Final

***Species at Risk Act***
Recovery Strategy Series
Adoption or Incorporation under
Section 44 of SARA

# Recovery Strategy for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), Alberta Populations in Canada

## Westslope Cutthroat Trout

2014

Canada

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry (SARA Public Registry).

**Cover photograph**: Shane Petry

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# Recovery Strategy for the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*), Alberta Populations, in Canada

**Final**

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# Adoption and Incorporation – Federal and Provincial Cooperation

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.

In the spirit of cooperation of the Accord, the Government of Alberta has provided the "Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017" that was completed by a joint Alberta-Canada recovery team. The recovery team considered the needs of both Canada and Alberta in the recovery process but completed the process following Alberta's recovery plan template. The federal Minister of the Fisheries and Oceans and the Minister responsible for the Parks Canada Agency as the competent ministers under the *Species at Risk Act* (*SARA)* adopts or incorporates, in whole or in part, the Alberta recovery plan as part of the federal recovery strategy pursuant to section 44 of SARA*,* with any exceptions or modifications as detailed within the body of this document.

The finalized recovery strategy, once included in the Species at Risk Public Registry, will be the *SARA* recovery strategy for this species.

The federal Ministers of Fisheries and Oceans Canada and the Minister responsible for the Parks Canada Agency recovery strategy for the Alberta populations of the Westslope Cutthroat Trout consists of two parts:

1. The additional federal text which completes the recovery strategy in terms of meeting the requirements of *SARA* section 41. This text includes additions, exceptions or modifications to the document being adopted or incorporated, in whole or in part.
2. The Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017, developed by the Alberta-Canada Westslope Cutthroat Trout recovery team for the province of Alberta and for Canada.

# 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 the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years.

The Minister of Fisheries and Oceans and the Minister responsible for the Parks Canada Agency are the competent ministers for the recovery of Alberta populations of Westslope Cutthroat Trout and have prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with:

- Province of Alberta (Alberta Environment and Sustainable Resource Development, Public Lands, Fish and Wildlife and Alberta Tourism Parks and Recreation)
- Environmental Non-Governmental Organization Coalition
- Spray Lake Sawmills
- TransAlta Corporation
- Trout Unlimited Canada
- University of Calgary
- Canadian Association of Petroleum Producers

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada and the Park Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Westslope Cutthroat Trout and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Fisheries and Oceans Canada and the Parks Canada Agency and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

# ACKNOWLEDGMENTS

Fisheries and Oceans Canada extends its sincere appreciation to numerous organizations that supported the development of this recovery strategy with financial and/or in-kind contributions and to the people who contributed their knowledge and hard work, including:

**Alberta-Canada Westslope Cutthroat Trout Recovery Team**

| | |
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- Alberta Conservation Association

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

# EXECUTIVE SUMMARY

Cutthroat Trout are widely distributed throughout much of western North America. There are four major subspecies that show considerable divergence from one other and they exhibit a great deal of phenotypic variation in terms of size, colouration, and life history characteristics. Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) are the only subspecies native to Alberta. Historically, Westslope Cutthroat Trout inhabited most streams in south-western Alberta from the alpine to the prairies. Currently, genetically pure Cutthroat Trout occupy only a small fraction of the original Westslope Cutthroat Trout distribution and occur as relatively small, disconnected populations. They are largely restricted to the Rocky Mountains and foothills in the uppermost reaches of mainstem rivers and the extreme headwaters of a few major tributaries.

In fall 2009, the Minister of Sustainable Resource Development supported the listing of Westslope Cutthroat Trout as Threatened under Alberta's *Wildlife Act*. This designation was due to the subspecies' small distribution and continuing decline in extent of occurrence, the severely fragmented nature of populations, continuing decline in quality of habitat, and the presence of barriers to dispersal making immigration between watersheds (and therefore rescue of the Alberta population from other jurisdictions) highly unlikely. The Committee on the Status of Endangered Wildlife in Canada assessed the status of Westslope Cutthroat Trout in Alberta and has designated the Alberta population as Threatened. In 2013, the Westslope Cutthroat Trout was listed as Threatened under the *Species at Risk Act*.

In 2009, a joint federal/provincial recovery team was established for the Westslope Cutthroat Trout to produce a recovery plan/strategy that would meet the needs of both Canada and Alberta. Membership on the team includes representatives from each of the responsible jurisdictions (Fisheries and Oceans Canada, Parks Canada Agency, Alberta Environment and Sustainable Resource Development, Alberta Tourism, Parks and Recreation) and key stakeholders including Trout Unlimited Canada, the University of Calgary, TransAlta Corporation, Spray Lake Sawmills, the Canadian Association of Petroleum Producers, and a consortium of non-government environmental conservation groups.

This recovery strategy has been prepared to guide the recovery of this Threatened species over the next five years and beyond. The population and distribution objectives are: *"To protect and maintain the existing ≥ 0.99 pure populations at self-sustaining levels and re-establish additional pure populations to self-sustaining levels, within the species original distribution in Alberta."* Key objectives of the strategy are to: identify and protect critical habitat for the remaining pure populations, improve knowledge of population genetics, size, distribution, and trends, identify opportunities to help recover pure and near-pure populations, increase education and awareness of the species for their conservation, re-establish pure populations in sites within the original Westslope Cutthroat Trout distribution and determine the role that introduced pure Westslope Cutthroat Trout may play in the recovery effort.

To help achieve this goal and meet the objectives, four broad strategies and general approaches are proposed: research, monitoring, management and regulatory actions, and education and outreach. Within each of these, a number of strategies and actions to implement them are outlined with the aim to protect and manage the species and to reduce or eliminate threats to its survival.

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# SPECIES AT RISK ACT REQUIREMENTS, MODIFICATIONS AND EXCLUSIONS TO THE INCORPORATED DOCUMENT

Once a species is placed on Schedule 1 of SARA, the responsible Minister(s) must consider the feasibility of the recovery of that species and if feasible, must address the threats to survival of the species identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The following (summarized from Section 41 of SARA) must also be addressed in the recovery strategy:

1. a description of the species and its needs;
2. an identification of the threats to the survival of the species and threats to its habitat and a description of the broad strategy to be taken to address those threats;
3. an identification of the species' critical habitat, to the extent possible, based on the best available information, and examples of activities that are likely to result in its destruction;
4. a schedule of studies to identify critical habitat, where available information is inadequate;
5. a statement of the population and distribution objectives that will assist the recovery and survival of the species, and a general description of the research and management activities needed to meet those objectives;
6. any other matters that are prescribed by the regulations;
7. a statement about whether additional information is required about the species; and
8. a statement of when one or more action plans in relation to the recovery strategy will be completed.

In addition to the above, and if applicable, the Ministers must also consider whether the species has a residence as defined by SARA and lastly, the Ministers may consider whether there could be exemptions to SARA prohibitions for such authorized activities as catch-and-release angling.

It should be noted that in Alberta, a species at risk recovery document is referred to as a recovery plan; federally the same type of document is referred to as a recovery strategy. This terminology is used when making reference to either document. Throughout the federal recovery strategy, the term original Westslope Cutthroat Trout distribution is used; it should be noted that the terms historic range, historical range and native range are used in the Alberta recovery plan and should be interpreted synonymously with the term original Westslope Cutthroat Trout distribution.

Since the Alberta provincial recovery plan (Alberta-Canada joint recovery team) contains many of the requirements of SARA, this part of the federal recovery strategy for Westslope Cutthroat Trout highlights important parts of the strategy but otherwise only discusses those requirements under SARA that are not fully discussed in the Alberta recovery plan. This recovery strategy does not conclude in five years and will be updated

when additional critical habitat is identified. SARA requires the competent minister to report on the implementation of the recovery strategy, and the progress towards meeting its objectives within five years after it is included in the public registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

## 1. Socio-economic Considerations

The provincial recovery plan contains statements on socio-economic considerations. As socio-economic factors are not considerations in any aspect of the preparation of SARA recovery strategies, the socio-economic considerations section of the provincial document is not considered part of the federal recovery strategy for this species.

## 2. Residence of the Westslope Cutthroat Trout

In Alberta, Westslope Cutthroat Trout generally spawn in small gravel-bottomed streams where the female prepares a redd in the gravel by thrashing her tail to displace gravel until a depression about 30 cm wide and 12 cm deep is dug. Eggs are deposited into the redd and a male fertilizes the eggs. The redd containing the eggs is covered with gravel by the female dislodging gravels just upstream of the redd (Nelson and Paetz 1992; Scott and Crossman 1973). Spawning takes place between May and July depending on location, and usually occurs when water temperatures reach 10˚C (Nelson and Paetz 1992) (6˚C in high elevation populations; S. Humphries pers. comm.). Incubation is also temperature dependent and generally lasts six to seven weeks. Once the eggs hatch, alevins will remain in the redd for another one to two weeks (Nelson and Paetz 1992; Scott and Crossman 1973). Following emergence, fry migrate to low energy lateral habitats, which are areas with low water velocity and appropriate cover.

The *Species at Risk Act* protects the residence of a species at risk and defines a residence as:

"*a dwelling place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*".

Redds created and used by Westslope Cutthroat Trout (Cutthroat Trout) for spawning demonstrate that there is significant investment in the creation and to some extent, in the protection of the residence (filling with gravel) by Cutthroat Trout. Thus, a redd is considered to be the residence of this fish. The residence is limited to the redd itself and the spawning and incubation time period during which eggs and alevins are present in the redd structure.

Currently, genetically pure populations of Westslope Cutthroat Trout inhabit only a small portion of the original Westslope Cutthroat Trout distribution and a residence for this species would only occur within habitat considered critical to the survival and recovery of this species. The residence for this species may occur anywhere within the population

of genetically pure Westslope Cutthroat Trout and is restricted to areas considered to be critical habitat.

## 3. Population and Distribution Objectives

The population and distribution objectives for this recovery strategy are taken directly from the Alberta recovery plan and are stated as the recovery goal in that plan:

*"Protect and maintain the existing ≥ 0.99 pure populations (currently believed to be approximately 51) at self-sustaining levels, and re-establish additional pure populations to self-sustaining levels, within the species' original distribution in Alberta."*

Population data for existing genetically pure Westslope Cutthroat Trout populations are lacking as are data to determine the feasibility of expanding many populations. Considering that, the recovery team was not comfortable providing empirical population targets at this point in time.

## 4. Broad Strategies and General Approaches to Meet Population and Distribution Objectives

This section is taken directly as stated from the Alberta recovery plan. Strategies proposed to address the identified threats, and to guide appropriate research and management activities to meet the recovery goal and objectives, are discussed under the broader approaches of:

1. **Research;**
2. **Monitoring;**
3. **Management and regulation; and**
4. **Education and outreach.**

Each strategy and or approach has been thoroughly discussed in the Alberta plan and they are designed to assess, mitigate, or eliminate specific threats to the species; to address information deficiencies that might otherwise inhibit species recovery; or to contribute to the species' recovery in general.

## 5. Critical Habitat

This section replaces the critical habitat section in the Alberta recovery plan document.

Critical habitat is defined in the *Species at Risk Act* (2002) as:

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

The Act defines habitat for aquatic species at risk as:

> *"... spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced."* [s. 2(1)]

## 5.1 Information and Methods Used to Identify Critical Habitat

Critical habitat for the Alberta populations of Westslope Cutthroat Trout is identified to the extent possible using the best information available. The critical habitat identified in this recovery strategy describes the geospatial area and the biophysical features that support the survival and recovery of this species (Appendix 2.). The approach taken by the recovery team to identify critical habitat was an area of occupancy approach, which means that all areas currently occupied by non-stocked pure-strain populations within the original Westslope Cutthroat Trout distribution are considered critical habitat (Figure 4). These populations all had an average purity of ≥ 0.99 % for the individual fish sampled. This approach is independent of a specific population recovery target and was based primarily upon the small number of individuals that comprise populations, few numbers of populations, the small proportion of a given waterbody that is occupied and the limited number of waterbodies still occupied by pure-strain Westslope Cutthroat Trout in Alberta. However, the approach aligns with the distribution objective of protecting and maintaining the pure populations within the original Westslope Cutthroat Trout distribution.

Given the small numbers of pure-strain populations, small numbers of individuals in many of those populations and the limited distribution of Westslope Cutthroat Trout in Alberta, the areas identified as critical habitat will be insufficient to achieve the population and distribution objectives. This is because it is not yet possible to identify suitable habitats and determine the feasibility of recovering genetically pure populations or even identify how many pure populations would need to be restored. As such, critical habitat is only partially identified at this point in time and additional critical habitat will be identified in a revised recovery strategy and or action plan. A schedule of studies is included to identify additional critical habitats necessary for survival and recovery. Critical habitat for Alberta populations of Westslope Cutthroat Trout is identified as all areas of bankfull waterbodies currently occupied by naturally occurring, pure-strain populations within the original Westslope Cutthroat Trout distribution (as defined in section 2.0 of the Alberta recovery plan). The bankfull level is the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the "active channel bank-full level" which is often the 1:2 year flood flow return level. The biophysical attributes of Westslope Cutthroat Trout critical habitat are described in Table 1.

It is estimated that, out of approximately 274 waterbodies historically occupied by Westslope Cutthroat Trout, there are approximately 51 pure-strain populations remaining in the original Westslope Cutthroat Trout distribution in Alberta. A population is defined as a group of individuals capable of breeding. Physical barriers and/or the presence of hybridized Westslope Cutthroat Trout are considered barriers and restrict the genetically pure Westslope Cutthroat Trout populations. The only pure-strain populations to exist in National Parks are in Banff National Park. It is important to remember that these

populations have been marginalized and largely only occupy portions of these waterbodies. Only the areas occupied by genetically pure Westslope cutthroat Trout populations are considered critical habitat not the entire waterbody in which they exist. Maps and text identifying geospatial locations of critical habitat are provide in Appendix 2.

## 5.2 Identification of Critical Habitat: Biophysical Functions, Features and Their Attributes

**Table 1. General description of functions, features and attributes of critical habitat for each life stage of the Westslope Cutthroat Trout**

| Life Stage | Habitat Requirement (Function) | Feature(s) | Attribute(s) |
|---|---|---|---|
| Spawn through alevins (resident, fluvial, adfluvial) | • Spawning<br>• Incubation | • Riffles (pool or shallow runs and tail-outs) | • Clean cold water<br>• Depth 0.10-0.75 m<br>• Velocity 0.25-0.8 m/s<br>• Sediment/silt free gravel substrate<br>• Temperature 6-10 $^{o}$C. |
| Fry to Parr (to age 1) | • Nursery cover | • Riffles<br>• Backwaters | • Clean cold water<br>• Velocities 0.01-0.4 m/s<br>• Sediment/silt free gravel/cobble substrates<br>• Depths 0.05 m - >1.5 m<br>• Temperature 4-15 $^{o}$C.<br>• Large woody debris, bedrock, boulders, riparian vegetation |
| Juvenile (age 1 to sexual maturity; males age 2 and females age 4) | • Over-wintering<br>• Cover<br>• Feeding | • Riffles<br>• Pools<br>• Backwaters<br>• Food availability | • Clean cold water<br>• Velocities 0.01-0.8 m/s<br>• Sediment/silt free gravel/cobble substrates<br>• Depths 0.05 m - >1.5 m<br>• Temperature 4-15 $^{o}$C.<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut bank |
| Adult | • Over-wintering<br>• Cover<br>• Feeding<br>• Movement (include migration, feeding etc.) | • Pools<br>• Runs<br>• Riffles<br>• Lakes<br>• Food availability | • Clean cold water<br>• Velocities 0.01- >1.0 m/s<br>• Sediment/silt free gravel/cobble substrates<br>• Depths 0.05 m - >1.5 m<br>• Temperature 4-15 $^{o}$C.<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks<br>• Barrier free movement to complete life cycle |

## 5.3 Identification of Critical habitat: Geospatial

Using the best available information, critical habitat has been identified for the Westslope Cutthroat Trout in the following waterbodies. Note that the term waterbodies is used to describe the names of the locations of genetically pure populations and does not necessarily represent the number of genetically pure populations. . Due to differences in resource and fisheries management, the descriptions of critical habitat within and outside of national parks has been separated

**Critical Habitat in Banff National Park:**

Sawback Lake
Elk Lake
Little Fish Lake
Big Fish Lake
Cuthead Creek
Upper Bow River
Spray River
Babel Creek
Helen Creek
Outlet Creek

**Critical Habitat in Alberta (outside of National Parks):**

Corral Creek
Livingstone River and tributariesBeaver Creek
White Creek
Oldman River and tributaries
Sharples Creek
South Todd Creek
Unnamed tributary to Blairmore Creek
Allison Creek
Lynx Creek and tributaries
Carbondale River and tributaries
Gardiner Creek
Syncline Brook
West Castle River and tributaries
Gorge Creek and tributary
Deep Creek
Unnamed “Cutthroat” Creek
Picklejar Lake (#2 Lake)
Prairie Creek
Silvester Creek
Waiparous Creek and tributaries
Speers Creek
Hidden Creek and tributaries
Racehorse Creek and tributaries
Vicary Creek
Unnamed tributary to Todd Creek
Rock Creek
Star Creek
Girardi Creek
North Lost Creek and tributaries
Unnamed tributary to Gardiner Creek
O’Haggen Creek
South Castle River and tributaries
Gold Creek and tributaries
Unnamed tributary to Flat Creek
Zephyr Creek
Picklejar Lakes (#4 Lake)
Picklejar Creek
Trail Creek
Evan-Thomas Creek
Unnamed tributary to Jumpingpound Creek

Appendix 2 provides the map and geographic coordinates that situate the boundaries within which critical habitat is found for the Westslope Cutthroat Trout. Existing permanent anthropogenic structures such as bridges and culverts, etc., that require routine maintenance and are within the areas delineated as critical habitat, are excluded and not considered to be critical habitat for the Westslope Cutthroat Trout.

