

Report on the Progress of Recovery Strategy Implementation for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) Alberta Population (also known as the Saskatchewan-Nelson River Populations) in Canada for the Period 2014 to 2019

Westslope Cutthroat Trout



2021

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Rapport d'étape sur la mise en œuvre du programme de rétablissement de la truite fardée versant de l'ouest (*Oncorhynchus clarkii lewisii*), population de l'Alberta (également appelées populations de la rivière Saskatchewan et du fleuve Nelson) au Canada pour la période de 2014 à 2019

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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 effective protection of species at risk throughout Canada. Under section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the recovery strategy was placed on the Species at Risk Public Registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

A "Recovery Strategy for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*), Alberta Populations in Canada [Final]" ([DFO 2014](#)) was finalized and published on the Species at Risk Public Registry in 2014. In 2019, the recovery strategy was amended and re-published on the Public Registry as the "Recovery Strategy and Action Plan for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) Alberta Population (also known as Saskatchewan-Nelson River Populations) in Canada [Final]" (DFO 2019) (henceforth called a recovery strategy and action plan). The amended recovery strategy and action plan was updated to include the identification of additional critical habitat and provide updated recovery measures for the species.

This document reports on the progress made on recovery strategy implementation between 2014 and 2019. Since two recovery documents were in place during that timeframe (that is, the recovery strategy until 2019, and the recovery strategy and action plan in the latter part of 2019), this document reports on all activities related to recovery strategy implementation within the five year time frame, but refers specifically to the 2019 recovery strategy and action plan since it replaced the 2014 recovery strategy. Reporting on the action plan portion of the document, including the ecological and socio-economic impacts, under section 55 of the SARA will occur in 2024, five years after the recovery strategy and action plan was published on the Public Registry.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent minister(s), provincial and territorial governments, and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of recovering species at risk. 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 implementation (progress report).

The Minister of Fisheries and Oceans and the Minister responsible for the Parks Canada Agency (PCA) are the competent ministers under SARA for the Westslope Cutthroat Trout Alberta population (also known as Saskatchewan-Nelson River populations).

As stated in the preamble to SARA, success in the 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 will not be achieved by Fisheries and Oceans Canada (DFO) and PCA, or any other jurisdiction, alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the latest recovery strategy and action plan for the

Westslope Cutthroat Trout Alberta population (also known as the Saskatchewan-Nelson River populations) for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Pooi-Leng Wong (DFO), Ashley Gillespie (DFO), and Robyn Kutz (DFO). This progress report has been prepared with input from the DFO, PCA and Alberta Environment and Parks (AEP). DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Westslope Cutthroat Trout in Alberta.

Executive summary

The Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) Alberta population was listed as Threatened under the *Species at Risk Act* (SARA) in 2013. The “Recovery Strategy for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), Alberta Populations in Canada [Final]” ([DFO 2014](#)) was finalized and published on the Species at Risk Public Registry in 2014. In 2019, an amendment was made to the document and it was re-published on the Public Registry as the “Recovery Strategy and Action Plan for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) Alberta Population (also known as Saskatchewan-Nelson River Populations) in Canada [Final]” ([DFO 2019](#)) (henceforth called a recovery strategy and action plan). This document reports on the progress made on recovery strategy implementation between 2014 and 2019. Since two recovery documents were in place during that timeframe (that is, the recovery strategy until 2019, and the recovery strategy and action plan in the latter part of 2019), this document reports on all activities related to recovery strategy implementation within the five year time frame, but refers specifically to the 2019 recovery strategy and action plan since it replaced the 2014 recovery strategy.

The main threats identified for the Westslope Cutthroat Trout include:

- impacts of non-native/invasive species such as hybridization with Rainbow Trout and competition with other species such as Brook Trout
- adverse effects on habitat such as changes in flow, sedimentation, and habitat loss/fragmentation
- consumptive use/exploitation, including incidental mortality from catch and release angling
- stocking
- pollution
- algae
- pathogens
- climate change

During the time period reported by this progress report, progress was made in:

- research projects that have characterized the permeability of the species’ genome
- identifying genes that differentiate pure and hybrid individuals
- determining the genetic markers for Westslope Cutthroat Trout and non-native Rainbow Trout, and assembling the diagnostic loci for both species
- delineating the distribution and genetic status of Westslope Cutthroat Trout in the Bow and Oldman River drainages

Research has also been completed to determine the impacts of stocking Westslope Cutthroat Trout, that is, assisted colonization on macroinvertebrates in headwater lakes.

The recovery of existing Westslope Cutthroat Trout populations within historical range was improved by efforts such as:

- removing non-native Rainbow Trout from Rainbow Lake, Sawback Creek, Hidden Lake, and upper Corral Creek in Banff National Park
- changing the angling regulation from a daily bag limit to catch-and-release in Picklejar Lake
- developing a provincial Fish Sustainability Index and Fisheries Management Objectives for Westslope Cutthroat Trout

- assessing riparian conditions in the headwaters of the Bow and Oldman River watersheds

Several monitoring studies were completed, or are ongoing, including:

- the monitoring of changes in fish composition and abundance in Quirk Creek
- monitoring of the Westslope Cutthroat Trout population in Sawback Lake
- assessments of the watershed scale population in the Upper Oldman, Waiparous Creek, and Silvester Creek areas as part of an ongoing Westslope Cutthroat Trout monitoring program to gauge fish population responses to recent government land management alterations and proposed restoration projects

Regulatory efforts to limit the spread of invasive and non-native aquatic species are improving through:

- the application of the federal government's *Aquatic Invasive Species Regulations*
- the amendment of the *Fisheries Act* of Alberta to include mandatory stopping of boats at designated boat inspection stations
- change of angling regulations in Waterton Lakes National Park in 2011 to prohibit the retention of Westslope Cutthroat Trout from water with native or genetically pure introduced Westslope populations
- implementation of mandatory decontamination protocols for employees and contractors working in Alberta waterways
- continuing studies on the distribution of *Myxobolus cerebralis*, a parasite that causes whirling disease in salmonids
- the distribution and genetic identification of *Tubifex tubifex*, a worm that acts as the secondary host for the parasite that causes whirling disease in salmonids

Education and outreach efforts have been widespread, both promoting Westslope Cutthroat Trout recovery efforts and aquatic invasive species (AIS) prevention including:

- the creation of a list of prohibited AIS to distribute to the public
- the implementation of an AIS campaign that included the "Don't Let It Loose" and "Clean, Drain and Dry" slogans
- the development of signage and posting of signage to target specifically the off-road vehicle users near waterways, and along streams designated as critical habitat
- the development of a Linear Footprint Management Plan and Recreation Plan for the Upper Oldman, Livingstone, and Porcupine Hills area

Ongoing work to recover Westslope Cutthroat Trout populations within its historical range includes the restoration of Cascade Creek in Banff National Park. Parks Canada Agency has removed non-native Brook Trout and is constructing a downscaled channel with habitat features, including augmented flows so that Westslope Cutthroat Trout can be re-introduced to this regulated creek below Minnewanka Dam. Some jurisdictions in Alberta are also collecting water temperature data using thermographs at several fishless sites to gauge their potential as refuges for the Westslope Cutthroat Trout.

Taken together, these ongoing and/or completed activities indicate progress is being made toward the goal of recovering Westslope Cutthroat Trout Alberta population. However, there are still a number of areas where further information is required. For example, more work should be done to establish priority watersheds for recovery and restoration of the species and its habitat. In addition, pilot projects should be conducted to restore and recover priority populations, where

feasible, expand genetically pure populations in candidate areas, and evaluate effectiveness of restoration efforts before proceeding with additional projects.

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1. Introduction

In 2014, the “Recovery Strategy for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*), Alberta populations in Canada [Final]” (DFO 2014) was finalized and published on the Species at Risk Public Registry. In 2019, an amendment was made to the document and it was re-published on the Public Registry as the “Recovery Strategy and Action Plan for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) Alberta Population (also known as Saskatchewan-Nelson River Population) in Canada [Final]” ([DFO 2019](#)) (henceforth called a recovery strategy and action plan). This document outlines the progress made on recovery strategy implementation for the Westslope Cutthroat Trout in Alberta between 2014 and 2019. Since two recovery documents were in place during that timeframe (that is, the recovery strategy until 2019, and the recovery strategy and action plan in the latter part of 2019), this document reports on all activities related to recovery strategy implementation within the five year time frame, but refers specifically to the 2019 recovery strategy and action plan since it replaced the 2014 recovery strategy. Reporting on the progress of recovery efforts will refer to those population and distribution objectives, recovery objectives, schedule of studies to identify critical habitat, and broad strategies and recovery measures that are common to both the 2014 recovery strategy and 2019 recovery strategy and action plan.

