughout tables 1 and 2 help to clarify the threats to Cultus Pygmy Sculpin. Some key threats researched from 2016 to 2021 include Smallmouth Bass introduction (Margetts pers. comm. 2021; refer to table 1 row 4) and cultural eutrophication (FBC 2020; Putt et al. 2019; Gauthier et al. 2020; refer to table 1 row 3 and 4).</p> <p>The extent to which Smallmouth Bass predation and feeding/rearing habitat overlaps with Cultus Pygmy Sculpin may inform ongoing invasive species management efforts (Wilson pers. comm. 2021; Margetts pers. comm. 2021). Suppression efforts are underway (refer to table 1 row 4).</p> <p>Long-term environmental monitoring of Cultus Lake will continue to help clarify and assess threats related to eutrophication (Selbie pers. comm. 2021; refer to table 1 rows 3, 4, 6, and 8). Mitigation needs have been identified for threats relating to eutrophication and airshed management (Putt et al. 2019), and sewer system management (Chan 2018; Selbie pers. comm. 2021) (refer to table 1 row 4).</p>

#	Performance measure	Status	Details
			Threat mitigation is ongoing, and partners ¹⁰ continue to work together to inform policy and effect change towards the prevention of key threats, including cultural (anthropogenic) eutrophication (Selbie pers. comm. 2021; refer to tables 1 to 3).
5	Has critical habitat been defined for Cultus pygmy sculpin?	Met	<p>Critical habitat was identified as the whole of Cultus Lake up to its wetted boundaries in the 2017 action plan (DFO 2017; Chiang et al. 2015).</p> <p>Legal protection of Cultus Pygmy Sculpin critical habitat from destruction was accomplished in 2019 through a SARA critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat.</p> <p>Further refinement of critical habitat may be informed by the studies noted in table 2 of this report.</p>
6	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?	Partially met, underway	<p>No formal monitoring program has been implemented to specifically monitor Cultus Pygmy Sculpin (Pon pers. comm. 2021); however, incidental bycatch data on Cultus Pygmy Sculpin caught during Cultus Lake Sockeye Salmon trawls has been used as an index of Cultus Pygmy Sculpin abundance. There are some limitations to using this data as an index; however, it is the only available long-term dataset that provides a historic (dating back to 1976) time series for this species (Pon pers. comm. 2021).</p> <p>There is a consistent, ongoing long-term environmental monitoring series for Cultus Lake, dating back to 2009 (Selbie pers. comm. 2021; refer to table 1 row 6 and section 3.2). This monitoring program can help inform threats related to cultural eutrophication, spatiotemporal critical habitat changes, long-term water quality, and drivers of habitat degradation (Selbie pers. comm. 2021; Putt et al. 2019). Monitoring approaches outlined in Harvey and Brown (2013b) and the DFO Lakes Research Program non-lethal trapping program for Cultus Pygmy Sculpin (refer to table 1 row 6) could help inform a monitoring program specific to Cultus Pygmy Sculpin.</p>

¹⁰ DFO, CLASS, British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development, and academic partners (including those from Simon Fraser University, the University of British Columbia, Thompson Rivers University, and McGill University).

#	Performance measure	Status	Details
7	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?	Partially met	<p>Cultus Pygmy Sculpin critical habitat was legally protected in 2019 through a SARA critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat.</p> <p>A watershed plan has not been developed; however, a watershed nutrient budget modelling study was completed and provides context for watershed and airshed management in Cultus Lake (Putt et al. 2019). Results of the modelling study suggest that novel watershed management actions are urgently needed to protect critical habitat for Cultus Pygmy Sculpin from further degradation (Putt et al. 2019; Selbie pers. comm. 2021).</p>
8	Have water quality and water use objectives been established and communicated to relevant regulators and stakeholders?	Partially met	<p>No formal water quality and water use objectives have been established for the entirety of Cultus Lake; however, water quality and use objectives have been developed for specific purposes:</p> <ul style="list-style-type: none"> • “Plan Cultus” establishes water quality objectives (section 2.3.2) for Cultus Lake Park (Cultus Lake Park Board 2016) (refer to table 1 row 10) <p>Research and monitoring from the DFO Lakes Research Program on Cultus Lake has informed water quality and water use objectives related to liquid waste management (Putt et al. 2019). These water quality and water use objectives have been communicated to the relevant stakeholders and are now part of the provincially regulated liquid waste management plan which can help reduce nutrient loading (FVRD 2020; Chan 2018; Selbie pers. comm. 2021).</p> <p>Ongoing research on sediment sampling, will be used to determine toxicants that could threaten Cultus Pygmy Sculpin in deep water habitat (Putt et al. 2019; Loudon 2020; Selbie pers. comm. 2021).</p>
9	Have educational materials been produced? Has public perception and awareness been affected? How many classes have received educational presentations?	Met, ongoing	<p>Since their inception in 2007, CLASS has worked on increasing public perception and awareness of species at risk, including Cultus Pygmy Sculpin, and threats to Cultus Lake (CLASS 2021). Outside of the time period impacted by COVID 19 restrictions, CLASS set up informational booths to educate the public at various event days at Cultus Lake (Toth pers. comm. 2021). When outdoor events were restricted, CLASS updated their website to include new and relevant educational materials on scientific studies, Cultus Pygmy Sculpin, and issues impacting the lake (Toth pers. comm. 2021).</p> <p>A total of 13 research presentations and lectures have been delivered at conferences, workshops or focus groups since 2016 on Cultus Lake critical habitat, eutrophication, and species at risk (refer to table 1 row 9).</p>