The critical habitat description includes the entire bankfull level, which is the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams)

this refers to the "active channel bank-full level" which is often the 1:2 year flood flow return level. In lakes this is the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land.

Brief explanations for the areas identified as critical habitat are provided below:

**Critical Habitat within Banff National Park:**

**Sawback Lake**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Sawback Lake (51° 20'58.9"N, -115° 46'10.6"W), to the lake outlet (51° 21'13.3"N, -115° 45'45.4"W). These locations represent a total area of 17.76 hectares.

**Elk Lake**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Elk Lake (51° 17'18.5"N, -115° 39'21.16"W, to the lake outlet (51° 17'21.1"N, -115° 39'23.3"W). These locations represent a total area of 3.90 hectares.

**Little Fish Lake**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Little Fish Lake (38'38.11"N, -116° 10'48.36"W). This location represents a total area of 3.7 hectares.

**Big Fish Lake**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Big Fish Lake (51° 38'32.94"N, -116° 11'56.99"W). This location represents a total area of 13.87 hectares.

**Cuthead Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Cuthead Creek from the confluence of Cuthead Creek and the Cascade River (51° 23'59.9"N, -115° 40'51.3"W) to an upstream location on Cuthead Creek (51° 25'17.0"N, -115° 41'19.9"W).

**Spray River**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Spray River from the confluence of an unnamed tributary and the Spray River (50° 44'24.4"N, -115° 23'39.6"W) to an upstream location on the Spray River (50° 43'14.4"N, -115° 23'20.6"W).

**Upper Bow River**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Upper Bow River from near the outlet of Bow Lake ($51^0$39'02.43"N, -$116^0$25'09.40"W) to a downstream location near the inlet of Hector Lake ($51^0$34'38.17"N, -$116^0$19'25.18"W).

**Babel Creek**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within Babel Creek from a steep non fish bearing section ($51^0$19'41.84"N, $116^0$09'48.62"W) to an upstream location ending near lower Consolation Lake ($51^0$19'05.97"N, -$116^0$09'18.43"W).

**Helen Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Helen Creek from near the confluence with the Bow River, $51^0$38'59.88"N, -$116^0$22'58.39"W, to an upstream location with a steep headwall identified by contour map and air photo inspections, $51^0$40'34.51"N, -$116^0$24'24.97"W.

**Outlet Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Outlet Creek from near the confluence with the Bow River ($51^0$23'59.60"N, -$116^0$07'38.07"W) to an upstream location with a steep headwall ($51^0$24'14.44"N, -$116^0$06'41.79"W.

**Critical Habitat in Alberta (outside of National Parks):**

**Corral Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Corral Creek from 50°15'35.167"N, -114°24'40.601"W to an upstream location on Corral Creek 50°14'54.208"N, -114°26'44.835”W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach that appeared to be fish bearing, although no fish were captured.

**Livingstone River and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Livingstone River from the Livingstone Falls, 50°06'05.080"N, -114°26'39.740"W, to an upstream location on the Livingstone River 50°10'59.794"N, -114°28'34.535"W. The upstream extent of critical habitat is the upstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught or at known barriers to upstream fish passage. The following tributaries to the Livingstone River are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Isolation Creek, Mean Creek, Savanna Creek and North Twin Creek.

**Beaver Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Beaver Creek from 50°06'09.577"N, -114°26'17.548"W to an upstream location on Beaver Creek 50°06'37.485"N, -114°25'16.033"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is the farthest upstream point of a sampling reach where Westslope Cutthroat Trout were caught.

**Speers Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Speers Creek from 50°02'49.860"N, -114°25'34.983"W to an upstream location on Speers Creek 50°03'32.016"N, -114°27'40.696"W. The downstream extent of critical habitat is at a

hanging culvert on Highway 40 (locally known as the Kananaskis or Forestry Trunk road) and the upstream extent is the downstream start point of a sampling reach where Westslope Cutthroat Trout were caught (no end point was provided in the electrofishing survey).

**White Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within White Creek from 49°59'40.758"N, -114°20'01.472"W, to an upstream location on White Creek 50°00'57.062"N, -114°17'56.124"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Hidden Creek and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Hidden Creek 49°58'49.421"N, -114°28'58.662"W to an upstream location on Hidden Creek 49°59'09.688"N, -114°35'35.594"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. Upstream extent of critical habitat is the upstream end point of sampling reaches where Westslope Cutthroat Trout were caught. The following tributaries to Hidden Creek are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): South Hidden Creek and an unnamed tributary to Hidden Creek.

**Oldman River and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Oldman River from 50°03'02.603"N, -114°35'09.761"W to an upstream location on the Oldman River, 50°07'02.698"N, -114°41'26.438"W. The downstream extent of critical habitat is the large waterfall on the Oldman River just downstream from Cache Creek at the southern extent of the Beehive Natural Area. The upstream extent of critical habitat is upstream or downstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught. The following tributaries to the Oldman River are included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Cache Creek, Beehive Creek, Soda Creek, Slacker Creek, Pasque Creek, Lyall Creek, Straight Creek, an unnamed tributary to Oyster Creek and Oyster Creek.

**Racehorse Creek and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Racehorse Creek from 49°49'48.527"N, -114°30'06.933"W to upstream locations on North Racehorse Creek, 49°50'52.337"N, -114°38'11.042"W, and South Racehorse Creek, 49°45'09.149"N, -114°36'53.273"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is generally the upstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught or at known barriers to upstream fish passage. On some tributaries critical habitat ended at the start point of a sampling reach where Westslope Cutthroat Trout were caught because no end point was provided in the electrofishing survey. The following tributaries to North and South Racehorse Creek are also included as critical habitat (see Appendix 2 for coordinates of

the upstream extent of critical habitat on these tributaries): First Creek and three unnamed tributaries to North Racehorse Creek, and Smith Creek, Spoon Creek, and two unnamed tributaries to South Racehorse Creek.

**Vicary Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Vicary Creek from 49°45'13.544"N, -114°29'18.992"W to an upstream location on Vicary Creek, 49°45'11.525"N, -114°30'09.282"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is a waterfall barrier (Vicary Creek is thought to be barren upstream of this falls).

**Sharples Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Sharples Creek from 49°52'52.320"N, -114°04'08.479"W to an upstream location on Sharples Creek, 49°52'53.575"N, -114°03'56.675"W. The extent of critical habitat is the downstream start point and upstream end point of the farthest upstream genetic sampling reach. No Westslope Cutthroat Trout records exist further upstream beyond this genetic sampling reach.

**Unnamed Tributary to Todd Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within an unnamed tributary to Todd Creek from 49°46'37.939"N, -114°17'40.635" to an upstream location on the unnamed tributary to Todd Creek, 49°46'44.634"N, -114°18'38.477"W. The extent of critical habitat is the downstream start point and upstream end point of the farthest upstream genetic sampling reach. No Westslope Cutthroat Trout records exist further upstream beyond this genetic sampling reach.

**South Todd Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within South Todd Creek from 49°45'04.970"N, -114°17'36.964"W to an upstream location on South Todd Creek, 49°44'59.020"N, -114°17'42.893"W. The extent of critical habitat is the downstream start point and upstream end point of the farthest upstream genetic sampling reach. No Westslope Cutthroat Trout records exist further upstream beyond this genetic sampling reach.

**Rock Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Rock Creek from a waterfall on Rock Creek, 49°37'52.485"N, -114°18'39.309"W, to an upstream location on Rock Creek, 49°37'43.250"N, -114°19'11.129"W. The upstream extent of critical habitat is the upstream extent of the farthest upstream most genetic sampling reach.

**Unnamed Tributary to Blairmore Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within an unnamed tributary to Blairmore Creek 49°41'01.926"N, -114°27'09.614"W, to an upstream location on the same unnamed tributary to Blairmore Creek, 49°41'10.112"N, -114°27'07.788"W. The extent of critical habitat is the downstream start point and upstream end point of the farthest upstream genetic sampling reach. No Westslope Cutthroat Trout records exist further upstream beyond this genetic sampling reach.

**Star Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Star Creek from 49°37'33.832"N, -114°32'17.808"W, to an upstream location on Star Creek, 49°37'06.281"N, -114°32'38.039"W. The extent of critical habitat in the upstream and downstream direction are waterfalls.

**Allison Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Allison Creek from 49°40'28.207"N, -114°35'39.698"W, to an upstream location on Allison Creek, 49°41'45.125"N, -114°36'29.769"W. The downstream extent of critical habitat is a waterfall at an old flume on Allison Creek. Upstream extent of critical habitat is the upstream end point of the farthest upstream reach where Westslope Cutthroat Trout were caught.

**Girardi Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Girardi Creek from 49°38'01.010"N, -114°36'23.004"W to an upstream location on Girardi Creek, 49°37'07.700"N, -114°36'16.595"W. The downstream extent of critical habitat is small barrier to upstream fish passage at the confluence with the Crowsnest River. Upstream extent of critical habitat is the downstream start point of a sampling reach where Westslope Cutthroat Trout were caught (no end point was provided in the electrofishing survey).

**Lynx Creek and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Lynx Creek from 49°27'46.706"N, -114°26'33.966"W, to an upstream location on Lynx Creek, 49°33'09.083"N, -114°30'41.366"W. The downstream extent of critical habitat is a waterfall on Lynx Creek upstream from the confluence of Gorge Creek. The upstream extent of critical habitat is generally the upstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught. On some tributaries critical habitat ended at the start point of a sampling reach where Westslope Cutthroat Trout were caught because no end point was provided in the electrofishing surveys. The following tributaries to Lynx Creek are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Goat Creek, two unnamed tributaries to Goat Creek, Snowshoe Creek and two unnamed tributaries to Lynx Creek.

**North Lost Creek and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within North Lost Creek from 49°26'52.795"N, -114°29'49.357"W, to an upstream location on North Lost Creek, 49°27'39.622"N, -114°32'28.749"W. The downstream extent of critical habitat is the downstream start point of the genetic sampling reach. The upstream extent of critical habitat is the downstream start points of sampling reaches where Westslope Cutthroat Trout were caught on the mainstem and one unnamed tributary (no end points were provided in the electrofishing surveys). The following tributaries to North Lost Creek are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Unnamed tributary to North Lost Creek.

**Carbondale River and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Carbondale River from 49°24'24.268"N, -114°29'55.227"W to an upstream location on Carbondale River, 49°24'10.413"N, -114°31'55.732"W. The downstream extent of critical habitat is the downstream start point of genetic sampling reach. The upstream extent of critical habitat is generally the downstream start point of sampling on the mainstem and tributaries (no end points were provided in the electrofishing surveys) except for one tributary for which the upstream endpoint of the sampling was provided. The following tributaries to Carbondale River are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Macdonald Creek, and two unnamed tributaries to the Carbondale River.

**Unnamed Tributary to Gardiner Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within an unnamed tributary to Gardiner Creek from 49°23'06.059"N, -114°27'45.055" W, to an upstream location on the unnamed tributary to Gardiner Creek, 49°23'07.271"N, -114°27'55.956"W. The extent of critical habitat is the downstream start point and upstream end point of the farthest upstream genetic sampling reach. No Westslope Cutthroat Trout records exist further upstream beyond this genetic sampling reach.

**Gardiner Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Gardiner Creek from 49°22'55.026"N, -114°27'42.597"W, to an upstream location on Gardiner Creek, 49°22'16.046"N, -114°28'15.653"W. The downstream extent of critical habitat is the downstream start point of genetic sampling reach. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**O'Haggen Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within O'Haggen Creek from 49°26'22.272"N, -114°23'24.566"W, to an upstream location on O'Haggen Creek, 49°25'09.847"N, -114°23'27.069"W. The downstream extent of critical habitat is a waterfall. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Syncline Brook**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Syncline Brook from 49°20'24.381"N, -114°25'16.156"W, to an upstream location on Syncline Brook, 49°19'34.087"N, -114°26'58.134"W. The downstream extent of critical habitat is the downstream start point of a genetic sampling reach. The upstream extent is a chute (Syncline Brook is thought to be barren upstream of this chute).

**South Castle River and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the South Castle River from 49°13'20.414"N, -114°13'41.560"W, to an upstream location on the South Castle River, 49°11'50.009"N, -114°08'44.492"W. The downstream extent of critical habitat is the downstream start point of a genetic sampling reach. The upstream extent of

critical habitat is the downstream extent of sampling reaches on the mainstem and a tributary where Westslope Cutthroat Trout were caught (no end points were provided in the electrofishing surveys). Front Creek is the tributary of the South Castle River that is also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on this tributary).

**West Castle River and Tributaries**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within the West Castle River from 49°16'45.402"N, -114°22'46.600"W, to an upstream location on West Castle River, 49°14'07.238"N, -114°20'59.831"W. The downstream extent of critical habitat is a waterfall and the upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught. There is an unnamed tributary to the West Castle River that is also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on this tributary).

**Gold Creek and Tributaries**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within Gold Creek from 49°36’27.797”N -114°23’34.32”W, to an upstream location on Gold Creek, 49°42'27.914"N, -114°23'49.456"W. The downstream extent of critical habitat is a water supply dam and the upstream extent of critical habitat is generally the upstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught. On one tributary critical habitat ended at the start point of a sampling reach where Westslope Cutthroat Trout were caught (no end points were provided in the electrofishing survey). The following tributaries to Gold Creek are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Morin Creek and Cauldron Creek.

**Gorge Creek and Tributary**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within Gorge Creek from 50°39'17.883"N, -114°43'03.745"W to an upstream location on Gorge Creek, 50°40'33.641"N, -114°46'25.228"W. The downstream extent of critical habitat is based on a precautious approach and reasonable extension below the farthest downstream pure Westslope Cutthroat Trout genetic sampling point mid-way into an assumed zone of hybridization. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught. There is an unnamed tributary to Gorge Creek that is also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on this tributary).

**Unnamed Tributary to Flat Creek**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within an unnamed tributary to Flat Creek from 50°28'15.863"N, -114°26'56.282"W, to an upstream location on the unnamed tributary to Flat Creek, 50°26'53.396"N, -114°30'04.205"W. The downstream extent of critical habitat is located at the farthest downstream recorded beaver dam barrier (based on 2008 aerial survey). The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Deep Creek**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within Deep Creek from 50°25'28.555"N, -114°28'28.511"W, to an upstream location on Deep Creek, 50°26'18.028"N, -114°31'11.831"W. The downstream extent of critical habitat is located at a set of falls, approximately one kilometre upstream of the mouth of Deep Creek. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught

**Zephyr Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Zephyr Creek from 50°23'23.599"N, -114°34'28.401"W, to an upstream location on Zephyr Creek, 50°21'23.040"N, -114°33'49.754"W. The downstream extent of critical habitat is the mouth of Zephyr Creek at the Highwood River. The upstream extent of critical habitat is the upstream extent of the farthest upstream sampling reach, where a potential barrier exists.

**Unnamed "Cutthroat" Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Unnamed "Cutthroat" Creek from 50°28'41.881"N, -114°29'22.504"W, to an upstream location on Unnamed "Cutthroat" Creek, 50°27'22.405"N, -114°31'37.680"W. The downstream extent of critical habitat is located at a waterfall at the mouth of Unnamed "Cutthroat" Creek. The upstream extent of critical habitat is the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Picklejar Lakes (#4 Lake and #2 Lake)**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within the Picklejar Lakes (#4 Lake, at 50°31'03.633"N, -114°46'59.601"W) and (#2 Lake at, 50°31'06.561"N, -114°46'26.451"W) (co-ordinates are mid-point of each lake). The Picklejar Lakes are a series of four lakes; two of the lakes (#4 Lake and #2 Lake) are known to contain pure Westslope Cutthroat Trout.

**Picklejar Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Picklejar Creek from 50°31'14.392"N, -114°47'47.703"W, to an upstream location on Picklejar Creek, 50°31'07.705"N, -114°47'04.285"W. Westslope Cutthroat Trout redds occur in Picklejar Creek at the #4 Lake outlet, so the critical habitat includes approximately one kilometre of stream to include spawning areas.

**Prairie Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Prairie Creek from 50°52'00.711"N, -114°47'08.564"W, to an upstream location on Prairie Creek, 50°52'40.131"N, -114°53'27.967"W. The downstream extent of critical habitat is located at the mouth of Prairie Creek at the Elbow River. The upstream extent of critical habitat extends upstream of the Powderface Trail to the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Trail Creek**

Critical habitat for Westslope Cutthroat Trout in Alberta is found within Trail Creek from 50°52'41.968"N, -114°53'18.570"W, to an upstream location on Trail Creek, 50°51'22.938"N, -114°53'34.929"W. The downstream extent of critical habitat is the mouth of Trail Creek at Prairie Creek. The upstream extent of critical habitat extends to the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Silvester Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Silvester Creek from 50°51'58.092"N, -114°43'22.128"W, to an upstream location on Silvester Creek, 50°50'04.313"N, -114°43'20.511"W. The downstream extent is the falls just upstream of the mouth of Silvester Creek at the Elbow River. The upstream extent of critical habitat extends to the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught.

**Evan-Thomas Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Evan-Thomas Creek from 50°53'25.816"N, -115°08'09.140"W, to an upstream location on Evan-Thomas Creek, 50°51'51.250"N, -115°06'15.192"W. The downstream extent of critical habitat is located at the Highway 40 bridge crossing. The upstream extent of critical habitat is located at the farthest downstream waterfall on the creek.

**Waiparous Creek and Tributaries**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within Waiparous Creek from 51°22'28.008"N, -115°00'07.466"W to an upstream location on Waiparous Creek, 51°23'27.914"N, -115°14'09.931"W. The downstream extent is located at the confluence of Waiparous Creek and Meadow Creek. The upstream extent of critical habitat is the upstream extent of sampling reaches on the mainstem and tributaries where Westslope Cutthroat Trout were caught. The following tributaries to Waiparous Creek are also included as critical habitat (see Appendix 2 for coordinates of the upstream extent of critical habitat on these tributaries): Johnson Creek, “Mockingbird” Creek and “Lookout” Creek.