This report is one in a series of documents for this species that should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports ([COSEWIC 2006](#); [COSEWIC 2016](#)) and the recovery potential assessment ([DFO 2009](#)).

Section 2 of this progress report summarizes key information on the threats to the population, as well as population and distribution objectives, approaches to meeting the objectives, and progress made in recovery. Section 3 reports the progress on activities identified in the recovery strategy and action plan to support achieving the population and distribution objectives. Section 4 provides a concluding statement about the progress toward achieving the objectives.

2. Background

2.1 COSEWIC assessment summary

The listing of the Alberta population of Westslope Cutthroat Trout in 2013, which led to the development and publication of the recovery strategy in 2014, was based on the information provided in the COSEWIC Status Report (COSEWIC 2006). This information has also been included in Section 1.1 of the Alberta Recovery Plan ([Alberta Westslope Cutthroat Trout Recovery Team 2013](#)), which was included in Part 2 of the 2019 recovery strategy and action plan.

Assessment summary: November 2006

Common name

Westslope Cutthroat Trout

Scientific name

Oncorhynchus clarkii lewisi

Status

Threatened

Reason for designation

Native populations have been reduced by almost 80% through over-exploitation, habitat degradation, and hybridization and competition with introduced, non-native trout. Remaining genetically pure individuals persist as mainly severely fragmented remnant headwater populations. It should be noted that this assessment includes only genetically pure, native populations of the species occurring within their historical range. Any populations known either to be hybridized significantly, (i.e., >1%), with other trout species, or to have been introduced into a system previously free of native populations, were not assessed.

Occurrence

Alberta

Status history

Designated Threatened in May 2005 and in November 2006. Assessment based on a new status report.

In 2016, COSEWIC re-examined and confirmed the status of the Westslope Cutthroat Trout as Threatened (COSEWIC 2016). It also recognized two distinct populations of Westslope Cutthroat Trout in Canada, the Saskatchewan-Nelson River populations (formerly called the Alberta population) in Alberta and the Pacific population in British Columbia (BC) (formerly called the BC population). However, at the time of the publication of this progress report, the Saskatchewan-Nelson River populations are still legally listed under the *Species at Risk Act* (SARA) as the Alberta population.

Assessment summary: November 2016**Common name**

Westslope Cutthroat Trout, Saskatchewan-Nelson River populations

Scientific name

Oncorhynchus clarkii lewisi

Status

Threatened

Reason for designation

This species inhabits cold streams and lakes in southwestern Alberta. It currently has a small declining range, and is severely fragmented. Over the last century, it has undergone substantial range contractions, resulting in a range that is currently less than 20% of that observed historically. Initially, range contraction was due to overharvest and, more recently, due to a combination of hybridization with Rainbow Trout and habitat deterioration. The recent detection of whirling disease in Alberta presents an additional threat to this species.

Occurrence

Alberta

Status history

Designated Threatened in May 2005. Status re-examined and confirmed in November 2006 and November 2016.

2.2 Threats

This section summarizes the information found in the recovery strategy and action plan on threats to survival and recovery of the Westslope Cutthroat Trout Alberta population and threats to its critical habitat.

2.2.1 Threats to the Westslope Cutthroat Trout

Table 1. Summary of the population-level threats identified for the Westslope Cutthroat Trout Alberta population, based on the detailed threats assessment found in Part 2 of the recovery strategy and action plan (DFO 2019).

Threat category	Threat	Activity/Detail	Threat significance ¹
Invasive Species	Hybridization and competition	Rainbow trout	High
Invasive Species	Hybridization and competition	Yellowstone Cutthroat Trout	Moderate
Invasive Species	Hybridization and competition	Coastal Cutthroat Trout	Data Deficient

Threat category	Threat	Activity/Detail	Threat significance ¹
Invasive Species	Hybridization and competition	Golden Trout	Data Deficient
Invasive Species	Competition	Brook Trout	High
Invasive Species	Competition	Brown Trout	Moderate High (National Park)
Invasive Species	Competition	Lake Trout	Low High (National Park)
Invasive Species	Algae	<i>Didymosphenia geminate</i>	Data Deficient
Invasive Species	Pathogens	Whirling Disease	Data Deficient
Invasive Species	Pathogens	Parasites	Low
Adverse Effects on Habitat	Changes in flow	Dam/Reservoir operation	High
Adverse Effects on Habitat	Changes in flow	Forest removal - harvest	Moderate-High Low (National Park)
Adverse Effects on Habitat	Changes in flow	Forest removal - fires	Moderate-High Low (National Park)
Adverse Effects on Habitat	Changes in flow	Water-extraction - surface ground water	Moderate-High Low (National Park)
Adverse Effects on Habitat	Sedimentation	Forest harvest, linear disturbance, grazing off highway vehicles (OHVs), recreational access, instream construction, municipal run-off	High Low (National Park)
Adverse Effects on Habitat	Habitat Loss	Dam and reservoir creation	Moderate-High
Adverse Effects on Habitat	Habitat fragmentation (loss of connectivity)	Dams, culverts	High
Adverse Effects on Habitat	Habitat alteration and loss	Linear disturbance (for example, roads, pipelines, railway, OHVs, recreational trails, culverts)	High
Adverse Effects on Habitat	Habitat alteration and loss	Grazing	Moderate
Adverse Effects on Habitat	Habitat alteration and loss	River training	Moderate
Consumptive Use/ Exploitation	Harvest	Intentional mortality	Low
Consumptive Use/ Exploitation	Harvest	Incidental or accidental mortality	Low
Consumptive Use/ Exploitation	Harvest	Illegal (poaching)	Low-Moderate, Data Deficient
Stocking	Current legal stocking of native fish	Westslope Cutthroat Trout	Low

Threat category	Threat	Activity/Detail	Threat significance ¹
Stocking	Current legal stocking of non-native fish	Rainbow Trout, Brook Trout, Brown Trout, Tiger Trout (and potential pathogens)	Low, data deficient (whirling disease)
Stocking	Illegal stocking of non-native fish	Many potential species	Low-High Low (National Park)
Pollution	Water quality and fish habitat degradation	Point source includes accidental spills associated with road/rail and pipeline crossings	Moderate
Pollution	Water quality and fish habitat degradation	Non-Point source surface run-off (for example, road, salt, increase nutrients as a result of fires)	Moderate
Climate Change	Climate change and severe weather	Increasing temperature trend, altered flow regimes, droughts, high flow events	Moderate-High

¹ Threat Significance – the risk of damage to the Westslope Cutthroat Trout Alberta population from a particular threat, based on its likelihood and extent of occurrence and on the severity and immediacy of its impacts.

2.2.2 Threats to critical habitat

Critical habitat for the Westslope Cutthroat Trout Alberta population is identified, to the extent possible, in section 4 of the recovery strategy and action plan (DFO 2019). Table 2 provides examples of activities that are likely to result in destruction to critical habitat, that is, threats to critical habitat. The list of activities provided in this table is neither exhaustive nor exclusive, and the inclusion of activities has been guided by the relevant threats to habitat described in the recovery strategy and action plan. For more details on the activities likely to result in the destruction of critical habitat, consult the recovery strategy and action plan.

Table 2. Threats to critical habitat of the Westslope Cutthroat Trout Alberta population, extracted from the recovery strategy and action plan (DFO 2019).

Threat	Activities	Effect-Pathway
Changes in flow	Dam/reservoir operation	<ul style="list-style-type: none"> • Loss of riverine, spawning, and riparian habitat • Transformed flow regime in downstream habitats resulting in habitat loss • Decreased movement of stream bed material that could impact redd building (or elimination of bed material that becomes trapped above dams)

Threat	Activities	Effect-Pathway
		<ul style="list-style-type: none"> • Blocked movements of fish both upstream and downstream • Reservoirs often heavily stocked with non-native fishes that are potential competitors to Westslope Cutthroat Trout
Changes in flow	Mechanical forest removal and loss due to high intensity fire	<ul style="list-style-type: none"> • Loss of riparian habitat • Increased peak flow • Altered snow interception and melt processes • Increased run-off resulting in nutrient loading affecting water quality • Increased summer water temperatures (due to loss of riparian habitat) • Reduced channel stability, cover and protection from predators and physical disturbances • Reduced late summer and winter flows
Changes in flow	Water extraction	<ul style="list-style-type: none"> • Decreased water discharge and velocity • Increased water temperature will negatively affect Westslope Cutthroat Trout which is very sensitive to changes in water temperature (preferred temperature range is 9° to 12°C) • Changes to invertebrate production will have negative impact on the diet of Westslope Cutthroat Trout resulting in slower growth • Changes in access to habitat resulting in displacement or stranding of fish
Sedimentation	Forest harvest, linear disturbance, urbanization, mining, grazing, high intensity or frequent off-highway vehicle use, recreational access, instream construction, increased sediment/silt (embeddedness)	<ul style="list-style-type: none"> • Changes to stream structure resulting in habitat loss • Increased fine sediment loading to spawning areas • Redds being trampled or silted in • Destruction of riparian habitat and undercut banks that provide cover • Changes in water temperature, invertebrate communities, and availability and transport of large woody debris
Habitat loss, fragmentation, and/or alteration	Dam or reservoir creation	<ul style="list-style-type: none"> • Associated with smaller scale water storages that are often stocked with non-native species • Water fluctuations would destroy the littoral zone • Destruction of fluvial spawning habitats • Change in habitat structure, cover, change in substrate composition