#	Performance measure	Status	Details
10	Have land management criteria been developed? Is land development meeting the criteria? Have Best Management Practices (BMPs) been developed and communicated? Is there compliance with BMPs?	Partially met	<p>Watershed and airshed management criteria have not been developed for Cultus Lake and BMPs have not been implemented. However, other actions have served to partially address this performance measure. These are detailed here.</p> <p>The Cultus Lake Park Board, in collaboration with the local community, developed and published “Plan Cultus” which functions as a guiding document for park planning (Cultus Lake Park Board 2016) (refer to table 1 row 10).</p> <p>Airshed management is critical for effective land and water management (Putt et al. 2019; Holtgrieve et al. 2011; Vingarzan et al. 2002) and will need to be incorporated into BMPs to effectively mitigate habitat degradation (Putt et al. 2019; Loudon 2020; Selbie pers. comm. 2021).</p>
11	Have scientific investigation protocols been set and communicated? Have they been implemented?	Partially met, underway	<p>No scientific investigation protocols specifically for Cultus Pygmy Sculpin have been developed and communicated since those outlined in Harvey and Brown (2013a, 2013b), with trapping methods further described in Woodruff and Taylor (2013).</p>

3.3.2 Critical habitat identification and protection

Critical habitat for the Cultus Pygmy Sculpin was identified to the extent possible in the 2017 action plan and identifies the functions, features, and attributes necessary to support the species' life-cycle processes and to achieve the species' recovery goal and objectives. Protection of Cultus Pygmy Sculpin critical habitat from destruction was accomplished in 2019 through a SARA critical habitat order made under subsections 58(4) and (5), which invoked the prohibition in subsection 58(1) against the destruction of the identified critical habitat (SOR/2019-3).

Section 3.2 of this progress report provides information on the implementation of the schedule of studies to identify critical habitat found in the recovery strategy. Further research may refine the understanding of the functions, features and attributes of the identified critical habitat necessary to support the species' recovery goal and objectives.

3.3.3 Socio-economic impact

Under subsection 55 of the SARA, the responsible federal minister is required to undertake "an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation". This section updates the socio-economic impacts associated with the implementation of the action plan between 2017 and 2021.

As per subsection 49(1) (e) of SARA, the action plan included a socio-economic evaluation of the costs of the action plan and the benefits to be derived from its implementation (section 2 of the action plan). Many of the economic costs associated with implementation of recovery actions have been, and will continue to be borne by government agencies (e.g. Fisheries and Oceans Canada (DFO) Lakes Research Program). These were evaluated as a reallocation of existing government funds and are not considered additional costs to society. There have also been opportunity costs associated with these government funded actions; however, these are not easily quantified (DFO 2017).

There are socio-economic benefits that have resulted from the implementation of the action plan, including positive impacts on biodiversity and the value individuals place on preserving biodiversity (Federal, Provincial, Territorial Governments of Canada 2014). The implementation of the action plan also provides broader ecosystem benefits, as it relates to maintaining water quality and managing AIS (DFO 2017). Funding through the DFO Lakes Research Program has helped to research broader environmental issues (eutrophication and water quality) at Cultus Lake and its impact on the Cultus Pygmy Sculpin. Other recovery implementation activities which target broad ecosystem benefits (for example, water quality monitoring), habitat restoration, and AIS management are also likely to help in the recovery of the Cultus Pygmy Sculpin.

The conservation of species at risk is an important component of the Government of Canada's commitment to conserving biological diversity, and is important to current and future economic and natural wealth (Parks Canada 2016).

3.3.4 Recovery feasibility

Based on the current best available information, recovery of Cultus Pygmy Sculpin is determined to be feasible (NRTCPS 2007; DFO 2017). No new information has been gathered

that would suggest that the Cultus Pygmy Sculpin population no longer meets the feasibility criteria laid out in the recovery strategy.

4 Concluding statement

Within the 2016 to 2021 reporting period, through the implementation of the activities identified in the recovery strategy and action plan, progress has been made toward the recovery of the Cultus Pygmy Sculpin. Notable achievements include:

- legally protecting the Cultus Pygmy Sculpin's critical habitat in January 2019 through a SARA critical habitat order
- increasing understanding of eutrophication within Cultus Lake, including its drivers, effects on Cultus Pygmy Sculpin, and abatement methods
- planning future upgrades of liquid waste facilities to reduce phosphorus and nitrogen inputs with the goal of mitigating eutrophication
- increasing understanding of the threat posed by the AIS Smallmouth Bass (*Micropterus dolomieu*) and implementing control efforts

While there has been measurable progress towards addressing the activities identified in the recovery strategy and action plan, further work is required to support the survival and recovery of the Cultus Pygmy Sculpin. Priority next steps that could be used to maintain the achievements noted above may include:

- re-establishment of a committee to address and mitigate nutrient management issues in Cultus Lake
- development and implementation of an AIS prevention plan with participation from stewardship groups and local stakeholders
- development and implementation of a long-term monitoring plan, land use plans and water use plans
- increased effort to reduce habitat-based threats, including habitat degradation, watershed/airshed pollution, eutrophication, and climate change
- further research addressing information gaps on biology, mortality, and limiting factors for Cultus Pygmy Sculpin

DFO remains committed to the survival and recovery of the Cultus Pygmy Sculpin. The work started and completed to date has built a strong foundation for continued recovery support for this species over the next reporting period. Progress to date would not have been achieved without contributions from DFO Science Branch, Cultus Lake Stewardship Society, British Columbia Ministry of Environment and Climate Change Strategy, and graduate researchers from various academic institutions. DFO looks forward to continued collaboration and welcomes the participation of additional partners. DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Cultus Pygmy Sculpin.

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