**Unnamed Tributary to Jumpingpound Creek**
Critical habitat for Westslope Cutthroat Trout in Alberta is found within an unnamed tributary to Jumpingpound Creek from 50°58'02.567"N, -114°57'25.235"W to an upstream location on the unnamed tributary to Jumpingpound Creek, 50°57'39.214"N, -114°56'27.660"W. The downstream extent of critical habitat is located at the mouth of the unnamed tributary to Jumpingpound Creek. The upstream extent of critical habitat extends to the upstream end point of the farthest upstream sampling reach where Westslope Cutthroat Trout were caught, at a potential barrier.

## 5.4 Schedule of Studies to Identify Critical Habitat

The schedule of studies (Table 2) describes a number of essential research items to identify sufficient critical habitat to achieve the population and distribution objectives for the species, including assessing the feasibility of recovery of populations that have some genetic introgression.

In addition, critical habitat identified within this recovery strategy will be refined and additional areas will be identified if new information comes to light regarding the life history needs of the Westslope Cutthroat Trout.

**Table 2. Schedule of studies to identify or refine Critical Habitat for Westslope Cutthroat Trout**

| Description of Study | Rationale | Timeline |
|---|---|---|
| Studies to identify and describe life history, movement and habitat use by life-stage (include quality of habitats) | It is assumed that the habitats containing pure-strain fish also contain all of the necessary habitat types to complete their life-cycle but little work has been completed to map and confirm habitat use by life stage, quality or whether there are sufficient amounts of habitats available to grow populations. Identifying and protecting these habitats will help survival and recovery. | 2014-2017 |
| Studies to identify suitable habitats and determine feasibility for recovering genetically pure Westslope Cutthroat Trout (outside current areas occupied by pure-strain populations) | The current amount of critical habitat will be insufficient for recovery of this species. This work will help identify additional candidate sites for re-establishment of genetically pure fish and add critical habitat where considered necessary. | 2014-2018 |

## 5.5 Examples of Activities Likely to Result in the Destruction of Critical Habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For the Westslope Cutthroat Trout critical habitat, it is anticipated that this will be accomplished through a SARA Protection Order made under subsections 58(4) and (5), which will invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

For critical habitats found in national parks, within 90 days from when this recovery strategy is included in the public registry, the Minister responsible for the Parks Canada Agency, must publish in the *Canada Gazette* a description of the portion of critical habitat located in those parks. Ninety days following that, the prohibition against destruction in subsection 58(1) applies to those lands.

The activities described in the table below are neither exhaustive nor exclusive and have been guided by the threats discussion in the Alberta recovery plan. Only those threats resulting in an over-all threat significance of high, as described in section 3.0 of the Alberta recovery plan, for the species were considered as activities likely to result in the destruction of critical habitat. However, the absence of a specific human activity in this table does not preclude or fetter the competent ministers' ability to regulate human activities to prevent destruction of critical habitat. Furthermore, the inclusion of an activity does not result in its automatic prohibition since it is the destruction of critical habitat that is prohibited not the activity.

The destruction of critical habitat is determined on a case-by-case basis. Destruction would result if part of the critical habitat were degraded, either

permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time.

**Table 3. Examples of activities likely to result in the destruction of critical habitat for Westslope Cutthroat Trout**

| Threat | Activity | Affected Pathway | Function Affected | Feature Affected | Attribute Affected | Provincial or National Parks |
|---|---|---|---|---|---|---|
| Changes in flow | Dam/reservoir operation | Reduction in available habitats | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Movement (include migration, feeding etc.)<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters | • Discharge and velocities<br>• Sediment/silt<br>• Substrates<br>• Depths<br>• Temperature<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks | • Provincial<br>• National Parks |
| | Mechanical forest removal and loss due to fire | Reduction in available habitats | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters | • Discharge and velocities<br>• Sediment/silt<br>• Substrates<br>• Depths<br>• Temperature<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks | • Provincial |
| | Water extraction | Reduction in available habitats | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters | • Discharge and velocities<br>• Sediment/silt<br>• Substrates<br>• Depths<br>• Temperature<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks | • Provincial |

| Threat | Activity | Affected Pathway | Function Affected | Feature Affected | Attribute Affected | Provincial or National Parks |
|---|---|---|---|---|---|---|
| Sedimentation | Forest harvest, linear disturbance (road or trail construction and maintenance or lack of maintenance etc.), urbanization, mining, grazing, high intensity or frequent off-highway vehicle use, recreational access, instream construction Increased sediment/silt (embeddedness) | Reduction in available habitats | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters<br>• Food availability | • Increased sediment/silt<br>• Substrates<br>• Depths<br>• Temperature<br>• Invertebrate production<br>• Undercut banks | • Provincial |
| Habitat loss, fragmentation and or alteration | Dam or reservoir creation | Large scale change from riverine to reservoir habitat | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters<br>• Food availability | • Discharge and velocities<br>• Sediment/silt<br>• Substrates<br>• Depths<br>• Temperature<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks | • Provincial<br>• National Parks |
| | Dams (include weirs) or culvert structures | Loss of access to habitats | • Movement | • Movement routes in water-bodies | • Barrier-free movement to complete life cycle | • Provincial<br>• National Parks |
| | Linear disturbance (construction and maintenance or lack of maintenance of roads, pipelines, railway, recreational vehicles, trails) | Reduction in available habitats | • Spawning<br>• Nursery<br>• Overwintering<br>• Feeding<br>• Cover | • Riffles<br>• Pools<br>• Runs<br>• Backwaters<br>• Food availability<br>• Movement | • Sediment/silt<br>• Substrates<br>• Temperature<br>• Large woody debris, bedrock, boulders, riparian vegetation<br>• Invertebrate production<br>• Undercut banks | • Provincial<br>• National Parks |

# 6. Activities Permitted by the Recovery Strategy

Subsection 32 (1) of the *Species at Risk Act* states that:

"*No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species.*"

Subsection 83(4) of the *Species at Risk Act* states that

"*Subsections 32(1) and (2), section 33 and subsections 36(1), 58(1), 60(1) and 61(1) do not apply to a person who is engaging in activities that are permitted by a recovery strategy, an action plan or a management plan and who is also authorized under an Act of Parliament to engage in that activity, including a regulation made under section 53, 59 or 71."*

The COSEWIC status assessment for Alberta Westslope Cutthroat Trout only considered genetically pure populations of Westslope Cutthroat Trout within the original Westslope Cutthroat Trout distribution in Alberta; therefore, the SARA prohibitions relating to individuals only apply to genetically pure populations within the original Westslope Cutthroat Trout distribution.

The concepts of Core, Conservation and Sportfishing populations discussed in the provincial recovery plan were developed to allow for the recovery of Westslope Cutthroat Trout while also maintaining fishing opportunities. While the term Sportfishing was applied to populations that are managed primarily for the benefit of recreational fisheries, the plan states that these definitions do not imply that the other categories of populations will not be open to angling opportunities, but this will be determined on a population specific basis.

As defined in the Alberta recovery plan, primary threats to the survival and recovery of Westslope Cutthroat Trout include hybridization (loss of Westslope Cutthroat Trout genetic materials) with Rainbow Trout (*Oncorhynchus mykiss*) and competition with other species such as Brook Trout (*Salvelinus fontinalis*) and Rainbow Trout. Mortality from catch-and-release angling is currently assumed to not be a significant negative impact to genetically pure Westslope Cutthroat Trout populations although Alberta recognizes that data is lacking on angling effort, catch and hooking mortality rates, particularly in the Oldman watershed, where fishing pressure may be higher.

Jurisdictional discussions of the management of Westslope Cutthroat Trout populations under their responsibility considered the origin of the population (i.e., whether it is native to a water body and not stocked for sportfishing purposes), the population trends (i.e., whether it is self-sustaining) and genetic purity. Discussions also considered knowledge of the impacts of recreational fisheries on populations from field research, published and unpublished literature (Sullivan 2007; Cleator *et al.* 2010) as well as the expert opinion of resource managers. In most cases native, naturally occurring (i.e. not stocked for sportfishing purposes), genetically pure populations retain the highest priority for protection and recovery. Some populations that are genetically pure but stocked were assigned a lower priority relative to pure, native, not stocked populations and are subject

to different management options (e.g., may be managed to provide sportfishing opportunities). Ultimately, three exemptions to the SARA prohibitions are considered appropriate for Westslope Cutthroat Trout in Alberta and are not expected to negatively impact the survival or recovery of the species.

### *Catch-and-release angling*

In considering whether to permit catch-and-release angling throughout the range of Alberta Westslope Cutthroat Trout, options for the management of the fisheries included complete closures of angling as well as partial closures or specific stream closures depending on what impacts were thought to be occurring as a result of angling pressure. It was determined that complete closures of recreational fisheries in these areas was unnecessary; however, some stream closures and angling restrictions are already in-place and will continue to be evaluated to ensure there are no negative impacts to genetically pure populations of Westslope Cutthroat Trout.

Generally, fishing pressure is assumed to be low across the species' current range where genetically pure populations occur, although there are some populations that have direct road access. Working under the assumption that fishing pressure is low in many of the pure populations, hooking mortality is therefore expected to be low in most cases. The possible exception to this are the genetically pure populations in the upper Oldman River watershed which could be subjected to relatively higher levels of fishing pressure than the population in the upper Bow watershed. The catch-and-release regulations being put in place and the bait bans already in place contribute directly to lowering angling mortality. In addition, numerous streams are not easily accessible, are very small, densely treed and most have limited angling seasons (2-3 months) and are therefore not attractive to anglers. Furthermore, many individual Westslope Cutthroat Trout within these populations do not grow to a very large size (<30 cm) which also makes them less attractive to anglers. The catch and release fishery will continue to be monitored relative to impacts to these populations and mitigation measures applied (see below) to ensure the survival and recovery of Alberta Westslope Cutthroat Trout.

### *Allowable Harvest in Picklejar Lakes*

Picklejar Lakes are located outside of national parks and managed by Alberta. They have a combined surface area of only 5.7 hectares (ha). The populations of Westslope Cutthroat Trout in Picklejar Lakes are considered to be genetically pure non-stocked populations (no stocking records located). They are self-sustaining but isolated and do not provide or receive rescue effect from any other genetically pure populations of Westslope Cutthroat Trout. The harvest of two fish that is proposed was one of a number of options considered. Alternatives included a complete closure to angling or conversion to a catch and release fishery at these lakes. It was concluded that harvest is acceptable at these lakes for reasons detailed below and largely since a closure or change to existing fishing regulations was not considered to provide any benefit or consequence to the survival and recovery of Westslope Cutthroat Trout in Alberta.

Creel data from these lakes revealed known fishing pressure averaged 57 rod-hours per ha and was as high as 114 rod-hours/ha during the 1986-2009 period. However, actual

fishing pressure was likely 2-10 times higher, given that historically only a small percentage of anglers take time to fill out creel cards. A conservative estimate of actual fishing pressure is likely to be approximately 100 rod-hours/ha. Despite this relatively heavy fishing pressure and despite having the second-highest average catch rate of all of the lakes in the high mountain lakes creel survey, there has been essentially no negative change in the catch rate or mean size of fish caught in Picklejar Lakes (Stelfox *et al.* 2005). In support of this conclusion, recent creel data show that average catch rates in Picklejar Lakes between 1986-2000 were 2.5 fish per hour, whereas subsequent to 2000 (2000-2012) average catch rates of fish increased to 3.9 fish per hour, suggesting that fish density increased despite angling and harvest (Alberta Fish and Wildlife file data 2012). Creel and age-length data show that cutthroat trout are so abundant in these lakes that the growth of individual fish is becoming stunted (Alberta Fish and Wildlife file data 2012).

Altogether, this illustrates the resilience of these populations to angling pressure. Providing angling opportunity could well increase support of recovery efforts by informing anglers of the state of Picklejar Lakes populations relative to the state of other Westslope Cutthroat Trout populations in Alberta.

### *Regulations for Catch-and-release angling*

In accordance with subsection 83(4) of SARA, this recovery strategy authorizes catch-and-release angling of Westslope Cutthroat Trout in all areas of Alberta. This includes areas managed by the Province of Alberta and those managed by Parks Canada Agency. This exemption is subject to the following conditions:

(a) in areas outside of national parks, angling is carried out:

(i) in accordance with a licence for sportfishing issued under the authority of the *Alberta Fishery Regulations, 1998*, SOR/98-246,

(ii) in accordance with a licence issued to an Indian under the authority of s.13(3) of the *Alberta Fishery Regulations, 1998*, SOR/98-246 to engage in fishing solely for the purpose of catching fish for food for their personal use or for the use of their immediate family, or

(iii) by an Indian engaged in sportfishing under the authority of s.13(2) of the *Alberta Fishery Regulations, 1998*, SOR/98-246;

(b) for areas in national parks, angling is carried out in accordance with a licence issued under the provisions of the *National Parks of Canada Fishing Regulations*, C.R.C., c.1120; and

(c) captured individual Westslope Cutthroat Trout shall be released without delay to the waters from which they were caught in a manner that causes the least harm to the fish.

***Regulations for Allowable Harvest in Picklejar Lakes***

In accordance with subsection 83(4) of SARA, this recovery strategy authorizes persons to catch and retain a maximum daily quota of up to two Westslope Cutthroat Trout from the four lakes known and regulated as Picklejar Lakes. This maximum quota is a combined total for all four lakes. The actual daily quota (which shall be no more than two), size limit and weight limit for this exemption shall be in accordance with limits set out under the *Alberta Fishery Regulations*, SOR/98-246 as may be varied pursuant to s.3 of that Regulation. The possession limit under this exemption shall be the same as the daily quota. This exemption is subject to the following conditions:

(a) angling is carried out:

(i) in accordance with a licence for sportfishing issued under the authority of the *Alberta Fishery Regulations, 1998*, SOR/98-246,

(ii) in accordance with a licence issued to an Indian under the authority of s.13(3) of the *Alberta Fishery Regulations, 1998*, SOR/98-246 to engage in fishing solely for the purpose of catching fish for food for their personal use or for the use of their immediate family, or

(iii) by an Indian engaged in sportfishing under the authority of s.13(2) of the *Alberta Fishery Regulations, 1998*, SOR/98-246; and

(b) any individual Westslope Cutthroat Trout that are caught and released shall be released without delay to the waters from which they were caught in a manner that causes the least harm to the fish.

***Regulations for Allowable Harvest in Specific Waterbodies in Alberta containing only Westslope Cutthroat Trout that are stocked by the Province of Alberta***

In accordance with subsection 83(4) of SARA, this recovery strategy authorizes persons to catch and retain Westslope Cutthroat Trout from water bodies that contain only Westslope Cutthroat Trout that are stocked by the Province of Alberta solely for the purposes of angling and not for the purposes of recovery of the species. The actual water bodies and daily quota, size limit and weight limit for each water body in this exemption shall be set out under the *Alberta Fishery Regulations*, SOR/98-246 as may be varied pursuant to s.3 of that Regulation. The possession limit under this exemption for any water body shall be the same as the daily quota. This exemption does not apply to water bodies within national parks. This exemption is subject to the following conditions:

(a) angling is carried out:

(i) in accordance with a licence for sportfishing issued under the authority of the *Alberta Fishery Regulations, 1998*, SOR/98-246,

(ii) in accordance with a licence issued to an Indian under the authority of s.13(3) of the *Alberta Fishery Regulations, 1998*, SOR/98-246 to engage in fishing solely for the purpose of catching fish for food for their personal use or for the use of their immediate family, or

(iii) by an Indian engaged in sportfishing under the authority of s.13(2) of the *Alberta Fishery Regulations, 1998*, SOR/98-246;

(b) any individual Westslope Cutthroat Trout that are caught and released shall be released without delay to the waters from which they were caught in a manner that causes the least harm to the fish.

In addition to the conditions above, the following mitigation measures are recommended to further minimize and understand hooking impacts to Westslope Cutthroat Trout populations:

- Bait ban to reduce hooking mortality is already in place or will be in-place in many locations in Alberta including Picklejar Lakes and National Parks.
- Educational awareness of proper handling and release techniques.
- In Alberta, to further investigate the potential effects of angling on species recovery, the possible effects of a variety of angling scenarios (e.g., different levels of angler effort and regulations) on stream populations of cutthroat trout were simulated using a population dynamics computer model (Sullivan 2007). The results of these simulations suggested that recovery of depressed cutthroat trout populations could occur under scenarios of limited and low angler effort, and no directed harvest (i.e., catch-and-release angling). Once recovered, the results also suggested that healthy populations of Westslope Cutthroat Trout may be maintained with catch-and-release angling with moderate fishing effort.
- The Alberta recovery plan recommends fish identification testing be a prerequisite for anglers for a harvest license in eastern slope waters in the South Saskatchewan River Watershed, so as to improve awareness of the species and better protect it from illegal harvest due to misidentification.
- Provide good quality fish identification information in Alberta's Guide to Sportfishing Regulations and on line.
- The open angling season in the National Parks and in Alberta is generally very restrictive regarding the period of time in which pure populations of Westslope Cutthroat Trout may be angled. In Alberta, many eastslope streams have a zero possession limit and may only be angled between June 16 and October 31 in a given year. Within Banff National Park, all waters have a zero possession limit for Westslope Cutthroat Trout. With the exception of the Upper Bow River population, Westslope Cutthroat Trout can be angled from approximately June 29 to October 31 (the opening date can change annually). The Upper Bow River is open from April 01- March 31, but is very inaccessible during the winter months.

Relevant to each of the above, there are recommendations in the recovery plan for population monitoring including population estimates, relative abundance, and population structure (e.g., size-frequency distribution). As well, there is a recommendation to

monitor angling pressure where appropriate and recommend changes to Alberta's Guide to Sportfishing Regulations where necessary to protect populations.