Threat	Activities	Effect-Pathway
Habitat loss, fragmentation, and/or alteration	Dams (include weirs) or culvert structures	<ul style="list-style-type: none"> • Blocking of upstream and/or downstream fish movements • Loss of migratory life history form (fluvial, adfluvial) • Inability to access habitats to meet all life history requirements
Habitat loss, fragmentation, and/or alteration	Linear disturbance (construction and maintenance or lack of maintenance of roads, pipelines, railway, recreational vehicles, trails)	<ul style="list-style-type: none"> • Increased surface erosion and run-off that impact water quality • Fine sediment deposition affecting spawning grounds and general habitat of Westslope Cutthroat Trout that prefer clear, cold water • Increased anthropogenic access to habitat, potential for increased riparian and aquatic habitat degradation • Physical loss of habitat from construction and use (for example, footprints) • Barriers to movement (for example, impassable culverts)

2.3 Recovery

This section summarizes the information found in the recovery strategy and action plan (DFO 2019) on the population and distribution objectives that are necessary for the recovery of Westslope Cutthroat Trout Alberta population.

2.3.1 Population and distribution objectives

Section 2 of the recovery strategy and action plan (DFO 2019) identified the following population and distribution objectives for the Westslope Cutthroat Trout Alberta population:

- protect and maintain the existing distribution of ≥ 0.99 genetically pure populations of Westslope Cutthroat Trout
- re-establish genetically pure populations to self-sustaining levels, within the species' original distribution in the Saskatchewan-Nelson River watershed in Alberta

Based on these overall population and distribution objectives, the following specific objectives were proposed to meet recovery goals and objectives, and to address threats to the survival of the species:

- identify and protect critical habitat for remaining genetically pure populations
- improve knowledge of populations genetics¹, size, distribution, and trends
- identify opportunities to help recover genetically pure and near-pure categories of Westslope Cutthroat Trout, partly by restoring habitat and eliminating or suppressing populations of non-native fish that are having negative impacts on Westslope Cutthroat Trout

¹ Including adopting novel analyses and tools as they become available and appropriate.

- increase education and awareness of Westslope Cutthroat Trout for their conservation
- re-establish genetically pure populations of Westslope Cutthroat Trout at sites within their historical range that recognize the diversity of their life history strategies in Alberta

2.3.2 Performance indicators

The recovery strategy and action plan did not include performance indicators. The progress towards achieving population and distribution objectives will be measured by the progression made under the approaches and studies in section 3 of the recovery strategy and action plan (DFO 2019).

3. Progress towards recovery

The recovery strategy and action plan for Westslope Cutthroat Trout Alberta population (DFO 2019) divides the recovery effort into four broad strategies: 1) research, 2) monitoring, 3) management and regulation, and 4) education and outreach. Progress in carrying out these broad strategies is reported in section 3.1 of this progress report. Section 3.2 reports on the activities identified in the schedule of studies to identify critical habitat. Section 3.3 reports on the progress made towards the recovery of the species and other commitments (for example, completion of the action plan and Critical Habitat Order).

3.1 Activities supporting recovery

Table 3 provides information on the implementation of activities undertaken to address the broad strategies and recovery actions identified in the recovery strategy and action plan (DFO 2019).

Table 3. Details of activities supporting the recovery of the Westslope Cutthroat Trout Alberta population from 2014 to 2019.

Activity	Approach	Broad strategy	Descriptions and results	Participants*
Using standardized sampling techniques and genetic analysis, conduct surveys to characterize the genetic structure and status of priority Westslope Cutthroat Trout populations in the species' original distribution. Particular consideration should be applied to areas with no, or incomplete, information to determine whether additional populations of Westslope Cutthroat Trout exist within their original distribution.	Improve knowledge of population genetics	Research	Extensive genetic sampling has been conducted since 2006 in the Bow and Oldman River drainages to delineate the distribution and genetic status of Westslope Cutthroat Trout populations.	Alberta Environment and Parks (AEP), Fisheries and Oceans Canada (DFO), Parks Canada Agency (PCA)

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Improve knowledge of population genetics	Research	Genetic sampling using a genome-wide approach was conducted on pure individuals in certain areas where genetic studies have previously been conducted, to characterize the permeability of the Westslope Cutthroat Trout genome and identify the genes that differentiate pure and hybrid individuals. Pure individuals that are profiled will be integrated into a recovery and restoration plan.	AEP
As above.	Improve knowledge of population genetics	Research	Westslope Cutthroat Trout Genetic Delineation Project maps the genetic status of all fishes in Westslope Cutthroat Trout streams in Alberta from the headwaters downstream to the historical extent of the species on the Bow and Oldman River drainages. This information will be used to direct and inform future work in order to fill data gaps and improve certainty, as well as to make informed management decisions towards best practices recovery of Westslope Cutthroat Trout on the landscape.	AEP
As above.	Improve knowledge of population genetics	Research	Westslope Cutthroat Trout genetics using single nucleotide polymorphism (SNP) markers are currently being used to provide an increased accuracy and precision of estimates of hybridization with non-native trout throughout the range of Westslope Cutthroat Trout. They will also distinguish native versus introduced Cutthroat Trout populations, identify potential source and target populations for stocking, highlight	AEP, DFO, University of Montana

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			potential for unique genetic diversity, and local adaptations in certain subpopulations of Westslope Cutthroat Trout in Alberta.	
As above.	Improve knowledge of population genetics	Research	PCA organized a workshop in 2017 to develop standardized genetic sampling techniques and analysis (using SNP markers) to determine hybridization levels in Westslope Cutthroat Trout populations. Participants were from AEP, PCA, DFO, British Columbia (BC) Ministry of Forests, Lands and Natural Resource Operations, the universities of Calgary, Alberta, BC, and Montana, as well as Montana Fish, Wildlife and Parks, and the United States Geological Survey.	PCA , AEP, DFO, University of Montana
As above.	Improve knowledge of population genetics	Research	RADcapture genomic technique was used to determine genetic markers of Westslope Cutthroat Trout and Rainbow Trout throughout most of their ranges. Diagnostic loci for each species have been assembled and will be used to analyse all future samples from PCA.	PCA , University of Montana
As above.	Improve knowledge of population genetics	Research	Lake sediment eDNA was used to reconstruct the >100-year colonization history of Westslope Cutthroat Trout in high elevation lakes in Banff National Park (Nelson-Chorney et al. 2019). Two lakes were found to have had Westslope Cutthroat Trout pre-dating human introductions. One of the lakes had no evidence of stocking since the stocking era began, suggesting the original population was still intact. With these data, two new	PCA , Alberta Conservation Association (ACA), DFO, University of Alberta

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			lakes were added to the list of pure Core populations.	
Classify and prioritize existing stream and lake populations according to status of threats and determine how threat elimination and mitigation might contribute to an increase in pure populations that are sustainable and resilient. Where desirable, examine the feasibility of enhancing existing populations by stocking, and keeping genetic diversity issues of utmost priority.	Conduct feasibility studies of recovering existing populations within historical range	Research	In 2015, two sites were sampled in the Upper Bow section of Banff National Park to determine if Westslope Cutthroat Trout are present and genetically pure.	PCA
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	A population assessment was completed in 2014 in the Picklejar Lakes, which resulted in a change from a daily recreational fishing bag limit to catch-and-release only regulations.	AEP, DFO
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	A risk assessment was completed for Westslope Cutthroat Trout in Helen Creek, from 2013 to 2014, to determine the risk of losing the population through competitive exclusion from Brook Trout or genetic introgression from Yellowstone Cutthroat Trout.	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	Alberta developed a Fish Sustainability Index and Fisheries Management Objectives for waterbodies that contain Westslope Cutthroat Trout.	AEP
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	The East Slope Riparian Assessment Project, conducted from 2015 to 2017, contributed to a better understanding of the riparian conditions and threats associated with land-use activities in the headwaters of the Bow and Oldman Rivers' watersheds in Alberta. The project found, on average, the riparian conditions across the study area were "functional but at high risk". It concluded that the poor riparian conditions in 55% of the streams were caused by natural events with the 2013 flood as a significant contributor, and the major anthropogenic factors associated with riparian decline are animal disturbances, specifically related to trampling by livestock and other animals, as well as grazing, erosion from roads/trails and recreation.	AEP, DFO

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	From 2017 to 2018, the Habitat Stewardship Program (HSP) funded a study to develop a barrier assessment methodology and concluded that barriers were complex features where passability could not be determined by simple barrier matrices such as height and length, water velocity, or fish performance. Further studies are required to develop a comprehensive classification and ranking system to effectively catalogue, analyze, and assess barrier features.	ACA, DFO
As above.	Conduct feasibility studies of recovering existing populations within historical range	Research	PCA modelled the distribution of <i>Tubifex tubifex</i> , the secondary host of <i>M. cerebralis</i> , based on landscape characteristics that can be used to predict risk of future infection. Two watersheds were sampled in Banff National Park. One watershed has a natural flow regime (Cascade watershed) and the other watershed was regulated by a hydropower dam (Spray watershed).	PCA
Conduct ongoing spatial and temporal population monitoring on priority populations. Monitoring should include population estimates, relative abundance, distribution, population structure (for example, size-frequency distribution, life history stage), genetic status, as well as abundance and distribution of non-native species. Frequency of monitoring will depend on the	Population monitoring	Monitoring	In 2015, PCA electrofished 106 randomly-allocated sites in the Upper Cascade watershed as part of Banff National Park’s routine stream fish monitoring (Hunt 2018). The occurrence of native trout such as Westslope Cutthroat Trout was three times higher than non-native trout. The long-term effects of removing rainbow trout from Rainbow Lake can be monitored using these data, as well as potential changes to non-native trout distributions in response to	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
priority of the population and whether monitoring is related to a restoration or mitigation project.			climate change. This survey will be repeated in 2025.	
As above.	Population monitoring	Monitoring	Sonotronics tags in conjunction with traditional hydroacoustic surveys sonars were used in Sawback Lake as a method counting both the pelagic and littoral Westslope Cutthroat Trout.	PCA
As above.	Population monitoring	Monitoring	In 2018, ACA established 39 sites and took genetic samples of Westslope Cutthroat Trout in the Upper Oldman River core area. These sites will form part of an ongoing Westslope monitoring program to gauge fish population responses to recent government land management alterations and proposed restoration projects. Two annual summary reports on current abundance and distribution of Westslope Cutthroat Trout were finalized in February and March 2020.	ACA
As above.	Population monitoring	Monitoring	Trout Unlimited Canada sampled previously unsampled tributaries of Waiparous Creek above and below two hanging culverts to determine genetic status and feasibility of reconnecting these streams (Genetic results pending).	Trout Unlimited Canada

Activity	Approach	Broad strategy	Descriptions and results	Participants*
<p>Prepare a priority list of waterbodies where suppression or removal of non-native species or a genetic recovery may be feasible. Based on this list, conduct pilot projects on candidate waterbodies and evaluate effectiveness before proceeding with additional projects. A review of existing literature and consultations with other jurisdictions, that is PCA, on similar projects should be conducted when designing methods.</p> <p>Note: The descriptions and results presented for this activity represent steps that will support the preparation of a priority list of waterbodies where suitable locations for the recovery of the species will be both maintained and promoted.</p>	<p>Limit the spread of non-native species</p>	<p>Management and regulation</p>	<p>In 2015, new federal <i>Aquatic Invasive Species Regulations</i> came into force to strengthen the prevention of aquatic invasive species (AIS) in Canadian waters. The Regulations provide tools for both DFO and provinces to prevent the introduction and spread of AIS and also greatly improve the ability to respond rapidly to an invasion or to manage the spread of established AIS.</p>	<p>DFO</p>
<p>As above.</p>	<p>Limit the spread of non-native species</p>	<p>Management and regulation</p>	<p>Angler surveys conducted on the Bow and Oldman Rivers, in partnership with the ACA in 2018, were used to assess anglers' level of awareness and understanding of whirling disease. To increase general knowledge of whirling disease in Alberta, AEP has updated signage, provided ongoing website updates, and attended numerous events and engagement sessions from 2016 to 2019.</p>	<p>ACA, AEP</p>