The competent ministers will monitor the activities authorized by this recovery strategy. Exemptions under s. 83(4) may be discontinued or altered if and when the minister discovers that any activity may be jeopardizing survival or recovery of this species.

# 7. Statement on Action plans

The Alberta-Canada joint recovery team completed an action plan as this is required by policy when recovery planning in Alberta. That action plan is not considered part of this recovery strategy because there are specific requirements to complete federal action plans that were not fully considered during the development of the Alberta action plan. However, the Alberta plan shall form the basis from which a subsequent federal action plan will be developed. Any such plan(s) will detail the actions considered necessary for the survival and recovery of Westslope Cutthroat Trout in Alberta. An action plan will be completed by March 31, 2015.

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# APPENDIX 1: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi)*. Other native fish species such as Bull Trout (*Salvelinus confluentus*) and Rocky Mountain Whitefish (*Prosopium williamsoni*) will also likely benefit from recovery activities associated with this strategy. The potential for the strategy to inadvertently lead to adverse effects on other species was considered and this strategy will not result in any significant adverse effects to the physical environment. However, recovery efforts have and will continue to result in impacts (mortality) to other non-native fish species such as Rainbow Trout and Brook Trout. Careful consideration will be given to potential effects to other species before implementing any actions should they be proposed (e.g. barrier placement to prevent hybridization).

# APPENDIX 2: MAPS AND LOCATIONS OF CRITICAL HABITAT

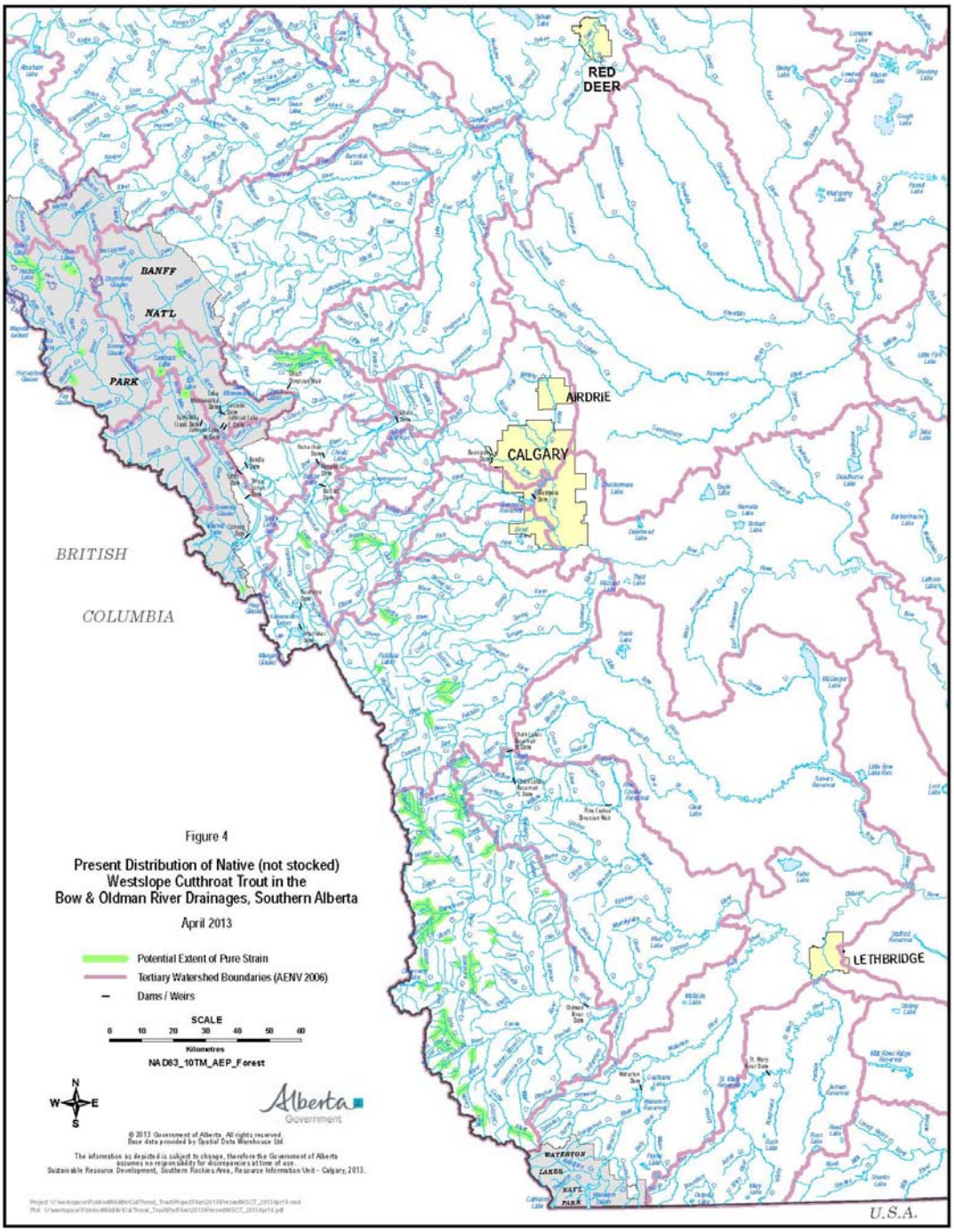


**Figure 4. Critical habitat (highlighted in green) for native (not stocked) Westslope Cutthroat Trout in the Bow and Oldman River drainages, southern Alberta.**

## Critical Habitat in Alberta

Locations of lakes identified as critical habitat for Westslope Cutthroat in Banff National Park, Alberta

| Waterbody Name | Latitude | Longitude |
|---|---|---|
| Sawback Lake | 51$^0$20'58.9"N | -115$^0$46'10.6"W |
| Elk Lake | 51$^0$17'18.5"N | -115$^0$39'21.16"W |
| Little Fish Lake | 51$^0$38'38.11"N | -116$^0$10'48.36"W |
| Big Fish Lake | 51$^0$38'32.94"N | -116$^0$11'56.99"W |

Locations of flowing waters identified as critical habitat for Westslope Cutthroat Trout in Banff National Park, Alberta

| Waterbody Name | Starting Latitude | Starting Longitude | Ending Latitude | Ending Longitude |
|---|---|---|---|---|
| Cuthead Creek | 51° 25’17.0”N | -115° 41’19.9”W | 51° 23’59.9”N | -115° 40’51.3”W |
| Spray River | 50° 43’14.4”N | -115° 23’20.6”W | 50° 44’24.4”N | -115° 23’39.6”W |
| Upper Bow River | 51$^0$34'38.17"N | -116$^0$19'25.18"W | 51$^0$39'02.43"N | -116$^0$25'09.40"W |
| Babel Creek | 51$^0$19'41.84"N | -116$^0$09'48.62"W | 51$^0$19'05.97"N | -116$^0$09'18.43"W |
| Helen Creek | 51$^0$40'34.51"N | -116$^0$24'24.97"W | 51$^0$38'59.88"N | -116$^0$22'58.39"W |
| Outlet Creek | 51$^0$23'59.60"N | -116$^0$07'38.07"W | 51$^0$24'14.44"N | -116$^0$06'41.79"W |

Locations of lakes identified as critical habitat for Westslope Cutthroat in Alberta (outside of National Parks)

| Waterbody Name | Latitude | Longitude |
|---|---|---|
| Picklejar Lakes (#4 Lake) | 50°31'03.633"N | -114°46'59.601"W |
| Picklejar Lakes (#2 Lake) | 50°31'06.561"N | -114°46'26.451"W |

Locations of flowing waters identified as critical habitat for Westslope Cutthroat Trout in Alberta (outside of National Parks)

| **Downstream end stream name** | **Latitude** | **Longitude** | **Upstream end stream name(s)** | **Latitude** | **Longitude** |
|---|---|---|---|---|---|
| Corral Creek | 50°15'35.167" | -114°24'40.601" | Corral Creek | 50°14'54.208" | -114°26'44.835" |
| Livingstone River | 50°06'05.080" | -114°26'39.740" | Livingstone River | 50°10'59.794" | -114°28'34.535" |
| | | | Isolation Creek | 50°07'08.882" | -114°26'57.646" |
| | | | Mean Creek | 50°09'06.371" | -114°25'50.309" |
| | | | Savanna Creek | 50°08'52.644" | -114°29'12.629" |
| | | | North Twin Creek | 50°11'18.567" | -114°26'31.584" |
| Beaver Creek | 50°06'09.577" | -114°26'17.548" | Beaver Creek | 50°06'37.485" | -114°25'16.033" |
| Speers Creek | 50°02'49.860" | -114°25'34.983" | Speers Creek | 50°03'32.016" | -114°27'40.696" |
| White Creek | 49°59'40.758" | -114°20'01.472" | White Creek | 50°00'57.062" | -114°17'56.124" |
| Hidden Creek | 49°58'49.421" | -114°28'58.662" | Hidden Creek | 49°59'09.688" | -114°35'35.594" |
| | | | South Hidden Creek | 49°58'24.176" | -114°35'24.057" |
| | | | Unnamed tributary to Hidden Creek | 49°58'46.995" | -114°34'06.132" |
| Oldman River | 50°03'02.603" | -114°35'09.761" | Oldman River | 50°07'02.698" | -114°41'26.438" |
| | | | Cache Creek | 50°01'38.448" | -114°37'31.115" |
| | | | Beehive Creek | 50°03'29.174" | -114°35'54.151" |
| | | | Soda Creek | 50°04'39.101" | -114°36'37.002" |
| | | | Slacker Creek | 50°04'52.021" | -114°36'19.702" |
| | | | Pasque Creek | 50°08'00.535" | -114°37'23.192" |
| | | | Lyall Creek | 50°06'18.019" | -114°37'53.645" |
| | | | Straight Creek | 50°08'17.392" | -114°38'21.054" |
| | | | Unnamed tributary to Oyster Creek | 50°09'26.903" | -114°41'36.476" |
| | | | Oyster Creek | 50°09'42.543" | -114°39'33.733" |

| Downstream end stream name | Latitude | Longitude | Upstream end stream name(s) | Latitude | Longitude |
|---|---|---|---|---|---|
| Racehorse Creek | 49°49'48.527" | -114°30'06.933" | South Racehorse Creek | 49°45'09.149" | -114°36'53.273" |
| | | | North Racehorse Creek | 49°50'52.337" | -114°38'11.042" |
| | | | Smith Creek | 49°48'22.768" | -114°34'14.291" |
| | | | Spoon Creek | 49°46'55.710" | -114°33'46.238" |
| | | | Unnamed tributary to South Racehorse Creek | 49°46'36.487" | -114°35'05.517" |
| | | | Unnamed tributary to South Racehorse Creek | 49°45'36.541" | -114°36'09.186" |
| | | | First Creek | 49°49'57.771" | -114°35'27.934" |
| | | | Unnamed tributary to North Racehorse Creek | 49°50'16.434" | -114°36'07.364" |
| | | | Unnamed tributary to North Racehorse Creek | 49°50'29.626" | -114°36'11.018" |
| | | | Unnamed tributary to North Racehorse Creek | 49°51'43.909" | -114°34'54.551" |
| Vicary Creek | 49°45'13.544" | -114°29'18.992" | Vicary Creek | 49°45'11.525" | -114°30'09.282" |
| Sharples Creek | 49°52'52.320" | -114°04'08.479" | Sharples Creek | 49°52'53.575" | -114°03'56.675" |
| Unnamed tributary to Todd Creek | 49°46'37.939" | -114°17'40.635" | Unnamed tributary to Todd Creek | 49°46'44.634" | -114°18'38.477" |
| South Todd Creek | 49°45'04.970" | -114°17'36.964" | South Todd Creek | 49°44'59.020" | -114°17'42.893" |
| Rock Creek | 49°37'52.485" | -114°18'39.309" | Rock Creek | 49°37'43.250" | -114°19'11.129" |
| Unnamed tributary to Blairmore Creek | 49°41'01.926" | -114°27'09.614" | Unnamed tributary to Blairmore Creek | 49°41'10.112" | -114°27'07.788" |
| Star Creek | 49°37'33.832" | -114°32'17.808" | Star Creek | 49°37'06.281" | -114°32'38.039" |
| Allison Creek | 49°40'28.207" | -114°35'39.698" | Allison Creek | 49°41'45.125" | -114°36'29.769" |
| Girardi Creek | 49°38'01.010" | -114°36'23.004" | Girardi Creek | 49°37'07.700" | -114°36'16.595" |

| Downstream end stream name | Latitude | Longitude | Upstream end stream name(s) | Latitude | Longitude |
|---|---|---|---|---|---|
| Lynx Creek | 49°27'46.706" | -114°26'33.966" | Lynx Creek | 49°33'09.083" | -114°30'41.366" |
| | | | Goat Creek | 49°28'58.116" | -114°33'32.321" |
| | | | Unnamed tributary to Goat Creek | 49°29'39.731" | -114°30'36.479" |
| | | | Unnamed tributary to Goat Creek | 49°30'28.338" | -114°31'44.036" |
| | | | Snowshoe Creek | 49°31'29.874" | -114°31'32.077" |
| | | | Unnamed tributary to Lynx Creek | 49°32'16.900" | -114°30'46.954" |
| | | | Unnamed tributary to Lynx Creek | 49°32'48.064" | -114°30'56.371" |
| North Lost Creek | 49°26'52.795" | -114°29'49.357" | North Lost Creek | 49°27'39.622" | -114°32'28.749" |
| | | | Unnamed tributary to North Lost Creek | 49°26'59.268" | -114°29'47.636" |
| Carbondale River | 49°24'24.268" | -114°29'55.227" | Carbondale River | 49°24'10.413" | -114°31'55.732" |
| | | | Macdonald Creek | 49°23'58.988" | -114°31'21.320" |
| | | | Unnamed tributary to Carbondale River | 49°24'07.582" | -114°30'33.791" |
| | | | Unnamed tributary to Carbondale River | 49°24'24.317" | -114°31'13.940" |
| Unnamed tributary to Gardiner Creek | 49°23'06.059" | -114°27'45.055" | Unnamed tributary to Gardiner Creek | 49°23'07.271" | -114°27'55.956" |
| Gardiner Creek | 49°22'55.026" | -114°27'42.597" | Gardiner Creek | 49°22'16.046" | -114°28'15.653" |
| O'Haggen Creek | 49°26'22.272" | -114°23'24.566" | O'Haggen Creek | 49°25'09.847" | -114°23'27.069" |
| Syncline Brook | 49°20'24.381" | -114°25'16.156" | Syncline Brook | 49°19'34.087" | -114°26'58.134" |
| South Castle River | 49°13'20.414" | -114°13'41.560" | South Castle River | 49°11'50.009" | -114°08'44.492" |
| | | | Font Creek | 49°12'31.466" | -114°11'55.543" |

| Downstream end stream name | Latitude | Longitude | Upstream end stream name(s) | Latitude | Longitude |
|---|---|---|---|---|---|
| West Castle River | 49°16'45.402" | -114°22'46.600" | West Castle River | 49°14'07.238" | -114°20'59.831" |
| | | | Unnamed tributary to the West Castle River | 49°14'45.571" | -114°21'09.058" |
| Gold Creek | 49°36'27.797" | -114°23'34.32" | Gold Creek | 49°42'27.914" | -114°23'49.456" |
| | | | Morin Creek | 49°39'00.586" | -114°23'41.120" |
| | | | Caudron Creek | 49°41'15.680" | -114°22'17.373" |
| Gorge Creek | 50°39'17.883" | -114°43'03.745" | Gorge Creek | 50°40'33.641" | -114°46'25.228" |
| | | | Unnamed tributary to Gorge Creek | 50°38'58.590" | -114°43'45.322" |
| Unnamed tributary to Flat Creek | 50°28'15.863" | -114°26'56.282" | Unnamed tributary to Flat Creek | 50°26'53.396" | -114°30'04.205" |
| Deep Creek | 50°25'28.555" | -114°28'28.511" | Deep Creek | 50°26'18.028" | -114°31'11.831" |
| Zephyr Creek | 50°23'23.599" | -114°34'28.401" | Zephyr Creek | 50°21'23.040" | -114°33'49.754" |
| Unnamed “Cutthroat” Creek | 50°28'41.881" | -114°29'22.504" | Unnamed “Cutthroat” Creek | 50°27'22.405" | -114°31'37.680" |
| Picklejar Creek | 50°31'14.392" | -114°47'47.703" | Picklejar Creek | 50°31'07.705" | -114°47'04.285" |
| Prairie Creek | 50°52'00.711" | -114°47'08.564" | Prairie Creek | 50°52'40.131" | -114°53'27.967" |
| Trail Creek | 50°52'41.968" | -114°53'18.570" | Trail Creek | 50°51'22.938" | -114°53'34.929" |
| Silvester Creek | 50°51'58.092" | -114°43'22.128" | Silvester Creek | 50°50'04.313" | -114°43'20.511" |
| Evan-Thomas Creek | 50°53'25.816" | -115°08'09.140" | Evan-Thomas Creek | 50°51'51.250" | -115°06'15.192" |
| Waiparous Creek | 51°22'28.008" | -115°00'07.466" | Waiparous Creek | 51°23'27.914" | -115°14'09.931" |
| | | | Johnson Creek | 51°21'26.163" | -115°10'53.880" |
| | | | Mockingbird Creek | 51°25'03.727" | -115°02'21.098" |
| | | | Lookout Creek | 51°24'41.220" | -115°05'20.719" |
| Unnamed tributary to Jumpingpound Creek | 50°58'02.567" | -114°57'25.235" | Unnamed tributary to Jumpingpound Creek | 50°57'39.214" | -114°56'27.660" |

# PART 2: Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017

## As provided by the Government of Alberta

The Alberta Westslope Cutthroat Trout Recovery Team. 2013. Alberta Westslope Cutthroat Trout Recovery Plan: 2012-2017. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 28. Edmonton, AB. 77 pp.