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Limit the spread of non-native species	Management and regulation	Amendments to the <i>Fisheries Act</i> of Alberta included the creation of a prohibited species list for AIS and mandatory stopping at designated boat inspection stations.	AEP
As above.	Limit the spread of non-native species	Management and regulation	Angling regulations in Waterton Lakes National Park, modified in 2011, prohibit the retention of Westslope Cutthroat Trout from waters with native or genetically pure introduced Westslope Cutthroat Trout populations.	PCA
As above.	Limit the spread of non-native species	Management and regulation	Decontamination protocol for provincial and federal government employees and contractors working in waterways. Protocol is effective against a variety of invasive species and has been successfully applied in all of the Rocky Mountain National Parks and the province of Alberta.	AEP, PCA
As above.	Limit the spread of non-native species	Management and regulation	Significant changes to angling regulations to reduce the spread of whirling disease were made by PCA, including: a) change to a catch and release only fishery in most waterbodies in Banff National Park to prevent the movement of dead fish, b) ban on felt-soled waders, and c) closure of all “Core” Westslope Cutthroat Trout waterbodies in Banff Park to reduce human vectors for whirling disease.	PCA
As above.	Limit the spread of non-native species	Management and regulation	Removal of whirling disease affected non-native fish populations in Banff National Park (Little Herbert Lake, and Johnson Lake reservoir) to reduce risk of whirling disease spreading to adjacent waterbodies.	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Limit the spread of non-native species	Management and regulation	Following concerns about population-level impacts to Rainbow Trout, AEP's Whirling Disease Program conducted a sentinel cage study in the Crowsnest River using Rainbow Trout. High parasite levels detected in the Crowsnest River and present growing concern for Westslope Cutthroat Trout that live in hydrologically connected waterbodies.	AEP
As above.	Limit the spread of non-native species	Management and regulation	Stream temperature data can be used as a preliminary, non-lethal method to understand the establishment potential and severity of <i>M. cerebralis</i> infections in untested watercourses. AEP established over 100 overwintering stream temperature monitoring sites within or adjacent to Westslope Cutthroat Trout populations as part of an ongoing stream temperature program started in 2018. All data has been submitted to the open-access provincial database, Fisheries and Wildlife Management Information System (FWMIS).	AEP
As above.	Limit the spread of non-native species	Management and regulation	AEP's Whirling Disease Program tested over 4,600 susceptible trout and whitefish individuals from the Bow and Oldman River drainages within and adjacent to Westslope Cutthroat Trout habitat to detect the presence of <i>M. cerebralis</i> , the causative agent for whirling disease. Approximately 60% of watercourses sampled in the Bow and Oldman River drainages have tested positive for the parasite, indicating an elevated risk to Westslope Cutthroat Trout.	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Limit the spread of non-native species	Management and regulation	Conventional methods to detect the whirling disease parasite require lethal sampling, which is problematic for species at risk such as Westslope Cutthroat Trout. AEP's Whirling Disease Program collaborated with whirling disease experts from the United States and researchers at the University of Alberta to develop and validate innovative non-lethal sampling and testing methods.	AEP
Recover priority populations, where feasible, to increase population levels and re-establish populations in candidate areas within the species' original distribution, by protecting and/or restoring habitat, managing harvest, reducing hybridization and eliminating or suppressing populations of non-native fish that are having negative impacts on Westslope Cutthroat Trout.	Recovery of populations within the historical range	Management and regulation	AEP provided funding and worked with several partners on the Backcountry Trail Flood Rehabilitation Program to inventory, repair, and restore backcountry trail systems on public lands along the eastern slopes from 2014 to 2019. Projects completed in areas (identified by Hydrologic Unit Codes) containing Westslope Cutthroat Trout resulted in 5,358 km of trail inventoried for flood damage, 155 bridges installed or repaired, 500 km of trails restored and 6,500 hours of volunteer partnership contribution.	AEP
As above.	Recovery of populations within the historical range	Management and regulation	The Southern Alberta Fisheries Habitat Enhancement and Sustainability (FISHES) program is directed at habitat restoration projects in areas of high disturbance due to flood-related impacts to restore and enhance aquatic productivity and fish populations at a watershed level. Habitat mitigation projects such as bank and gravel bar stabilizations, trail closures and improvements, and river reconstruction, have been completed on Silvester, Allison, Lynx, Waiparous, Hidden,	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			and Girardi Creeks, as well as Carbondale River. Trout Unlimited Canada partnered on the streambank rehabilitation of Hidden and Girardi Creeks.	
As above.	Recovery of populations within the historical range	Management and regulation	The Roadway Watercourse Crossing Remediation Directive was established in March 2015 with the intent to protect or restore fish habitat through effective stream-crossing practices and to promote and support a watershed-based approach to effective, collaborative watercourse-crossing inspection, monitoring, management, and remediation.	AEP, AER
As above.	Recovery of populations within the historical range	Management and regulation	In 2017 and 2018, stream crossing improvements were made on Gold Creek. Two off highway vehicles (OHV) bridge crossings were installed on the main-stem of Gold Creek and two on tributaries. In addition, hitching posts were installed on duplicate crossings in the area to exclude traffic.	AEP
As above.	Recovery of populations within the historical range	Management and regulation	A Watercourse Crossing Program was developed to address threats to fish survival stemming from poorly constructed and maintained watercourse crossings that cause habitat fragmentation, erosion, and sedimentation. The program involves watercourse-crossing inspections, reporting, compliance and, if needed, remediation. A citizen science app, Alberta Watercourse Crossing Inventory, was developed for identifying problem crossings.	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Recovery of populations within the historical range	Management and regulation	In 2015 and 2016, the ACA assessed Westslope Cutthroat Trout abundance and population structure relative to sediment quantity in the Upper Oldman River core area. A report was completed in 2017 and posted to the ACA website titled: Trends in Distribution and Abundance of Westslope Cutthroat Trout and Sedimentation in the Upper Oldman River Watershed, 2015 to 2016.	ACA
As above.	Recovery of populations within the historical range	Management and regulation	Castle Provincial Park and Castle Wildland Provincial Park were established in 2017 and encompass several areas of critical habitat for Westslope Cutthroat Trout. Existing recreational activities are managed for their compatibility with conservation objectives. Land uses such as grazing, recreation and access by Indigenous Peoples will be managed to achieve a balance between the demands and conservation intent.	AEP
As above.	Recovery of populations within the historical range	Management and regulation	Development and implementation of the Livingston-Porcupine Hills Recreation Management Plan and Land Footprint Management Plan took place in 2017 and 2018, respectively. Public Land Use Zones for the Livingstone-Porcupine Hills areas were established effective May 2018 and encompass streams bearing Westslope Cutthroat Trout and Bull Trout. The Public Land Use Zone enables recreation management in the Livingston-Porcupine Hills as specified in the Recreation	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			Management Plan. The Livingston-Porcupine Hills Land Footprint Management Plan sets limits and thresholds for motorized access density including roads and trails, and sets spatial human footprint targets based on Valued Ecosystem Components including Westslope Cutthroat Trout.	
As above.	Recovery of populations within the historical range	Management and regulation	Non-native Brook Trout were removed from Hidden Lake and upper Corral Creek in Banff National Park from 2011 to 2018, using netting, electrofishing, angling and a compound called rotenone. Once all Brook Trout are confirmed to be removed from this area, it will be restocked with Westslope Cutthroat Trout.	PCA, AEP, DFO, Trout Unlimited Canada
As above.	Recovery of populations within the historical range	Management and regulation	In 2015, Rainbow Trout were removed from Rainbow Lake since they were the source of hybrids (that is, crosses between Rainbow Trout and Westslope Cutthroat Trout) and Rainbow Trout appearing in Sawback Creek. This removal restored the genetic integrity of Westslope Cutthroat Trout in Sawback Creek, which is a tributary of the Cascade River.	PCA
As above.	Recovery of populations within the historical range	Management and regulation	Westslope Cutthroat Trout are reappearing in Cascade Creek, within their historic range in Banff National Park. Cascade Creek is a small creek that flows out of Minnewanka Dam and has been impacted by river regulation and historic brook trout stocking. Brook Trout have now been removed from Cascade Creek. The channel and flow regime are being restored to match the hydraulic	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			needs of Westslope Cutthroat Trout. A fish barrier has been installed at the terminus of Cascade Creek to support future goals of reintroducing Westslope Cutthroat Trout. Westslope Cutthroat Trout in Cascade Creek will have downstream passage, yet will also be protected from upstream invasion by non-native trout in the Bow River.	
As above.	Recovery of populations within the historical range	Management and regulation	Alberta Forestry and forestry Research Institute (fRI) developed the Road Erosion and Delivery Index and netmap modelling platform to help identify and prioritize field assessments and restoration of legacy sediment sources from linear features.	Province of Alberta, fRI
As above.	Recovery of populations within the historical range	Management and regulation	The method of Remote Streamside Incubation (RSI) of Westslope Cutthroat Trout eggs was tested as a proof of concept study in Gold Creek in 2018. In 2019, AEP began using RSI to introduce Westslope Cutthroat Trout into barren stream sections above barriers in the headwaters of the Oldman River (Slacker Creek, native Westslope Cutthroat Trout range). This project is intended to continue for a minimum of four more years, and will likely expand to other streams in the native Westslope Cutthroat Trout range.	AEP
As above.	Recovery of populations within the historical range	Management and regulation	Thermographs were used to collect water temperature data at sites found to be fishless during surveys, but which may have potential as refuges, that is, assisted colonization.	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Recovery of populations within the historical range	Management and regulation	AEP has worked with Alberta Riparian Habitat Management Society (Cows and Fish) in conducting a stream-crossing and habitat restoration project at O’Haggen Creek which involved bioengineering and seeding. AEP worked with other organizations, including Alberta Riparian Habitat Management Society, Oldman Watershed Council, Spray Lakes Sawmills, Crowsnest Pass Quad Squad, Ghost Watershed Alliance Society, Elbow River Watershed Partners, Trout Unlimited Canada, Alberta Conservation Association and various recreation clubs and industrial partners to implement or helped fund riparian habitat improvement projects on Allison, Smith, Silvester, Beaver, Dutch and South Racehorse Creeks, and human impact mitigation signage at Gold, Green and Dome Creeks.	AEP, Alberta Riparian Habitat Management Society (Cows and Fish)
As above.	Recovery of populations within the historical range	Management and regulation	Alberta Riparian Habitat Management Society (Cows and Fish) have conducted extensive assessments of riparian health status and habitat improvement needs for Westslope Cutthroat Trout streams across the eastern slopes. The riparian health inventory monitoring data is collected to offer a baseline understanding of existing Westslope Cutthroat Trout habitat, help direct implementation work, and help evaluate the impact of implementation work.	Alberta Riparian Habitat Management Society (Cows and Fish)

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Recovery of populations within the historical range	Management and regulation	<p>The Government of Alberta funds grants for mitigation measures to reduce the intensity, magnitude, duration, and effects of flooding and drought through the Watershed Resiliency and Restoration Program. Several projects that received grants have been located in Westslope Cutthroat Trout range including:</p> <ul style="list-style-type: none"> • Alberta Riparian Habitat Management Society (Cows and Fish) – worked with 13 riparian landowners to support 18 projects that benefited riparian habitat, some of which were in Westslope Cutthroat Trout habitat • Elbow River Watershed Partnership – conducted soil bioengineering on degraded sites in the Elbow River headwaters and provided education and engagement for local volunteers • fRI Research – conducted riparian assessment of Rocky Mountain southeast slopes and developed a tool for prioritization of on-the-ground restoration in forested riparian areas • Oldman Watershed Council – conducted riparian health assessments at 28 sites, engaged 60 landowners on riparian management practices, installed fencing along the Crowsnest River, and delivered 12 outreach events to 497 people • Southern Alberta Land Trust Society – mapped hydrological priority areas in 	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			<p>Oldman River basin and conducted landowner engagement to promote stewardship and conservation practices.</p> <ul style="list-style-type: none"> • Oldman Watershed Council - worked with AEP on public lands to increase stewardship, restoration, and behavioural change in recreation management. • Castle Grazing Stewardship Group – purchased and deployed portable fencing systems in Castle Park to improve ecological integrity of grazing areas. 	
As above.	Recovery of populations within the historical range	Management and regulation	Under AEP’s management, that is, since 2016, all external and internal development projects in Castle Provincial Park and Castle Wildland Provincial Park have been subject to an enhanced environmental screening process. Components of the Environmental Review process include identification of potential project impacts on fish habitat and populations, including Westslope Cutthroat Trout, and assignment of applicable setbacks and mitigations as required (for example, adherence to species’ specific Restricted Activity Periods).	AEP
As above.	Recovery of populations within the historical range	Management and regulation	Development and implementation of the Castle Management Plan (2018), which specifically identifies strategies for protecting Westslope Cutthroat Trout, including a commitment to “apply best practices to	AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			<p>manage Westslope Cutthroat Trout habitat and buffer zones. Additional buffers will be established in areas that will enhance the critical habitat.” In line with this commitment, a rigorous planning process has been undertaken, resulting in the draft Castle Development Plan and draft Trails Strategy being published in 2018. Both documents support minimizing or phasing out undesignated trails and routes where possible, as part of ensuring protection of various conservation and biodiversity goals identified in the management plan. The development of a reclamation plan for the Castle also commenced in 2019, with Alberta Parks’ restoration projects occurring as part of infrastructure development and enhancement. An example of one restoration project included willow staking along a portion of the West Castle River adjacent to the Syncline Group Use facility in 2019 to reduce erosional issues and sediment loading into fish bearing habitat at the site.</p>	
<p>As above.</p>	<p>Recovery of populations within the historical range</p>	<p>Management and regulation</p>	<p>Trout Unlimited Canada carried out bioengineering and OHV access control/trail rerouting and OHV bridge replacement in the Waiparous Watershed.</p>	<p>Trout Unlimited Canada, Alberta Backcountry Hunters and Anglers, Ghost Watershed Alliance,</p>

Activity	Approach	Broad strategy	Descriptions and results	Participants*
				Calgary ATV riders association, and Alberta Riparian Habitat Management Society (Cows and Fish)
<p>Identify target audiences (for example, landowners, anglers, industry, contractors, general public) and determine how each may contribute to and/or be impacted by recovery plan activities and why protecting/recovering genetically pure populations of Westslope Cutthroat Trout is important (explain genetic tools, principles and why this matters). Based on this information, define key messages and outreach options (for example, target social media, community meetings, signage, fact sheets, popular articles, podcasts, digital stories, information-specific items in sport fishing regulations, GPS features, Bow Habitat Station) to target each group.</p>	<p>Improve awareness of the species</p>	<p>Education and outreach</p>	<p>A short film about the introduction of Westslope Cutthroat Trout into Rainbow Lake was developed (titled: “One Hundred”). It highlighted the relevance of Westslope Cutthroat Trout to the Rocky Mountain ecosystem and the importance of conserving this increasingly rare species on the landscape.</p>	<p>PCA</p>

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Improve awareness of the species	Education and outreach	The “Don’t Let It Loose” campaign was developed to discourage aquatic invasive species (AIS) introductions (aquarium pets, water garden plants, live food or live bait). The campaign included education and awareness of AIS prevention initiatives.	AEP
As above.	Improve awareness of the species	Education and outreach	The “Clean, Drain and Dry” campaigns were developed to discourage AIS and disease introductions via watercrafts and associated gear. The campaign included education and awareness of AIS prevention initiatives related to zebra or quagga mussels, invasive plants, whirling disease.	AEP, PCA
As above.	Improve awareness of the species	Education and outreach	A Westslope Cutthroat Trout fact sheet has been created to provide information on the species, its threats and protection under the <i>Species at Risk Act</i> .	DFO
As above.	Improve awareness of the species	Education and outreach	<p>In-park interpretive programs were offered for visitors at campgrounds and at popular day-use areas in the southern portion of Banff National Park. The programs focussed on Westslope Cutthroat Trout as a species at risk, the Rainbow Lake project, and the Cascade Creek Restoration Project.</p> <p>Temporary in-park interpretive signage was created for sections of the Banff Legacy Trail and at Cascade Ponds day use area, explaining the Cascade Creek Restoration Project.</p>	PCA

Activity	Approach	Broad strategy	Descriptions and results	Participants*
As above.	Improve awareness of the species	Education and outreach	Since 2016, PCA has provided more than 15 media interviews, including at least one proactive pitch per year about Westslope Cutthroat Trout and/or the Cascade Creek Restoration Project in Banff National Park. The story has garnered local, regional and national coverage from outlets including the Rocky Mountain Outlook, Canadian Broadcasting Corporation, and Canadian Press. In 2019, one story featuring the Cascade Creek Restoration Project had the potential reach of more than 5.2 million readers.	PCA
As above.	Improve awareness of the species	Education and outreach	Supported by funds from the Canada Nature Fund for Aquatic Species at Risk, AEP has created partnerships with many organizations for native trout conservation, including Westslope Cutthroat Trout. Resources are being used for on-the-ground activities and education initiatives. These funds must be matched one-to-one with provincial or other partner dollars.	AEP, DFO
As above.	Improve awareness of the species	Education and outreach	DFO and AEP developed and installed educational signage for Westslope Cutthroat Trout to increase public awareness of the species and promote conservation (2018). Signs were installed along Waiparous Creek (near critical habitat), in the Ghost Public Land Use Zone.	DFO, AEP
As above.	Improve awareness	Education and outreach	DFO's Conservation and Protection Program and AEP developed and installed signage targeting off-highway vehicle users near	DFO, AEP

Activity	Approach	Broad strategy	Descriptions and results	Participants*
	of the species		waterways along Gold Creek and Sylvester Creek in Alberta. Additional signs were installed along streams in the Livingstone and Porcupine Hills area (2018).	
As above.	Improve awareness of the species	Education and outreach	Annual Westslope Cutthroat Trout Stakeholder Workshops were held in partnership with Alberta Riparian Habitat Management Society (Cows and Fish), Oldman Watershed Council, AEP and other partners to inform stakeholders of research, projects, fish status and needs. Many of the conservation organizations, including the Oldman Watershed Council, Alberta Riparian Habitat Management Society (Cows and Fish), Trout Unlimited Canada and others have continued to deliver in-person, written, and on-line information to increase awareness of the species and land use impacts.	AEP, Alberta Riparian Habitat Management Society (Cows and Fish), Oldman Watershed Council, Trout Unlimited Canada
As above.	Improve awareness of the species	Education and outreach	The Oldman Watershed Council has been using their Engaging Recreationists Program to engage backcountry users in restoring places where Albertans recreate, changing behaviours to reduce impacts, and becoming better environmental stewards. The Oldman Watershed Council has Outreach Assistants out in the backcountry to engage with motorized recreationists, random campers, anglers, and boaters. They help people understand the cumulative effects of linear development (such as roads, industry access routes or recreational trails) on the watershed	Oldman Watershed Council

Activity	Approach	Broad strategy	Descriptions and results	Participants*
			to protect the headwaters, water quality, and critical habitat for Westslope Cutthroat Trout in the Oldman watershed.	
As above.	Improve awareness of the species	Education and outreach	Enforcement advisories have been provided to Alberta Fish and Wildlife officers to assist in directing enforcement efforts to areas of highest concern for Westslope Cutthroat Trout protection.	AEP
As above.	Improve awareness of the species	Education and outreach	Annual outreach activities to enhance awareness and communicate on restoration include social media updates, newsprint, radio, conferences, and public meetings.	PCA

*Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all activities have specific participants identified.

3.2 Activities supporting the identification of critical habitat

Table 4 provides information on the implementation of the studies outlined in the schedule of studies to identify critical habitat within the recovery strategy. Each study has been assigned one of four statuses:

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

Table 4. Status and details of the implementation of the schedule of studies outlined in the recovery strategy and action plan (DFO 2019).

Study	Timeline	Status	Descriptions and results	Participants*
Studies to identify and describe life history, movement and habitat use by life-stage (includes quality of habitats)	2017 to 2021	Completed	A bioenergetics study showed that at 10°C, the standard metabolic rate, spontaneous maximum metabolic rate, and forced metabolic rate of Westslope Cutthroat Trout were higher than those of the Rainbow Trout. Correspondingly, both the spontaneous and forced aerobic scope (difference between standard and maximum metabolic rates) was higher in Westslope Cutthroat Trout than Rainbow Trout (Enders and Murray 2016). Metabolic rates of Westslope Cutthroat Trout increase with water temperature and body mass. Aerobic scope reaches an optimum at approximately 15°C. Heat stress was observed at temperatures greater than 20°C (Macnaughton et al. 2019). These results suggest that thermal performance alone may not drive the observed distribution range of Westslope Cutthroat Trout in Alberta.	Fisheries and Oceans Canada (DFO)

Study	Timeline	Status	Descriptions and results	Participants*
As above.	2017 to 2021	Completed	A study characterizing thermal biology of Westslope Cutthroat Trout, using laboratory-raised juveniles, showed its average daytime temperature preference was 18.6°C±0.7°C and, on average, it preferred temperatures ranging between 17.7°C and 20.6°C. (Note: juveniles were raised at 12°C and therefore may prefer warmer temperatures). There were significant diel fluctuations in behaviour; fish preferred higher temperatures and decreased their swimming speed between 20:00h to 08:00h, suggesting juveniles chose the warmer experimental chamber to rest during the night. The study showed photoperiod significantly influenced temperature preferences; nighttime temperature preference consistently reached 26°C (Macnaughton et al. 2018). The results of this study may direct research into the possibility of re-establishing Westslope Cutthroat Trout populations in its historic warmer habitat, such as the plains, rather than its current cold headwaters habitat. Also, the species' preference for warmer temperatures may mean it is more likely to be able to adapt to such conditions in the future as a result of climate change.	DFO
As above.	2017 to 2021	Completed	Water temperature was monitored to better understand long-term trends in stream temperature, and how stream temperature affects the distribution of Westslope Cutthroat Trout as the species responds to climate change. A stream temperature model was completed for Banff National Park and will be updated as loggers are deployed permanently.	Parks Canada Agency (PCA)
As above.	2017 to 2021	In progress	All core populations of Westslope Cutthroat Trout in Banff National Park, as identified in the recovery strategy, have been closed to angling and aquatic recreation to prevent the spread of AIS as these threats are being investigated.	PCA
As above.	2017 to 2021	In progress	A ten-year riparian habitat enhancement agreement was signed between the Alberta Conservation Association (ACA) and a landowner in the headwaters of Todd Creek in 2018. Habitat improvements on the property included leasing of idled habitat, construction of off-site watering troughs, riparian exclusion fencing, and winterizing a portable watering unit. An annual summary report was completed March 2019, which outlines habitat securement and enhancement activities on the property.	ACA