# Alberta Westslope Cutthroat Trout Recovery Plan 2012 – 2017

**Alberta Species at Risk Recovery Plan No. 28**

# Alberta Westslope Cutthroat Trout Recovery Plan 2012 – 2017

**Prepared by:**

**The Alberta Westslope Cutthroat Trout Recovery Team**


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## PREFACE

Albertans are fortunate to share their province with a variety of wild species. Most plant and animal populations are healthy and secure. A small number, however, are either naturally rare or imperiled because of human activities. Recovery plans establish a basis for cooperation among government, industry, conservation groups, landowners and other stakeholders to ensure these species and populations are restored or maintained for future generations.

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

Alberta species at risk recovery plans are prepared under the supervision of the Species at Risk Program, Alberta Environment and Sustainable Resource Development. Recovery plans are prepared by recovery teams composed of a variety of stakeholders including conservation organizations, First Nations, industry, landowners, resource users, universities, government agencies and others. Membership is by invitation from the Director of Wildlife Management, and includes representation from a diversity of interests unique to each species and circumstance. Conservation and management of these species is ongoing during preparation of the recovery plan.

Recovery plans are provided by the recovery team as advice to the Minister responsible for fish and wildlife management (the Minister) and to all Albertans. Alberta's Endangered Species Conservation Committee reviews draft recovery plans and provides recommendations to the Minister. In addition, an opportunity for review by the public is provided. Plans accepted and approved for implementation by the Minister are published as a government recovery plan. Such approved plans are a summary of the Department's commitment to work with involved stakeholders to coordinate and implement the conservation actions necessary to restore or maintain Threatened and Endangered species.

Recovery plans include three main sections: background information which highlights the species' biology, population trends, and threats; a recovery section that outlines goals, objectives, and strategies to address threats; and an action plan that delineates prioritized actions required to maintain or restore the *Threatened* or *Endangered* species. These plans are "living" documents that are revised as conditions change or circumstances warrant. Each approved recovery plan undergoes an annual review by which progress of implementation is evaluated. Implementation of each recovery plan is subject to the availability of resources from both within and outside government.

## Caring for Cutthroat

Lorne Fitch, P. Biol.

Westslope cutthroat trout now exist on the edges, fringes and margins of their former range. Populations are disconnected from one another and are small enough some are at significant risk of winking out of existence. A combination of things has led to this state: changes in habitat caused by various developments; stocking of non-native trout species, some of which hybridize with cutthroat trout, others that compete with them for space and resources; and, the additive feature of multiple, synergistic cumulative effects. Most of these impacts on cutthroat trout continue to influence the status of the Alberta population, plus climate change is an added concern.

Although cutthroat trout survived and thrived for about 10,000 years the recent, rapid pace of change in as short a period as a human life span has been beyond their ability to cope and evolve. A recovery strategy is a life boat of sorts, in the face of these perils. It is a mechanism to delay the negative trajectory of the population and, over time, allow a modest recovery so the species is not so imperiled and in danger of disappearing from Alberta watersheds.

Why would we, why should we care about cutthroat trout?

Partly because governments, at various levels have committed and are mandated to ensure species do not slip through our fingers, between the cracks and sink beneath our collective consciousness. So legally we have to care.

Morally, to allow a species like cutthroat trout to disappear through apathy, ignorance, inaction or greed would be a blot on our record as stewards of shared resources. These resources have been entrusted to our care, not for our exclusive use and disposal but to pass on, unimpaired, for subsequent generations.

Functionally, protecting and restoring cutthroat populations transcends the fish. Cutthroat trout are a part, a feature of a watershed and an indicator of landscape health. The clarity of the medium cutthroat swim in should jog our sensibilities and remind us of the source of our drinking water. Having cutthroat occupy these watersheds is the gold seal of water quality. The ripples that extend outward from a pebble dropped in a stream containing cutthroat inevitably find us.

All of us, governments, industry, academia, conservationists and the public have a duty to ensure cutthroat trout are allowed to survive and recover. The debate isn't about whether they should be saved but rather how to save them and how quickly we need to act. Two essentials for these fish are place and space - cutthroats and their habitats are intertwined, interconnected and incapable of being separated.

If we can protect some places and spaces for the cutthroat and allow recovery of populations to more robust levels, the intended effects will benefit other species. It may well be that our own species will need these healthy watersheds with natural expressions of biodiversity and ecosystem services. It truly needs them now!

Touching, seeing or knowing a wild cutthroat trout exists exposes and sensitizes us directly and immediately to the very elements from which we evolved - earth, water, air and other living kin, large and small. A cutthroat trout can help us remember our place in the fabric that connects us and upon which our lives are mysteriously and inextricably linked.

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## ACKNOWLEDGEMENTS

The Alberta Westslope Cutthroat Trout Recovery Team extends its sincere appreciation to many organizations that supported the development of this recovery plan with financial and/or in-kind contributions and to the people who contributed their knowledge and hard work. Portions of the recovery plan were written or informed by Dave Mayhood, Aquatic Ecologist, of Freshwater Research Ltd. and a complete version of the supporting documents has been prepared under separate cover. The recovery team would also like to recognize James Guthrie, formerly Senior Environmental Specialist at TransAlta Corporation for his significant contribution to team discussions. Funding to support Recovery Team meetings was provided by Alberta Environment and Sustainable Resource Development (AESRD), and Fisheries and Oceans Canada. Distribution maps were prepared by Margaret Bradley and Angela Braun of the Southern Rockies Area Resource Information Unit (AESRD). The recovery team would like to thank Jim Stelfox and Matthew Coombs (Fisheries Biologists, AESRD), Richard Quinlan (Provincial Species at Risk Specialist, AESRD) and Diane Casimir (Species at Risk Coordinator, Parks Canada) for their constructive reviews of the plan. The recovery team acknowledges Dr. Eric Taylor (Department of Zoology, University of British Columbia) for his contributions to genetic analyses and related discussions. Finally, the recovery team thanks the numerous individuals and organizations, especially the Alberta Conservation Association, who contributed tissue samples to help further our understanding of genetic issues.

## EXECUTIVE SUMMARY

Cutthroat trout are widely distributed throughout much of western North America. There are four major subspecies that show considerable divergence from one other and they exhibit a great deal of phenotypic variation in terms of size, colouration, and life history characteristics. Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) are the only subspecies native to Alberta. Historically, westslope cutthroat trout inhabited most streams in south-western Alberta from the alpine to the prairies. Currently, genetically pure cutthroat trout occupy only a small fraction of their historic range and occur as relatively small, disconnected populations. They are largely restricted to the Rocky Mountains and foothills in the uppermost reaches of mainstem rivers and the extreme headwaters of a few major tributaries.

In fall 2009, the Minister of Environment and Sustainable Resource Development supported the listing of westslope cutthroat trout as *Threatened* under Alberta's *Wildlife Act.* This designation was due to the subspecies' small distribution and continuing decline in extent of occurrence, the severely fragmented nature of populations, continuing decline in quality of habitat, and the presence of barriers to dispersal making immigration between watersheds (and therefore rescue of the Alberta population from other jurisdictions) highly unlikely. The Committee on the Status of Endangered Wildlife in Canada has also assessed the status of westslope cutthroat trout in Alberta and has designated the Alberta population as *Threatened*. In 2013, this population was listed as Threatened under the Federal *Species at Risk Act*.

In 2009, a joint federal/provincial recovery team was established for the westslope cutthroat trout to produce a recovery strategy that would meet the needs of both Canada and Alberta. Membership on the recovery team includes representatives from each of the responsible jurisdictions (Fisheries and Oceans Canada, Parks Canada Agency, Alberta Environment and Sustainable Resource Development, Alberta Tourism, Parks and Recreation) and key stakeholders representing a broad range of interests.

The recovery plan has been prepared to guide the management of this *Threatened* species over the next five years and beyond. The goal of the recovery plan is: *"To protect and maintain the existing ≥ 0.99 pure populations at self-sustaining levels and re-establish additional pure populations to self-sustaining levels, within the species historical range in Alberta".* Key objectives of the plan are to: identify and protect critical habitat for the remaining pure populations, improve knowledge of population genetics, size, distribution, and trends, identify opportunities to help recover pure and near-pure populations, increase education and awareness of the species for their conservation, re-establish pure populations in sites within their historical range, and determine the role that introduced pure westslope cutthroat trout may play in the recovery effort.

To help achieve this goal and meet the objectives, four general approaches are proposed: research, monitoring, management and regulatory actions, and education and outreach. Within each of these, a number of strategies and actions to implement them are outlined with the aim to protect and manage the species and to reduce or eliminate threats to its survival. The recovery plan will undergo periodic review during its designated life span of five years, after which it will be updated as needed.

# 1.0 INTRODUCTION

## 1.1 Provincial and National Status

In December 2007, Alberta's Minister of Environment and Sustainable Resource Development (the Minister) approved listing the westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) as *Threatened* under Alberta's *Wildlife Act* based on the recommendations from the Endangered Species Conservation Committee (ESCC). The species was formally listed under Schedule 6 of the Alberta Wildlife Regulation in fall 2009. This designation was due to the subspecies' small distribution and continuing decline in extent of occurrence, the severely fragmented nature of populations, continuing decline in quality of habitat, and the presence of barriers to dispersal making immigration between watersheds (and therefore rescue of the Alberta population from other jurisdictions) highly unlikely.

The national status of westslope cutthroat trout was reviewed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2006 (COSEWIC 2006a, 2006b). Two designatable units for the species were formalized at the time, consisting of one population in British Columbia, and one population in Alberta. This determination was made on the basis of the marked difference in conservation status and distinctive ecozones inhabited by the two groups, and the lack of current dispersal opportunities between them (separated by the Rocky Mountains). It should be noted that this assessment includes only genetically pure native populations of the species (i.e., where genetic analyses elucidate that 99% of a population's genome originates from westslope cutthroat trout) occurring within their historical range. The population in British Columbia was designated as Special Concern by COSEWIC due to habitat loss and degradation, as well as competition and hybridization with introduced species. The British Columbia population is listed as Special Concern on Schedule 1 of the Federal *Species at Risk Act* (February 2010).

In Alberta, COSEWIC determined that pure populations of westslope cutthroat trout, once found in a wide range in Alberta, have become severely isolated and depressed in response to a variety of factors including habitat loss and degradation, exploitation by anglers, and competition and hybridization with introduced species. It was therefore recommended that the Alberta population be listed as *Threatened*, and this designation was made under *SARA* in 2013.

## 1.2 Recovery Team

In 2009, a joint federal/provincial recovery team was established for the westslope cutthroat trout to produce a recovery strategy that would meet the needs of both Canada and Alberta. Membership on the Alberta Westslope Cutthroat Trout Recovery Team (herein, the recovery team) includes representatives from each of the responsible jurisdictions (Fisheries and Oceans Canada, Parks Canada Agency, Alberta Environment and Sustainable Resource Development, Alberta Tourism, Parks and Recreation) and key stakeholders including Trout Unlimited Canada, the University of Calgary, TransAlta Corporation, Spray Lake Sawmills, the Canadian Association of Petroleum Producers, and a consortium of non-government environmental

conservation groups. The Alberta Fish and Game Association and Representatives from Treaty 7 First Nations were also invited to participate as members of the recovery team but declined. The primary role of the recovery team is to develop a recovery plan that consists of a broad based recovery strategy accompanied by an action plan which details how specific components of the recovery strategy will be implemented. The recovery team may have an ongoing role in overseeing, monitoring, and evaluating the implementation of the recovery plan.

## 2.0 SPECIES BIOLOGY

Most of the information in this section is specific to the westslope cutthroat trout subspecies. However, surrogate data describing other subspecies of cutthroat trout have been used where necessary. Several terms related to species biology and genetic description have been defined in a glossary located at the end of the document.

### 2.1 Species Description

Cutthroat trout exhibit a great deal of phenotypic variation in terms of size, colouration, and life history characteristics, which has led to considerable taxonomic confusion. Fourteen subspecies of cutthroat trout are generally recognized (Allendorf and Leary 1988; Behnke 2002). Four major subspecies (coastal, westslope, Lahontan and Yellowstone cutthroat trout) are widely distributed and show considerable divergence from each other. Westslope cutthroat trout are the only subspecies native to Alberta.

In general, cutthroat trout exhibit the streamlined body typical of salmonids, characterized by a terminal mouth, small cycloid scales, and the presence of an adipose fin. Colouration consists of dark spots on a lighter background. Body colour ranges from silver to yellowish-green with lower sides and belly somewhat reddish to bright red in some individuals at spawning time (Nelson and Paetz 1992). A narrow pink band may also be present along the sides of the fish. When present, this is much less prominent than similar markings on the closely related rainbow trout (*Oncorhynchus mykiss*). Bright orange to red slashes in the skin folds along the inner edge of the lower jaw give this fish its common name and distinguish it from other fish. The spotting pattern characteristically forms an arc from the pectoral fin back to the anterior base of the anal fin, with the spots becoming more numerous at the posterior end and concentrated above the lateral line. Spots are also located on the dorsal, adipose and caudal fins (Figure 1). Introgressive hybridization between westslope cutthroat trout and rainbow trout produces a wide diversity of spotting patterns, as well as individuals which may lack the characteristic slash below the jaw, or have a slash which is faded in colour.

**Figure 1. Westslope cutthroat trout (photo: S. Petry)**

## 2.2 Genetic Description

Westslope cutthroat trout are subject to introgressive hybridization with closely related species (such as other cutthroat subspecies or rainbow trout) which have been introduced into their range (ASRD and ACA 2006). The ongoing spread of introgression in the wild (e.g., Rubidge *et al.* 2001; Hitt *et al.* 2003; Taylor and Gow 2007) suggests that at least some hybrids survive and are capable of successful reproduction. Hybridization and introgression present significant threats to the persistence of native strains of cutthroat trout due to outbreeding depression (disruption of local adaptation through introduction of foreign alleles) (Miller *et al.* 1989; Rhymer and Simberloff 1996; Allendorf *et al.* 2001).

The genetic population structure of cutthroat and rainbow trout was investigated in Banff and Waterton Lakes National Parks between 1997 and 2002 (Potvin *et al.* 2003). The aim of the study was to determine the relative impact of stocking rainbow trout on the genetic integrity of cutthroat trout populations, as well as determine the genetic structure of the latter populations. The researchers found "low" levels of hybridization between cutthroat trout and rainbow trout in the areas tested. While roughly half of the waterbodies surveyed contained pure cutthroat trout, they were from populations which originated from stocking (i.e., previously fishless lakes). Results of the study also showed that within-population genetic diversity was low but the populations were significantly different genetically, either within or among drainages. Therefore, the authors recommended that they should be managed independently, even for populations that were stocked or founded by stocking. Evidence of hybridization between westslope cutthroat and introduced Yellowstone cutthroat trout was also found as part of the study.

Recent studies have been undertaken in Alberta to investigate the genetic population structure of westslope cutthroat trout (Taylor and Gow 2007, 2009). Genetic diversity at nine microsatellite DNA loci was assayed in trout (*Oncorhynchus* spp.) sampled from localities in south-western Alberta and adjacent British Columbia to investigate the extent of: (i) hybridization and introgression between westslope cutthroat trout and rainbow trout (*O. mykiss*), and between westslope cutthroat trout and Yellowstone cutthroat trout (*O. c. bouvieri*), as well as (ii) population subdivision among pure westslope cutthroat trout populations.

The genetic purity data were summarized by reporting the "westslope cutthroat trout ancestry coefficient" for each fish and the average across the populations of fish analyzed for each locality. The coefficient is an index of the proportion of each fish's genome that originates from westslope cutthroat trout (e.g., "pure" westslope cutthroat trout would have a coefficient = 1.0, $F_1$ hybrids a value of 0.5 and pure rainbow trout a value of 0).

Analyses of genetic purity in populations outside the national parks indicated that pure populations were well distributed at sites in the Oldman River drainage but were concentrated in a small number of sub-basins in the Bow River drainage, especially in the Highwood River drainage. Pure rainbow trout were generally found in tributaries to lower reaches of rivers and often below impassable barriers. Pure populations of westslope cutthroat trout were usually located in the upper reaches of streams and often above impassable barriers (both natural or man-made).

An initial examination of population subdivision established that an extensive degree of genetic independence among populations exists which appears to be concentrated at the level of individual stream (rather than among major watersheds). This implies some level of demographic independence among these populations, such that they may have individual responses to environmental changes or different management regimes (Taylor and Gow 2007).

Taylor and Gow (2007, 2009) suggested that the actual value of any measure of introgression which is used to define genetic "purity" (e.g., 0.99 versus 0.95, etc) is the subject of some debate (see Allendorf *et al.* 2005; Campton and Kaeding 2005; Taylor and Gow 2007). A study by Muhlfeld et al. (2009a) on non-native rainbow trout and native westslope cutthroat trout showed that small amounts of hybridization markedly reduced fitness of male and female trout, with reproductive success sharply declining by approximately 50%, with only 20% admixture. These results strongly support the view that less or no hybrid content is preferable. A criterion of 0.99 is the most conservative, and is based on the rationale that there is good evidence for natural and historical hybridization between westslope cutthroat trout and rainbow trout (hence a value of 1.0 is not biologically expected) and that such historical effects appear to be at a level of about 0.01 or less (Taylor and Gow 2007). Results of the genetic analyses clearly indicated that few native pure populations still exist in provincial waters, and those that do are often remnant populations isolated above barriers.

For the purposes of this plan, the recovery team decided to define a pure population as one with an average purity of ≥0.99. This means that a small number of hybridized fish may have existed in the sample, however, the overall average of all fish tested was ≥0.99.

COSEWIC guidelines suggest that "populations exhibiting >1% introgression may be considered hybridized and will generally be excluded from COSEWIC status assessments." While the recovery team generally supports adhering to this stringent level of purity, it has also been recognized that slightly hybridized populations (e.g., ≥0.95 but <0.99 on average) may be important for species conservation and recovery. While the emphasis is on protecting the native pure populations, the recovery team acknowledges the importance of introduced pure populations, as well as those exhibiting slight hybridization.