Study	Timeline	Status	Descriptions and results	Participants*
As above.	2017 to 2021	Completed	The distributions of Westslope Cutthroat Trout in the Cascade River and Spray watersheds have been modelled. Genetic samples have been archived for long-term monitoring of hybridization.	PCA
As above.	2017 to 2021	Completed	Watershed-scale population assessments were conducted on select streams in the Bow and Oldman watersheds. These assessments will help establish distribution, relative abundance, absolute density and population structures of pure and near-pure Westslope Cutthroat Trout. Habitat use and conditions will also be monitored. These data will be used to update the Alberta Fish Sustainability Index and to update critical habitat.	Alberta Environment and Parks AEP, DFO
Studies to identify suitable habitats and identify areas where genetic recovery of pure-strain Westslope Cutthroat Trout is feasible (outside current areas occupied by pure-strain populations)	2017 to 2021	Completed	Non-native Rainbow Trout and Rainbow Trout and Westslope Cutthroat Trout hybrids were removed from Sawback Creek (2011 to 2014) (Nelson-Chorney et al. 2019). This improved the genetic purity of the population, thus establishing a new population of pure Westslope Cutthroat Trout in Sawback Creek.	PCA

Study	Timeline	Status	Descriptions and results	Participants*
As above.	2017 to 2021	Completed	Non-native Brook Trout were removed from Cascade Creek (2011 to 2016). Work to restore hydraulic habitat suitable for re-introducing Westslope Cutthroat Trout also took place.	PCA
As above.	2017 to 2021	Completed	Environmental DNA analysis of sediment from Marvel and Mystic Lakes in Banff National Park, 2014 to 2016, revealed historic presence of Westslope Cutthroat Trout. Both lakes are now considered critical habitat.	PCA, ACA, DFO, University of Alberta
Studies to determine the width of riparian habitat**	2019 to 2023	Completed	DFO’s Canadian Science Advisory Secretariat (CSAS) completed a research document titled “Review of information to guide the identification of Critical Habitat in the riparian zone for listed freshwater fishes and mussels” (Caskenette et al. 2020). This document is a literature review to determine the relevant riparian features and the processes by which they affect aquatic features and water quality attributes. Westslope Cutthroat Trout was used in one of the case studies in this document, in an example of how practitioners may apply the guidance to determine riparian Critical Habitat for a listed species. This document can be used to inform future refinements the definition of riparian Critical Habitat for Westslope Cutthroat Trout.	DFO
As above.**	2019 to 2023	Completed	DFO’s CSAS completed the document titled “Guidance on the identification of Critical Habitat in the riparian zone for freshwater species at risk” (DFO 2020). This document provides guidance on the identification of Critical Habitat in the riparian zone for freshwater species at risk, while building on and complementing the Department’s existing approaches to identify Critical Habitat. This document can be used to inform future refinements to the definition of riparian Critical Habitat for Westslope Cutthroat Trout.	DFO, Alberta Riparian Habitat Management Society (Cows and Fish), British Columbia Environment

Study	Timeline	Status	Descriptions and results	Participants*
Studies to better understand the thresholds of tolerance to disturbance from human activities	2017 to 2021	In progress	Modelling is underway to assess the cumulative effects of factors such as habitat degradation, climate change and consumptive pressure on Westslope Cutthroat Trout within the Saskatchewan-Nelson River watershed in Alberta.	AEP

*Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all studies have specific participants identified.

**Study was completed in 2020 and is outside of the scope of this progress report. However it was included as it will contribute to our understanding and identification of riparian critical habitat.

3.3 Summary of progress towards recovery

3.3.1 Status of progress

One of the greatest and most challenging threats to the continued existence of native Westslope Cutthroat Trout in Alberta is the hybridization and introgression (the transfer of genes from one species to another) with closely related species, such as Rainbow Trout and other cutthroat subspecies. In order to meet the population and distribution objective of protecting and maintaining the existing distribution of genetically pure populations of Westslope Cutthroat Trout, progress must be made to understand the population genetics of the Westslope Cutthroat Trout. A genome-wide approach was used to determine genetic status for Westslope Cutthroat Trout to characterize the permeability of the Westslope Cutthroat Trout genome, and to identify the genes that differentiate pure and hybrid individuals. Pure populations that are profiled will be integrated into a recovery and population restoration plan. A study was also conducted to delineate the distribution and genetic status of Westslope Cutthroat Trout in the Bow and Oldman Rivers drainages. A different ongoing project uses the RADcapture genomic technique to determine genetic markers of Westslope Cutthroat Trout and Rainbow Trout throughout most of their ranges. Diagnostic loci for each species have been assembled and will be used to analyse all future samples by Parks Canada Agency (PCA). In addition, the Government of Alberta created the Westslope Cutthroat Trout Genetic Delineation Project that maps the genetic status of the species in all the streams containing Westslope Cutthroat Trout, from the headwaters (excluding national parks) downstream to the historical extent of Westslope Cutthroat Trout in the Bow and Oldman Rivers drainage systems. Information from this project will be used to direct appropriate recovery actions in specific watersheds.

Progress was also made in recovering existing populations within the historical range of Westslope Cutthroat Trout. This includes work on two sites in the Upper Bow River section of Banff National Park to determine if Westslope Cutthroat Trout are present and genetically pure. The Government of Alberta assessed the population of Westslope Cutthroat Trout in the Picklejar Lakes, which resulted in changing the angling regulation from daily bag limit to catch-and-release. In addition, the Government of Alberta developed a Fish Sustainability Index (FSI) and Fisheries Management Objectives for waterbodies containing Westslope Cutthroat Trout. The FSI assesses fish stocks on a provincial scale using various data sources such as fisheries surveys and multiple biological metrics, as well as threats and mitigation information to describe the current status of fish populations, their habitat, and the threats they face. The FSI is continually updated with new data, and results can be used for a variety of actions such as for directing future recovery and management of Westslope Cutthroat populations, for education purposes, and for the development of watershed restoration plans and integrated watershed strategies. Progress made in recovering existing populations also includes the East Slope Assessment project, which was conducted in 2015 to 2017 in the headwaters of the Bow and Oldman Rivers watersheds, and which found that on average, the riparian conditions across the study area were “functional but at high risk”. Major anthropogenic factors associated with riparian decline include trampling by livestock and other animals, grazing, and erosion from roads/trails and recreation. The project also characterized both the poor and most intact riparian conditions and identified the streams associated with these conditions. This knowledge will be helpful in directing future research on the suitability of establishing populations of Westslope Cutthroat Trout in those streams with good riparian conditions.

Several population monitoring studies were undertaken. Alberta Environment and Parks (AEP) has undertaken a non-native Brook Trout suppression project on Quirk Creek from 1995 to

2014, and population monitoring is still ongoing; a final report is in preparation. In addition, PCA is currently deploying sonotronics tags in conjunction with hydroacoustic sonars to accurately assess the population of Westslope Cutthroat Trout in Sawback Lake. Finally, in 2018, the Alberta Conservation Association (ACA) established 39 sites in the Upper Oldman River core area as part of a Westslope Cutthroat Trout monitoring program to gauge fish population responses to recent government land management alterations and proposed restoration projects.

Several steps were taken to manage the spread of non-native species in Alberta. For example, the federal *Aquatic Invasive Species Regulations*, enacted in 2015, aided both Fisheries and Oceans Canada (DFO) and the Government of Alberta in preventing the introduction and spread of aquatic invasive species (AIS), as well as improving the rapid response to an invasion or managing the spread of established AIS. In addition, the Government of Alberta amended its *Fisheries Act* to include the mandatory stopping of boats at designated boat inspection stations and the creation of a list of prohibited AIS for distribution to the public. It also implemented an AIS awareness campaign, which includes the “Don’t Let It Loose” education drive to discourage AIS introductions, and started watercraft inspections.