## 2.3 Life History

Westslope cutthroat trout are highly diverse in their life history. Fluvial and resident populations are common throughout Alberta, as well as some adfluvial populations. Mixed life history strategies may also be present within the same population. Stream-resident westslope cutthroat trout seldom exceed a fork length of 250–300 mm, whereas fluvial and adfluvial fish often attain sizes greater than 300 mm and 0.9–1.4 kg in weight (Shepard *et al.* 1984; McIntyre and Rieman 1995).

Spawning usually occurs in small gravel bottomed streams where the female prepares a redd in the gravel. Males reach sexual maturity as early as two years of age, and females mature as late as five or six years (Scott and Crossman 1973; Nelson and Paetz 1992). The average age at first spawning is two to four years. Spawning takes place between May and July depending on location, and usually occurs when water temperatures reach 10˚C (Nelson and Paetz 1992) (6˚C in high elevation populations; S. Humphries pers. comm.). Incubation is also temperature dependent and generally lasts six to seven weeks. Following emergence, fry migrate to low energy lateral habitats, which are areas with low water velocity and appropriate cover. Cutthroat trout are iteroparous and some may reproduce every year or every alternate year.

Although mortality rates are rarely known and likely vary both within and between different populations, the time of greatest mortality likely occurs early in life, from the egg to juvenile stage (ASRD and ACA 2006). Adult fish are vulnerable to a variety of predators, as well as harvest. In general few adults are thought to survive past five years of age, although in rare cases some fish from unproductive high elevation lakes may live to 12 years (A. Costello pers. comm. 2006 *in* ASRD and ACA 2006).

The diet of westslope cutthroat trout is specialized to focus on invertebrates even in instances when forage fish are abundant (Shepard *et al.* 1984). Chironomid (midges) larvae are an important food source for young-of-the-year fry, while older juveniles and adults feed on a variety of terrestrial and aquatic insects. The most important dietary components for larger size classes are ephemeropterans (mayflies) and dipterans (crane flies etc.). Trichopterans (caddisflies) are an important dietary component for larger fish, and increasing fish size has been correlated to an increasing diversity of diet (Liknes and Graham 1988). Zooplankton can also be an important food source during the winter months (Shepard et al. 1984).

Westslope cutthroat trout exhibit a preference for cooler water temperatures and higher gradient streams than other trout species. This appears to make them a superior competitor at higher elevation stream reaches, supporting the "temperature/elevation refugia" theory for this species (Griffith 1988; Fausch 1989; Paul and Post 2001; Rasmussen *et al.* 2010). Westslope cutthroat trout populations are less likely to coexist with introduced brook trout (*Salvelinus fontinalis*) than with other native salmonids due to the latter's competitive advantage (Griffith 1988). The introduction of brook trout in a number of locations has resulted in the disappearance of westslope cutthroat trout (Varley and Gresswell 1988; Paul and Post 1996).

## 2.4 Habitat

In general, habitat requirements consist of cold, clean water and varied forms of riparian and instream cover (such as undercut banks, pool-riffle habitat, and riparian vegetation) (ASRD and ACA 2006, COSWEWIC 2006b). Stream temperature is an important habitat parameter for cutthroat trout. This species is sensitive to changes in water temperature and are not usually found in waters where temperatures repeatedly exceed 22˚C (Behnke and Zarn 1976). Their preferred temperature range is 9 to 12˚C (ASRD and ACA 2006). In Alberta, westslope cutthroat trout historically occupied a variety of habitats ranging from headwater streams and tributaries to mainstem river sections extending out onto the plains. Currently this subspecies is largely restricted to headwater streams and lakes and the upper reaches of mainstem rivers.

Spawning habitat for cutthroat trout consists of small, low gradient streams with unsilted gravels and cold, well-oxygenated water (ASRD and ACA 2006). It often occurs at the downstream edge of deep pools during moderate to high flow events that are short in duration (Brown and Mackay 1995; Schmetterling 2001). Shoal spawning does not appear to be common (e.g., Carl and Stelfox 1989). Cover is also an important requirement, and spawning habitat is characterized by the proximity of large woody debris, boulders, or bedrock.

Rearing for this species occurs in small streams (ranging from first to third order) that remain permanently wetted and offer a diversity of cover. Young-of-the-year cutthroat trout migrate to shallow riffles or backwaters with protective cover and low water velocities, while larger juveniles move into pools.

Adult cutthroat trout utilize a variety of habitats depending on life history type. Resident individuals may remain in their natal stream for their entire life cycle, whereas migratory forms leave small natal streams to move into larger systems or mainstem habitat. Fluvial cutthroat trout frequently occupy pools adjacent to fast water with abundant nearby cover such as undercut banks, boulders or large woody debris. Adfluvial and lacustrine adults inhabit lakes and reservoirs with water temperatures lower than 16 ˚C (McIntyre and Rieman 1995).

The suitability of overwintering habitat for this species is largely determined by the absence of anchor ice and the presence of groundwater influx (Brown and Mackay 1995). During winter months fluvial adults will congregate in slow deep pools sheltered from high flows (ASRD and ACA 2006). Juveniles often overwinter in cover provided by boulders and other large instream structures. Adfluvial fish will often overwinter in lakes.

## 2.5 Distribution

### 2.5.1 Global distribution

Westslope cutthroat trout originally occupied parts of Montana, Wyoming, Idaho, Oregon, Washington, British Columbia and Alberta in the upper Missouri, upper Columbia, upper Fraser and upper South Saskatchewan basins in the United States and Canada (Behnke 1992, Figure 2). The Saskatchewan basin cutthroat trout are native only to the upper Bow River and upper

Oldman River drainages (McIllrie and White-Fraser 1983 (re 1890); Sisley 1911; Prince *et al.* 1912; Nelson and Paetz 1992).


**Figure 2. Original global distribution of westslope cutthroat trout (shaded). Figure modified from AESRD and ACA (2006). Distribution data primarily from Behnke (1992) (see text).**

The present global distribution of westslope cutthroat trout is vastly reduced from the historical range. In the United States, just six percent of the original range is still occupied by this species (eight percent if mixed populations holding some unhybridized individuals are counted) (Shepard *et al.* 2003). In British Columbia, genetically-pure westslope cutthroat trout populations were recently found in only 22% of the original range in the upper Kootenay River drainage (Rubidge and Taylor 2005). In Alberta the range currently occupied by westslope cutthroat trout is also severely reduced to approximately five percent of the original range (Mayhood 1995, 2000).

### 2.5.2 Alberta Distribution

#### 2.5.2.1 Historical Distribution

Westslope cutthroat trout originally occupied the Bow and Oldman River drainages and accessible tributaries (i.e., below waterfalls and other impassable barriers) out onto the plains at least to the current cities of Calgary and Lethbridge, and may have extended downstream into the upper Milk River drainage of Alberta from the Montana headwaters (Figure 3; Prince *et al.* 1912; Behnke 1992). Numerous historical records indicate that these trout were abundant throughout most of the native range in Alberta (Mayhood *et al.* 1997; Mayhood unpublished data).

#### 2.5.2.2 Present Distribution

At present, native westslope cutthroat trout occupy considerably less than five percent of the native range in the Bow drainage, where they appear to be restricted to the extreme headwaters of a few of the major tributaries and the upper mainstem (Figure 4; Mayhood 1995, 2000). The extent of hybridization in various populations has not been firmly established, but is currently under investigation (Taylor and Gow 2007 and 2009; ASRD 2008; Robinson 2008). Many remaining Bow drainage populations within the native range appear to be or are known to be hybridized (McAllister *et al.* 1981; Carl and Stelfox 1989; Strobeck 1994; Bernatchez 1999; Janowicz 2005; Taylor and Gow 2007, 2009; ASRD 2008; Robinson 2008). Nearly all remnant populations are small and isolated (Mayhood 2000; ASRD 2008).

In the Oldman River drainage westslope cutthroat trout still occupy much of the native range in the upper Oldman basin (Figure 4), but have been lost from native waters in the mainstem east of the mountain front and most of its fish-accessible tributaries (Radford 1975, 1977; Fitch 1977–80; Mayhood *et al.* 1997). Westslope cutthroat trout are uncommon to rare in the St. Mary and Belly River drainages and may no longer exist except as hybrids even in the headwaters of these drainages. They have been all but extirpated from their native waters in the Crowsnest River drainage (Fitch 1977–80; Mayhood *et al.* 1997; ASRD 2008).

Distribution of this species in the national parks in Alberta is variable. The only pure populations (in native range) occur in Banff National Park (Figure 4). Other populations in Banff National Park exhibit a range of hybridization or have been extirpated. It is thought that all of the westslope cutthroat trout populations within the historic range of the species in Waterton Lakes National Park are hybridized with either stocked rainbow trout or Yellowstone cutthroat trout (McAllister *et al.* 1981; Potvin *et al.* 2003). In Jasper National Park there are two pure westslope cutthroat trout populations that occur outside the historic range for the species; these populations were stocked, and now potentially threaten Athabasca rainbow trout.

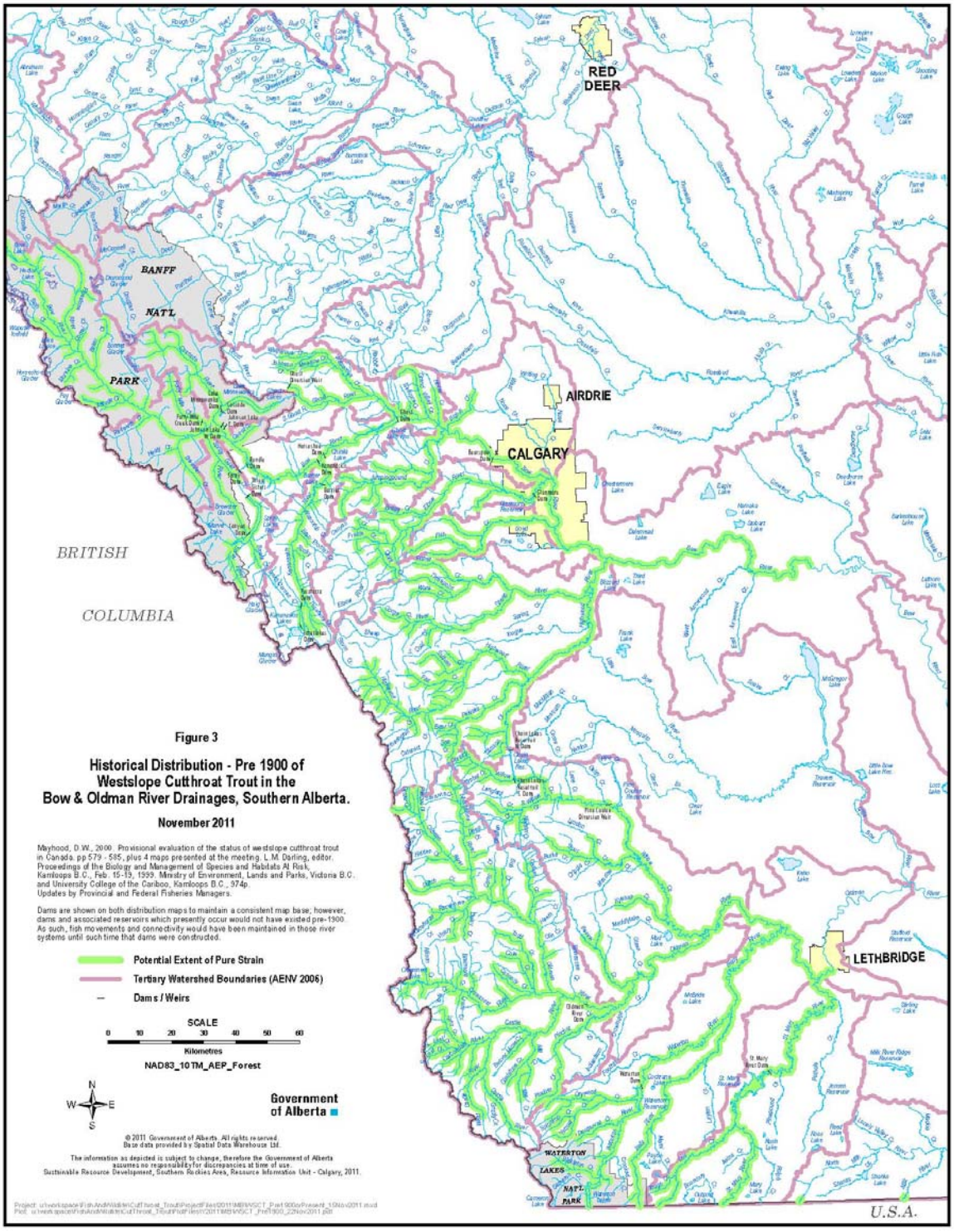


**Figure 3. Historical distribution – pre-1900 of westslope cutthroat trout in the Bow and Oldman River drainages, southern Alberta.**

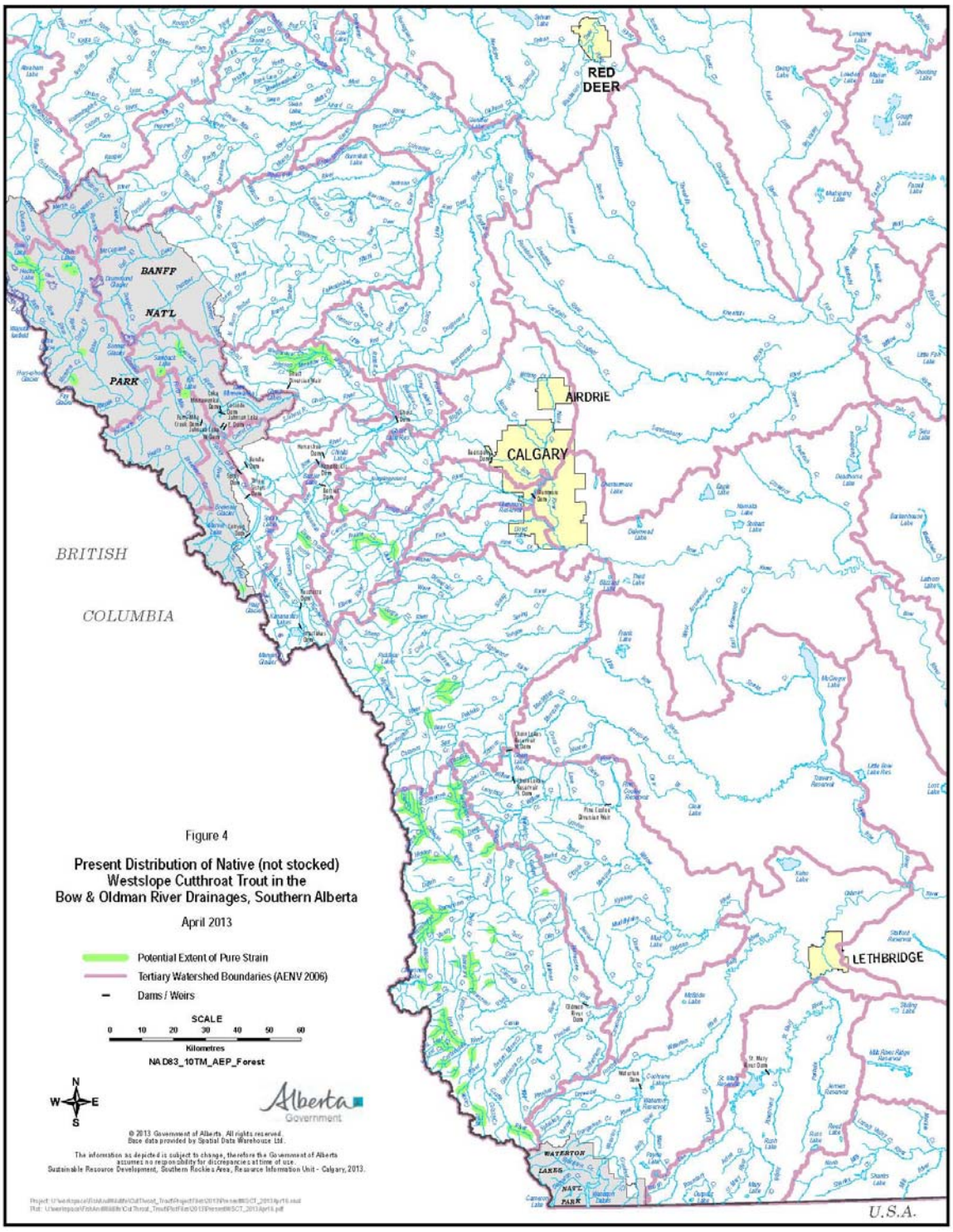


**Figure 4. Present distribution of native (not stocked) westslope cutthroat trout in the Bow and Oldman River drainages, southern Alberta.**

## 2.6 Population Size and Trends

### 2.6.1 Historical Abundance

In Alberta, very large declines in westslope cutthroat trout abundance are evinced by the loss of entire historical populations and the virtual absence of the subspecies from large parts of the documented historical range (Nelson 1965; Mayhood 1995, 2000). Although exact numbers of westslope cutthroat trout for given waterbodies or watersheds are not known, it is estimated that 274 streams or rivers in Alberta historically contained native populations of this species (ASRD and ACA 2006). Numerous historical accounts attest to there being large numbers of westslope cutthroat trout in the streams throughout the native range (e.g., Aldous 1881; Miles 1890; MacMillan 1909; Vick 1913; Miller and MacDonald 1949; Mayhood *et al.* 1997).