Angling regulations in Waterton Lakes National Park were changed in 2011 to prohibit the retention of Westslope Cutthroat Trout from waters with native or genetically pure introduced Westslope Cutthroat Trout populations. In addition, decontamination protocols have been implemented for all provincial and federal employees and contractors working in Alberta waterways. In Banff National Park, PCA has completed a study on the distribution of the freshwater worm *Tubifex tubifex*, the whirling disease’s secondary host. PCA also implemented a ban on felt-soled waders, a zero possession limit for most waterbodies in Banff Park to eliminate the movement of dead fish, and closed over 10 “core” Westslope Cutthroat Trout waterbodies, all in an effort to minimize the impacts of whirling disease and other aquatic invasive species. PCA also completed the removal of non-native fish populations known to be affected with whirling disease in Little Herbert Lake and Johnson Lake reservoir in Banff National Park.

Some work was done to recover populations of Westslope Cutthroat Trout within its historical range. This work consisted of restoration projects in Banff National Park conducted by PCA. For example, a multi-year project was conducted to restore the genetic integrity of Westslope Cutthroat Trout in Rainbow Lake in the Cascade River watershed. As part of this project, Rainbow Trout were removed from Rainbow Lake and pure Westslope Cutthroat Trout introduced from Sawback Lake. Westslope Cutthroat Trout and Rainbow Trout hybrids were also removed from Sawback Creek. Another project restored instream habitat in Cascade Creek. As part of this project, PCA continues to work towards re-introducing Westslope Cutthroat Trout to this historically occupied montane creek. A different study to gather water temperature data using thermographs was also conducted at several fishless sites to gauge their potential as refuges for the Westslope Cutthroat Trout.

Efforts were made by DFO and in collaboration with AEP to improve public awareness of Westslope Cutthroat Trout in Alberta. In the area of education, factsheets on Westslope Cutthroat Trout were developed and made available to the public, and signage was developed and posted near waterways and along streams designated as critical habitat. Enforcement efforts include notifying Alberta Fish and Wildlife officers of any advisories so that enforcement can be re-directed to areas of highest concerns. The development of a Linear Footprint Management Plan and Recreation Plan for the Upper Oldman, Livingstone, and Porcupine Hills area is also currently in progress.

Work was completed for some aspects of the life history and habitat of the Westslope Cutthroat Trout. A comparison study of metabolic rates between the Westslope Cutthroat Trout and non-native Rainbow Trout showed the former has higher standard, spontaneous maximum and forced metabolic rates (and corresponding forced aerobic score) than the latter. Both metabolic rates and corresponding aerobic scores increase with temperature. The results suggest the Rainbow Trout, with its lower oxygen needs, may have the competitive advantage over the Westslope Cutthroat Trout in suboptimal conditions (Enders and Murray 2016). Thermal biology of juvenile Westslope Cutthroat Trout was also characterized. Juveniles preferred warmer daytime temperatures and sought warmer conditions to rest during the night. The photoperiod significantly influences temperature preferences, with nighttime temperature preference consistently reaching 26°C. This data may have implications on future studies and on re-establishing populations in its historical range, such as the warmer prairies. Other instream water temperature monitoring studies are ongoing to better understand the long-term trends in stream temperature and how it affects distribution and timing of spawning of Westslope Cutthroat Trout as it responds to climate change. In addition, riparian habitat was greatly improved by the signing of a 10-year riparian habitat enhancement agreement between the ACA and a landowner in the headwaters of Todd Creek in 2018. An annual summary report was completed in March 2019, which outlines habitat securement and enhancement activities on the property. Work was also done to monitor the distribution of Westslope Cutthroat Trout in historically-occupied watersheds in Banff National Park. Surveys will be repeated on a 10-year scale. Finally, Marvel and Mystic Lakes in Banff National Park are now new critical habitat after environmental DNA studies of their sediment (2014 to 2016) revealed historic presence of Westslope Cutthroat Trout.

3.3.2 Completion of action plan

The recovery strategy and action plan for the Westslope Cutthroat Trout Alberta population (DFO 2019) was posted to the Species at Risk Public Registry in December 2019, and upon posting, it replaced the 2014 recovery strategy (DFO 2014).

The recovery strategy and action plan amends the critical habitat for the Westslope Cutthroat Trout Alberta population, includes recovery measures and provides an evaluation of socio-economic costs and benefits (to meet section 49(1) of SARA).

In addition, in 2017, PCA completed multi-species action plans for Banff National Park, and for Waterton Lakes National Park and the Bar U Ranch National Historic Site. Both documents identify recovery measures for Westslope Cutthroat Trout within these Parks Canada places.

3.3.3 Critical habitat identification and protection

Critical habitat for the Westslope Cutthroat Trout Alberta population, was identified to the extent possible in the 2014 recovery strategy (DFO 2014). Since 2014, some studies outlined in the schedule of studies have been completed, resulting in the identification of additional critical habitat. These changes are reflected in the recovery strategy and action plan (DFO 2019).

The critical habitat in Banff National Park must be protected by a Critical Habitat Description under section 58(2) of SARA, while the critical habitat outside of Banff National Park must be protected by a Critical Habitat Order under section 58(5) of SARA. On June 28, 2014, PCA issued a notice indicating that 90 days after the publication of the recovery strategy, critical habitat for Westslope Cutthroat Trout in Banff National Park would be protected by the making

of a Critical Habitat Description, and on December 2, 2015, a Critical Habitat Order prohibiting the destruction of the critical habitat of the Alberta population of Westslope Cutthroat Trout was published for critical habitat outside of Banff National Park.

Under subsection 83(4) of SARA, section 7 of the recovery strategy and action plan outlines activities that are exempt from SARA prohibitions for the Westslope Cutthroat Trout Alberta population. The *Alberta Fishery Regulations* set out conditions for these activities in areas managed by the province, and the *National Parks Canada Fishing Regulations* govern these activities carried out within Banff National Park.

3.3.4 Recovery feasibility

Currently, there is no need to review the recovery feasibility for this species as no new information exists that would suggest that Westslope Cutthroat Trout populations in Alberta no longer meet the feasibility criteria laid out in the recovery strategy and action plan. For example, suitable habitat still exists to support recovery objectives, and threats to the species can be addressed through restoration efforts and the promotion of public awareness and education.

4. Concluding statement

Overall, recovery activities conducted over the last five years have helped provide a better understanding of the population genetics of Westslope Cutthroat Trout and its non-native competitors such as Rainbow Trout and Brook Trout in the Saskatchewan-Nelson River basin. Rainbow Lake in Banff National Park was successfully restocked with Westslope Cutthroat Trout, helping to expand the species' historical range. Management tools were developed to map the genetic status of fishes in streams occupied by Westslope Cutthroat Trout in the Oldman and Bow Rivers watersheds, and to assess fish stocks on a provincial scale. These management tools will provide information to direct future work, fill data gaps and help with the development of watershed restoration plans to increase the distribution of Westslope Cutthroat Trout. Mitigation measures to date have included changing angling regulations to help maintain existing populations of Westslope Cutthroat Trout in Waterton Lakes National Park, and the implementation of decontamination protocols for all provincial and federal employees and contractors working in Alberta waterways to help to reduce the spread of AIS.

Awareness activities such as a public campaigns and boat inspections have helped to reduce or prevent the spread of AIS that are a threat to Westslope Cutthroat Trout and other fish species. Other awareness activities were aimed specifically at off-road vehicle users near waterways, and along streams designated as critical habitat, to help protect the critical habitat of the Westslope Cutthroat Trout. In addition, enforcement has emphasized the notification of advisories to the Alberta Fish and Wildlife Officers so that they can be re-directed to areas of highest concerns. All core populations of Westslope Cutthroat Trout in Banff National Park, as described in the recovery strategy and action plan, are closed to aquatic activities to prevent the spread of AIS as investigations continue. An emerging threat is whirling disease, caused by a microscopic parasite, *Myxobolus cerebralis*, and investigations are underway to understand its distribution, and the genetics of the parasite's secondary host, the freshwater worm *Tubifex tubifex*. And finally, new critical habitats were established in Sawback and Cascade Creeks through non-native trout removal programs, and in Marvel and Mystic Lakes through confirmation of historical presence, which improved the survival of the Westslope Cutthroat Trout.

Finalization of the recovery strategy and action plan expanded on the extent and locations of critical habitat for Westslope Cutthroat Trout in Alberta which resulted in strengthened habitat protection measures, including the identification of riparian areas as critical habitat. The action plan portion of the document outlines measures that provide the best chance of achieving the population and distribution objectives, including measures to be taken to address the threats and monitor the recovery of the species.

These measures include:

- continuing to improve knowledge of population genetics
- conducting feasibility studies of recovering populations within recovery watersheds
- monitoring the population
- suppressing non-native species in recovery areas
- expanding and/or restoring genetically pure populations
- managing and reducing the footprint of human activities
- improving awareness of the species with stakeholders and the public

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