### 2.6.2 Present Abundance

A combination of factors led to the severe depletion of populations of westslope cutthroat trout. Currently, an estimated 51 pure populations of westslope cutthroat trout remain in their documented native range in Alberta. This number is based on the best information available to date and is subject to change pending additional field surveys and genetic work. It should be noted that most of these populations currently occupy only portions of their former range in streams and lakes. The recovery team's definition of a pure population is consistent with the COSEWIC assessment and status report (COSEWIC 2006), in that at a population level there is an average purity of $\geq$0.99. This means that a small number of hybridized fish may have existed in some of the samples, thereby suggesting a potential threat of further hybridization which will need to be monitored.

In the Bow River basin an estimated minimum of 63 populations have been lost from a combination of factors including habitat changes, competition, and hybridization (Mayhood 2009 and unpublished data). These losses include apparent complete eradication of the species from the Bow River below Lake Louise and the lower mainstems of the Highwood, Elbow, Spray, Jumpingpound, Sheep, and Kananaskis rivers. Extensive hybridization is apparent in the upper reaches of most of these mainstems. In every case pure westslope cutthroat trout are restricted to small habitats in the extreme headwaters. As a consequence, it appears certain that the migratory fluvial and adfluvial life-history forms are no longer present. Only small stream-resident populations are likely to remain.

The situation is similar in the Oldman River basin. An estimate in the order of 49 westslope cutthroat trout populations have been lost, primarily due to hybridization, habitat changes, and competition (Mayhood 2009 and unpublished data). The subspecies appears to be extirpated from the Crowsnest River mainstem, and exists only as heavily-introgressed stocks in the mainstems of the mid to lower Oldman, Belly and Castle rivers. The fluvial and adfluvial life-history forms (at least in their genetically-pure state) have been completely lost from the Oldman River basin. Only small stream-resident populations still exist in the upper headwaters.

Alberta's present total population of wild, native westslope cutthroat trout has been estimated at no more than 5 100 mature individuals (Note: this is down from the 7 000 estimate given in ASRD and ACA (2006) due to the revised smaller number of pure populations). The estimated

average size of each population is 100 (range 30 — 200) mature fish (ASRD and ACA 2006; COSEWIC 2006b). If we accept these estimates, the relevant figures for judging extinction risk for this subspecies in the province therefore would be approximately 51 populations, each comprised of 100 adults. However, applying the average number of mature individuals per population may overestimate the actual number (ASRD and ACA 2006). Furthermore, not every adult will spawn, those that do will not do so every year, and post-spawning mortality appears to be high (Shepard *et al.* 1984; Liknes and Graham 1988; McIntyre and Rieman 1995). Of those that do spawn, a few will be much more successful than others: larger females produce more eggs, for example. As a result of these and other issues, the reproductively effective size is likely much smaller than 100 per population. Based on this, the extinction risk is very high for individual populations of 200 adults or fewer in the absence of human assistance. For additional details and a discussion of extinction risk, see Mayhood and Taylor (2011).

# 3.0 THREATS AND LIMITING FACTORS

## 3.1 Overview

Historical human activities are perhaps the single greatest threat and limiting factor confronting native westslope cutthroat trout and their prospects for recovery in Alberta. Historical actions are, in many cases, irreversible, and their consequences have created several intractable problems for conserving this species.

## 3.2 Threats Assessment

The recovery team undertook a detailed assessment of threats to the species based on both published information and local knowledge. Six primary categories of threat were identified:

- Invasive species
- Adverse effects on habitat
- Consumptive use/exploitation
- Stocking
- Pollution
- Climate change

These threats are not mutually exclusive, and can interact to have cumulative and synergistic effects on the species. A brief description of the methods and assessment of threats is provided in Appendix A. The results are summarized in Table 1 and are discussed in more depth below. A more detailed threats assessment is provided in the technical report prepared by Mayhood (2009).

**Table 2. Detailed threats assessment for westslope cutthroat trout in Alberta.**

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Invasive Species** | Hybridization and competition | Rainbow trout | **H** | **H**<br>**M (NP)** | **H**<br>**M (NP)** | **P,C,F** | **H** | **L** | No stocking currently occurs in areas where rainbow trout could threaten pure remnant westslope cutthroat trout populations but stocking policy to be reviewed.<br>Opportunities to mitigate in stream systems is low but in lakes may be moderate-high. |
| | | Yellowstone cutthroat trout | **H** | **L** | **L** | **P,C,F** | **M** | **L** | Found in some national park waters and in Island Creek (Crowsnest drainage). Severity high for Island Creek population.<br>Opportunities to mitigate in stream systems is low but in lakes may be moderate-high. |
| | | Golden trout | **?** | **L** | **?** | **P,C,F** | **?** | **M** | Four lakes in Castle drainage and possibly in Temple Lake (BNP). Uncertain if lake populations have migrated into downstream systems. Also uncertain if the two species hybridize.<br>Opportunities to mitigate in stream systems is low but in lakes may be moderate-high. |
| | Competition | Brook trout | **H** | **H** | **H** | **P,C,F** | **H** | **M** | Includes competition, range constriction or elimination of native species.<br>No stocking currently occurs in areas where brook trout could threaten pure remnant westslope cutthroat trout populations but stocking policy to be reviewed.<br>Opportunities to mitigate in stream systems is low-moderate but in lakes may be moderate-high. |

[1] Threats are not listed in any particular order.
[2] H= High, M=moderate, L=Low. Codes are further explained in Appendix A.
[3] Where a separate rating is not given for National Parks, the rating is the same inside and outside National Parks, unless the comments indicate this threat does not apply.
[4] P=Past, C=Current, F=Future, ? = data deficient, NP=National Parks). Codes are further explained in Appendix A.

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Invasive Species** | Competition | Brown trout | **H** | **M** | **M-H** | **P,C,F** | **M**<br>**H (NP)** | **L** | Includes competition, range constriction or elimination of native species.<br>No stocking currently occurs in areas where brown trout could threaten pure remnant westslope cutthroat trout populations but stocking policy to be reviewed.<br>A serious threat where they occur, but more of an issue in medium to large systems e.g., Bow, Kananaskis, Crowsnest, lower Oldman, Waterton rivers. |
| | | Lake trout | **L**<br>**H (NP)** | **L**<br>**M (NP)** | **M**<br>**H (NP)** | **P,C,F** | **L**<br>**H (NP)** | **L**<br>**L-M (NP)** | Lake trout stocked into some waterbodies and others thought to be in native range. Found in Crowsnest, Waterton Lakes as well as in Spray Lakes, Ghost and Bearspaw Reservoirs. Possibly naturally co-occurring in Lake Minnewanka. In reservoirs, native species have typically been reduced in abundance or extirpated. Where the two species naturally co-occur the threat significance is low, however, where lake trout are introduced, the threat significance is high.<br>Bow and Hector lakes mitigation potential is low to moderate. |
| | Algae | *Didymosphenia geminata* | **?** | **L** | **?** | **C,F** | **?** | **?** | Freshwater algae; single cells are capable of expanding into large mats that can completely cover stream bottoms, reducing available habitat for fish and invertebrates.<br>Insufficient information to further evaluate at this time. |
| | Pathogens | Parasites | **L** | **L** | **H** | **C,F** | **L** | **M** | Limited information available. Whirling disease is of concern but does not currently occur in Alberta. Moderate mitigation potential in terms of introduction of pathogen.<br>If whirling disease were to enter Alberta, the waters most likely to be affected would be the lower portions of watersheds, as opposed to the headwater streams where most of the remaining westslope cutthroat trout populations are found (see text for explanation). |
| **Adverse Effects on Habitat** | Changes in flow | Dam/Reservoir operation | **H** | **M**<br>**H (NP)** | **H** | **P,C,F** | **H** | **L-M** | Loss of riverine and spawning habitat, transform flow regime in downstream habitats, reduce downstream flow (e.g., irrigation dams and weirs), decreased high flows and increased low flows, decreased movement of stream bed material and LWD. Depends on purpose i.e., power, municipal, irrigation. Possible future dams and diversions. |

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects on Habitat** | | Forest removal - harvest | **H** | **M-H**<br>**L (NP)** | **M**<br>**L (NP)** | **P,C,F** | **M-H**<br>**L (NP)** | **M** | Increased peak flow, altered snow interception and melt processes, increased run-off, increased summer temperatures (due to changes in channel form i.e., widening of channel and shallower) and reduced late summer and winter flows. Appropriate riparian buffer width required. Uncertainty regarding effects of changes in flow depending on timing of change. Severity may change depending on space and time. |
| | | Forest removal - fire | **H** | **H**<br>**L (NP)** | **L-H**<br>**L (NP)** | **P,C,F** | **M-H**<br>**L (NP)** | **L** | Increased summer temperatures. Ratings would depend on forest fire severity. |
| | | Water extraction – surface and groundwater | **H** | **M** | **M**<br>**L (NP)** | **P,C,F** | **M-H**<br>**L (NP)** | **M-H**<br>**M (NP)** | Snow making, gas plants, hydrostatic testing, instream construction (upset). Uncertainty for groundwater extraction which could result in high threat significance, unknowns concerning connectivity between ground and surface water. |
| | Sedimentation | Forest harvest, linear disturbance, grazing, OHVs, recreational access, instream construction, municipal run-off | **H**<br>**M (NP)** | **H**<br>**L (NP)** | **M-H**<br>**M (NP)** | **P,C,F** | **H**<br>**L (NP)** | **M-H**<br>**H (NP)** | Especially a problem if occurs in or upstream of spawning areas. Potential for high severity impact on small, isolated populations.<br>Use of OHVs as an activity is unpredictable, therefore, the extent and severity are hard to assess. |
| | Habitat loss | Dam and reservoir creation | **H**<br>**H (NP)** | **M** | **M-H** | **P,C,F**<br>**P,C (NP)** | **M-H** | **L-M** | Associated with dams, smaller scale water storage, often stocked with non-native species, often low productivity, water level fluctuations destroy littoral zone. Destroy fluvial spawning habitats. Resulting in decreased bedload movement to areas downstream, as well as lack of scouring flows to clean fines out of substrate.<br>Severity moderate to high – extirpation could be related to combination of introduction of non-native species and habitat loss.<br>Mitigation potential could be moderate for any new dams or reservoirs (location, fish passage). |

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Adverse Effects on Habitat** | Habitat fragmentation (loss of connectivity) | Dams, culverts | **H** | **H** | **H** | **P,C,F** | **H** | **L-H** | Block upstream and/or downstream fish movements. Loss of migratory life history forms (fluvial, adfluvial). Inability to access habitats to meet all life history requirements.<br>Mitigation potential is low for dams but moderate to high for culverts.<br>Consider impassable barriers that separate natives and non-natives before initiating corrective actions. |
| | Habitat alteration and loss | Linear disturbance (e.g., roads, pipelines, railway, OHVs, recreational trails, culverts) | **H** | **H** | **H** | **P,C,F** | **H** | **M** | Increased surface erosion and run-off, fine sediment deposition, increased access, physical loss of habitat from construction and use (e.g., footprint), barriers to movement (e.g., impassable culverts). Impact of each linear disturbance may be local but cumulatively can result in significant overall negative effects on habitat quality and quantity. |
| | | Grazing | **H** | **H** | **M** | **P,C,F** | **M** | **M** | Riparian disturbance, changes to stream structure, fine sediment delivery.<br>Common land-use throughout species range. Can result in redds being trampled or silted in and destruction of riparian habitat and undercut banks.<br>Typical entry/exit dates for cattle grazing are early June to mid-October.<br>Not applicable to national parks. |
| | | River training | **H** | **L** | **M-H** | **P,C,F** | **M** | **M** | Bank armouring, channelization from a variety of causes e.g., road crossings, protection of property, flood prevention, urban areas. Loss of high quality habitat (e.g., undercut banks, sweepers and log jams). Extent of occurrence and severity are high in urban areas. |
| **Consumptive Use/ Exploitation** | Harvest | Intentional mortality | **M**<br>**L(NP)** | **L** | **L** | **P,C,F**<br>**P (NP)** | **L** | **H** | Legal harvest. Catch-and-release, size limits implemented for sensitive fisheries. Most harvest permitted on stocked fisheries. |
| | | Incidental or accidental mort | **H** | **M**<br>**L(NP)** | **L-M?** | **P,C,F** | **L?** | **M** | Hooking mortality of released fish, fish misidentification resulting in harvest, scientific sampling. Uncertainty around angler pressure. |

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | Illegal (poaching) | **H** | **M** | **L-M?** | **P,C,F** | **L-M?** | **M** | Consider potential for closing fisheries to result in increase in poaching and illegal introductions. Could also include angler misidentification. |
| **Stocking** | Current legal stocking of native fish | Westslope cutthroat trout | **L** | **M** | **L** | **C,F** | **L** | **H** | Stocking on top of native populations may have occurred in the past but records are frequently unreliable or unavailable.<br>Stocking is currently limited to high mountain lakes or beaver ponds with no or limited connectivity to downstream habitats but stocking policy to be reviewed.<br>Likelihood of occurrence is rated high as a result of past stocking practices which have had an unknown effect on some populations.<br>Not applicable to national parks. |
| | Current legal stocking of non-native fish | Rainbow trout, brook trout, brown trout | **H** | **M** | **M-H** | **C,F** | **L** | **H** | Severity high as a result of past stocking practices. No stocking currently occurs on top of or upstream of existing pure remnant westslope cutthroat trout populations. However, it may occur in a few areas where populations are already severely hybridized or where triploid fish are used. Stocking policy to be reviewed.<br>No stocking in national parks. |
| | Illegal stocking of non-native fish | Many potential species | **H**<br>**L (NP)** | **M**<br>**L (NP)** | **L-H**<br>**L (NP)** | **P,C,F** | **L-H**<br>**L (NP)** | **M**<br>**H (NP)** | Depends on the species, locations of introductions. Could compromise small systems currently dependent on a barrier. |
| **Pollution** | Water quality and fish habitat degradation | Point source - includes accidental spills associated with road/rail and pipeline crossings | **H** | **L-H** | **L-H** | **C,F** | **M** | **L-M** | Effects depend on substance released, location of spill, potential to mitigate impacts. |
| | | Non-Point source - surface run-off (e.g., road salt, incr. nutrients as a result of fires) | **H** | **M** | **M** | **P,C,F** | **M** | **M** | High flows, agricultural and urban run-off, elevated sediment, nutrients etc. |

| Threat Category | Threat[1] | Activity/ Detail | Likelihood of Occurrence[2,3] | Extent of Occurrence[2,3] | Severity of Impact[2,3] | Immediacy of Impact[3,4] | Threat Significance[2,3] | Mitigation Potential[2,3] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| **Climate Change** | Climate change and severe weather | Increasing temperature trend, altered flow regimes, droughts, high flow events | **H** | **H** | **M-H** | **C,F** | **M-H** | **L** | Changes in water temperature, basin hydrology, channel morphology, riparian habitat, stream flows, habitat quality and availability, competitive advantage to non-native fish.<br>Threats evaluation based on modeling scenarios for changes in mean annual precipitation and temperature from 2020s to 2080s. See Mayhood (2009) for details.<br>Severity range based on various modelling scenarios. Depends on location and timing of changes. |

### 3.2.1 Invasive Species

Invasive species may include fish or species such as algae or pathogens. Mechanisms by which non-native invasive species may be (or have been) introduced into westslope cutthroat trout habitat include the legal or illegal stocking of fish and the unintentional translocation of invasive species.

#### 3.2.1.1 Fish Species

A number of invasive fish species threaten the continued existence of native westslope cutthroat trout populations and limit prospects for recovery of the subspecies. They impact westslope cutthroat trout through hybridization, introgression, competition, predation, or possibly as vectors and reservoirs of parasites and agents of disease.

*Rainbow Trout*

Rainbow trout are the single greatest threat to the continued existence of native westslope cutthroat trout stocks in Alberta. Early trout hatcheries were established in Banff (1913), Jasper (early 1920s) and Waterton Lakes (1928), with the first trout hatchery in the province, outside the national parks, established in 1936 in Calgary (Nelson and Paetz 1992). All of these hatcheries contributed trout for introduction into the native range of westslope cutthroat trout in Alberta (Department of Marine and Fisheries 1914; Mayhood 1992; Nelson and Paetz 1992). When native cutthroat trout eggs proved to be difficult to obtain in sufficient numbers (around 1914 to 1920; see Department of Marine and Fisheries (1914) and subsequent annual reports), the more readily-produced hatchery stocks of rainbow trout were used and distributed widely on top of the depleted cutthroat trout populations. Rainbow trout readily hybridize with westslope cutthroat trout and produce fertile offspring which can then interbreed among themselves and with either parental species. In many cases the ultimate outcome of this process is a fully-introgressed hybrid population called a hybrid swarm.

While genetically pure westslope cutthroat trout appear to be competitively superior in cooler headwaters, they appear to be inferior competitors to rainbow trout and rainbow-cutthroat hybrids in warmer waters, where rainbows trout and hybrids dominate (Paul and Post 2001; Robinson 2007; Muhlfeld *et al.* 2009c; Rasmussen *et al.* 2010). As a result, pure westslope cutthroat trout stocks are now almost exclusively confined to small, higher elevation headwater streams. The populations are small and isolated from each other, making rescue effects unlikely and increasing susceptibility to extirpation from the effects of inbreeding and stochastic events. In national parks, most of the native westslope cutthroat trout populations are found in headwater lakes and above barriers or are in tributary streams above barriers. Based on this, competition from brook trout is the larger concern.

*Yellowstone Cutthroat Trout*

Yellowstone cutthroat trout likewise introgressively hybridize with westslope cutthroat trout in a similar manner as do rainbow trout. Yellowstone cutthroats, however, appear to be less effective in competition with westslope cutthroat trout, which suggests that the hybrids of the two subspecies may likewise be weaker competitively than the native westslope cutthroat stocks. In Glacier National Park, Montana, introduced Yellowstone cutthroat trout have been unable to replace or significantly hybridize with native westslope cutthroat trout in any lake in which the

latter is indigenous (Marnell *et al.* 1987). The non-native subspecies has successfully colonized only small, high-elevation lakes in that park that were previously barren of fish. Similarly, Yellowstone cutthroats have been singularly unsuccessful in colonizing waters throughout North America and elsewhere, despite 818 million eggs being shipped from Yellowstone National Park for this purpose (Varley and Gresswell 1988). Yellowstone cutthroats are less competitive in a number of respects in comparison to rainbow trout in laboratory experiments (Seiler and Keeley 2007a, b, 2009). Hybrid populations of westslope cutthroat and Yellowstone cutthroat subspecies are primarily found in Banff and Waterton Lakes National Park waters. However, the degree to which they may be invasive is unknown (Taylor and Gow 2007).

*Golden Trout*

Golden trout (*Oncorhynchus mykiss aguabonita*) have been introduced into four lakes in the Castle River drainage and possibly into Temple Lake in Banff National Park. While golden trout and westslope cutthroat trout are closely related, it is unknown if they hybridize in these systems, and it is also uncertain if lake populations have migrated into downstream systems.

*Brook Trout*

Brook trout are also a non-native invasive species. Some populations have greatly expanded their range in certain watersheds over time, while other populations have not (Adams *et al*. 2000, 2001; Peterson and Fausch 2003; Carlson *et al*. 2007). If successful, brook trout may displace -- and often replace, native salmonids -- especially various subspecies of cutthroat trout (Behnke 1992; Stelfox *et al.* 2001; Peterson *et al.* 2004; Fausch 2007; McGrath and Lewis Jr. 2007; Peterson *et al.* 2008; Earle *et al.* 2010 a, b). The mechanism of replacement may sometimes be related to differential susceptibility of native cutthroat trout to harvest (MacPhee 1966; Stelfox *et al.* 2001; Paul *et al.* 2003), because this species is notably susceptible to anglers (MacPhee 1966; Schill *et al.* 1986; Varley and Gresswell 1988; Stelfox *et al*. 2001). Displacement mechanisms involve competition effects from brook trout on survival of cutthroat trout at early life-history stages (Shepard *et al.* 2002; Peterson *et al.* 2004; McGrath and Lewis Jr. 2007), and high immigration from well-established brook trout populations, typically situated downstream (Peterson *et al.* 2004; Benjamin *et al.* 2007), but sometimes from populations stocked into headwater lakes (Adams *et al.* 2001). They can be particularly difficult to eradicate, but successful attempts have yielded greatly increased numbers of native westslope cutthroat trout in some cases (Shepard *et al.* 2002). As such, brook trout populations within Alberta's westslope cutthroat trout native range are a serious threat to the continued existence of westslope cutthroat trout populations.

*Brown Trout*

Brown trout are an invasive species that have replaced westslope cutthroat trout in certain native habitats, notably the lower-gradient, larger, and warmer mainstem rivers to which the former seem largely to be confined. The mechanism of exclusion (if it exists) is not clear, but several possibilities have been suggested in the literature. These include competition between early life stages for habitat (Griffith and Smith 1993) and more aggressive behaviour observed by juvenile brown trout during interactions with juvenile cutthroat trout (Wang and White 1994). Cutthroat trout are also much more susceptible to angling than are brown trout (Behnke 1992). In the US Southwest, brown trout are a serious predator of at-risk Rio Grande cutthroat trout, Gila trout and

Apache trout (Rinne and Calamusso 2007). The evidence of this literature survey and additional studies reviewed in Mayhood (2009) strongly suggest that brown trout can exclude or seriously reduce cutthroat trout populations where the two occur together, both through competition and predation. There are nevertheless some indications that the two species can coexist in some circumstances despite these negative impacts (Aitken 1997; Hepworth *et al*. 2001). Attempts to restore native westslope cutthroat trout to those habitats currently occupied by brown trout would likely be limited by the presence of this species.

*Lake Trout*

Lake trout are native to parts of Alberta but have also been introduced into lakes and reservoirs in westslope cutthroat trout range. Lake trout are believed to be native in headwater lakes of the South Saskatchewan River drainage including Waterton Lake and Lake Minnewanka (Donald and Alger 1993). From the latter, they are thought to have migrated further down the Bow River and taken up residence in the Ghost and Bearspaw Reservoirs. This species was also stocked into the Ghost Reservoir between 1948 and 1952. They were introduced into Crowsnest Lake as well as into Spray Lakes Reservoir, where they were stocked numerous times between 1951 and 1987 to provide recreational fishing opportunities. In lakes and reservoirs where lake trout have been introduced, native species including westslope cutthroat trout have typically been reduced in abundance or are extirpated (AESRD file data; Schindler and Pacas 1996; Anderson *et al.* 1996; Pacas and Hunt 2004).

#### 3.2.1.2 Algae and Pathogens

The freshwater algae *Didymosphenia geminata* are capable of expanding into large mats that can completely cover stream bottoms, reducing available habitat for fish and invertebrates. This species has been documented in the upper Bow River in Banff National Park and in the upper reaches of the Oldman watershed, including in the Waterton and Belly Rivers, and tributaries in Waterton Lakes National Park (Kirkwood *et al.* 2007; B. Johnston, pers. comm.), as well as in the Bow River near Calgary (Kirkwood *et al.* 2007). Unlike most other bloom-forming algae, it proliferates under high water quality (i.e., low turbidity and low nutrient) conditions. Analysis of three years of data from one study river (Red Deer River) revealed consistently higher *D. geminata* cell densities at a dam site compared to the upstream reference. In regards to the link between dam proximity and *D. geminata* occurrence, the overarching mechanism is likely lower discharge velocities and less variation in discharge. Currently, there is insufficient information to further evaluate the threat of this species to westslope cutthroat trout.

Whirling disease (caused by the myxosporidean *Myxobolus cerebralis*) is of particular recent concern because it is strongly pathogenic to cutthroat trout (Hedrick *et al.* 1998), although there is some variation in the susceptibility among different stocks and subspecies (Wagner *et al.* 2002; DuBey *et al.* 2007). This pathogen is not currently in Alberta but is widespread in Montana waters immediately south of remnant cutthroat trout stocks in Alberta, and it has been feared that the organism would soon invade Alberta trout waters (e.g., via mud on waders and angling equipment) (Gates *et al.* 2007). Whether or not it could become a major threat to Alberta native westslope cutthroat trout populations if it became established here is unclear. Headwater streams where the remnant westslope cutthroat trout populations now exist are not likely to hold the obligate intermediate host (*Tubifex tubifex*) which reaches significant populations mainly in mud substrates of lower-elevation mainstem rivers. Should *M. cerebralis*

enter Alberta waters, it may present an additional obstacle to restoring mainstem fluvial cutthroat trout populations by further isolating populations in headwater reaches.

### 3.2.2 Adverse Effects on Habitat

Issues associated with habitat loss/degradation include changes in flow, sedimentation, habitat loss (including river training), habitat fragmentation, and grazing. Since these issues can be the result of multiple activities and land uses, and in turn these activities themselves frequently have more than one impact, separating the individual impacts is complex. A cumulative effects analysis with related range of natural variability reference points will inform the discussion. An overall assessment of habitat related threats is provided below and a breakdown by detail is provided in Table 1. For a more detailed assessment of habitat-related threats, including a summary of major dams in westslope cutthroat trout habitat and their effects and limits on recovery and restoration, see Mayhood (2009).

The westslope cutthroat trout range in Alberta is heavily impacted by human land-uses. Linear disturbance density (a good measure of the intensity of land use) within the native range in Alberta is high — among the highest observed in western North America (Sawyer and Mayhood 1998; Alberta Environment and Olson + Olson Planning and Design 1999). One consequence is that stream channels in most watersheds are at moderate to high risk of damage from the combined effects of increased peak flows and increased surface erosion as a result of forestry, oil and gas, urbanization, mining, recreation and other land-uses. There are many examples of actual damage to westslope cutthroat trout habitat due to linear disturbances throughout the native range, including within national parks (e.g., TransCanada Highway, Canadian Pacific Railway; see Taylor and Helms 2008; Blank and Clevenger 2009). At-risk basins have been at risk for many decades to as much as a century. Many channels have probably been damaged for a long time, so restoration success may be both more difficult and less likely. In some cases additional changes have happened in those channels such that returning them to pre-impact conditions may not be possible.

Higher road densities have been associated with reduced population densities of cutthroat trout (Eaglin and Hubert 1993), including the westslope subspecies (Valdal and Quinn 2010; Dunnigan *et al*. 1998; Huntington 1998), as has higher watershed surface disturbance (Shepard 2004). Fine sediment deposition in spawning areas, barriers to movement such as hanging culverts, cutoff side channels, channel straightening and rerouting, and improved access for anglers may be the most important proximate causes of reduced cutthroat trout population densities associated with watershed surface disturbance and roads.

Roads are the principal source of fine sediments to streams, typically being much greater than that from all other land management activities combined (Furniss *et al.* 1991). Measures of road development in watersheds commonly are correlated with the amount of fine sediment deposition in streams (Shepard *et al.* 1984; Leathe and Enk 1985; McCaffery *et al.* 2007). Problems often arise at crossings of small, intermittent, and ephemeral headwater streams (Shaw and Thompson 1986; Chamberlin *et al*. 1991), because protection for such minor watercourses may be given less priority. Unfortunately small headwater streams or the headwater mainstems into which they drain are disproportionately important ecologically (Chamberlin *et al.* 1991),

often providing important habitat for cutthroat trout (Rosenfeld *et al.* 2000, 2002; Robinson 2008).

Even small increases in fine sediment loading to spawning areas can cause dramatic losses of early life-history stages of salmonids (Weaver and Fraley 1993; Irving and Bjornn 1984, cited by Weaver and Fraley 1993). Fine sediment levels in the substrate are a major limitation (natural or otherwise) on the carrying capacity of streams for westslope cutthroat trout. Fine sediment deposition is thus a major limiting factor affecting the recovery prospects of westslope cutthroat trout.

Road culverts represent a major artificial limitation on stream carrying capacity for westslope cutthroat trout (Furniss *et al.* 1991; Eaglin and Hubert 1993). Improperly placed and obstructed culverts are very common, blocking fish access to the upstream stream network. If fish cannot move past culverts to complete their life-history the amount of habitat lost is potentially very large. For example, a survey of 188 crossing locations assessed for fish passage in Banff National Park found that 55 percent were full barriers, 36 percent were partial barriers, and only 9 percent were passable to salmonids (Taylor and Helms 2008). Conversely, barrier culverts may protect remnant westslope cutthroat trout stocks above them from non-native rainbow, brook and brown trout. For this reason it will be important to carefully evaluate the function of every existing barrier before a decision is made to remove it or make it passable as part of westslope cutthroat trout restoration efforts.

Protection and management of westslope cutthroat trout involves the management of public access and trails for recreation. In particular, use of off-highway vehicles (OHVs) can result in sedimentation, physical destruction of stream habitats and riparian areas, and increased angler access where trails run along or cross streams. Current land management practices in Alberta allow for OHV activity that is largely unpredictable through space and time, therefore the extent and severity of effects are difficult to assess.

Forestry operations take place throughout the east slope watersheds where westslope cutthroat trout occur. Potential impacts on aquatic ecosystems can include changes in flow (at macro and micro scales), water storage (as groundwater), water temperature, sediment, access, riparian impacts, and sources of large woody debris. The impacts of some of these (e.g., sediment, road access) have been discussed above. Flow-related changes which have been reported in the literature (Meehan 1991; Brewin and Monita 1998; Peterson 2011) include increased peak snowmelt, increased spring run-off (Beaudry 1998), increases in suspended sediment and channel widening (McCleary *et al.* 2004). The effects and severity of flow-related changes will depend on timing and spatial extent. Other effects reported in the literature may include changes in water temperature (e.g., increased mean temperatures; Macdonald *et al.* 2003), changes to invertebrate communities (e.g., decreased invertebrate diversity and abundance; Clare and Bothwell 2003), and changes in the availability and transport of large woody debris (Hauer *et al.* 1999).

Dams are another major threat and limiting factor affecting westslope cutthroat trout recovery. Dams block movements of fish both upstream and downstream, transform upstream habitats from running water to standing water, substantially transform flow regimes in downstream

habitats, and reduce downstream flows (in the case of irrigation dams and diversion weirs), among many other effects. Reservoirs are often heavily stocked with non-native fishes to mitigate the loss of native stocks. Dam maintenance activities or catastrophic failure can result in either de-watering downstream riverine sections or in extreme flushing flows while work is undertaken within the dam or generation facility. These events may be more common in the future as these facilities age and require major upgrades. All of these effects have the potential to severely disrupt fish populations, and have done so to native westslope cutthroat trout populations in Alberta.

Ten major dam projects now modify native westslope cutthroat trout habitat in the Bow River basin, and four more do so in the Oldman (Mayhood 2009). Dams could be proposed in the native range in response to increased demand for water and summer streamflow reductions arising from climate change. As well, there are many smaller dams on tributaries in the Oldman and Bow river basins, and a very large number of impassible road culvert crossings of streams that have many of the effects of dams. All of these dams have seriously affected native westslope cutthroat trout habitat, populations, and range. All pose limitations on the possibilities for recovering the subspecies.

Grazing livestock (cattle) has impacts on riparian integrity, channel form, and fine sediment delivery, which are well-known within the Alberta native range of westslope cutthroat trout (Adams and Fitch 1995; Paul and Boag 2003) and elsewhere (Gresswell *et al.* 1989; Platts 1991; Armour *et al*. 1994; Wohl and Carline 1996). Grazing is a common land use throughout the native range outside of national parks, so habitat damage from that source could be widespread within the native range of westslope cutthroat trout in Alberta. However, actual impacts in Alberta have not been measured.

River training includes bank armouring and channelization. It can be the result of a variety of activities such as road crossings, protection of property, and is especially severe in urban areas. These activities can result in significant losses of high quality habitat such as undercut banks, sweepers and log jams. This practice eliminates habitat diversity thus negatively impacting westslope cutthroat trout.

### 3.2.3 Consumptive Use/Exploitation

Current angling regulations are highly restrictive, and would appear to permit very little legal harvest of native or potentially native remnant populations, in part because of high minimum size limits in many stream populations that make them effectively catch-and-release only fisheries. There is a question of whether the size limits have some undesirable selective effects which would require further research to evaluate. However, it is likely that harvests (legal and illegal) are promoted by some of the highest road densities in western North America (Sawyer and Mayhood 1998; Alberta Environment and Olson + Olson Planning and Design1999), which make nearly all remnant populations easily accessible. Angling regulations (since 1993) in Banff National Park and Waterton Lakes National Park (modified in 2011) prohibit the retention of native cutthroat trout from all waters at any time. In Jasper National Park, the total catch and possession limit for cutthroat trout is two.

Recent simulations of angling effects on small-stream westslope cutthroat trout populations under various regulatory scenarios (Sullivan 2007) suggest that presently depressed cutthroat trout stocks could recover under catch-and-release management that allows only low angler effort. Healthy populations of westslope cutthroat trout could be maintained through the use of angler education and catch-and-release angling if fishing effort is no more than moderate. It would be important to limit accidental hooking mortality and illegal harvest to maintain and recover these populations. For a more detailed assessment of angling regulations and angling-related impacts, see Mayhood (2009).

### 3.2.4 Stocking

Massive numbers of fish were removed from streams and rivers by almost every conceivable means in the earliest years of European settlement. Brook trout and rainbow trout, then brown trout, lake trout, and Yellowstone cutthroat trout, all of them not native to the region, were introduced on top of native westslope cutthroat trout stocks. As a result, the remnant native fish were permanently displaced, replaced or hybridized out of existence. In Banff National Park 1 686 different fish stocking events resulted in over 38 million fish and fish eggs being deposited into 249 different waterbodies within the Bow River watershed (C. Pacas, pers. comm.). This severe manipulation of the fisheries resource constitutes a major factor limiting both the opportunities and the probability of success of many recovery actions.

In addition to stocking of non-native species, westslope cutthroat trout have also been stocked into previously fishless waters, as well as on top of existing native westslope cutthroat trout populations. In some cases records of past stocking efforts and locations are unreliable or unavailable making it difficult to assess the extent of the threat.

### 3.2.5 Pollution

Point sources of pollution include accidental spills associated with road/rail and pipelines particularly at stream crossings. The inadvertent release of a toxic substance at or near a stream crossing could have serious consequences. The extent and severity of any damage to the aquatic community including westslope cutthroat trout and their habitat would depend on the substance, the amount released, the location of spill, timing of the spill, and the potential to mitigate impacts.

Non-point sources of pollution may include surface run-off such as road salt, sediment and increased nutrients (e.g., as a result of fires). Similar to point sources of pollution, the extent and severity of damage to the aquatic community would depend on the substance and amount, location deposited, time of year and the potential to mitigate the impacts.

### 3.2.6 Climate Change

Alberta (and the planet as a whole) is presently experiencing an increasingly variable but warmer climate. These changes are expected to alter the habitat and biotic interactions of remnant westslope cutthroat trout stocks.

Measured air temperatures across the prairies have increased an average of 1.6°C since 1895, with more extensive regional warming over the last 50 years, particularly in certain winter and spring months (Sauchyn and Kulshreshtha 2008 *in* Mayhood 2009). There have been large

contemporary decreases in Rocky Mountain glacier extent, mass, and water yield over the same period (Schindler and Donahue 2006). This is a serious issue because in the Bow River basin, glaciers provide a large proportion of streamflow during summer, when flows would otherwise be low and declining.

These climate changes suggest warmer fall, winter, and spring temperatures combined with higher precipitation during those seasons (more precipitation as rain). Fall streamflows might be somewhat higher, and peak spring runoff may also be higher and earlier. Higher-volume peak spring streamflows in particular can be expected to change stream channel morphology and the physical structure of the riparian zone. In contrast, higher summer temperatures combined with perhaps lower summer precipitation implies higher evapotranspiration, less runoff and lower summer streamflows. The higher air temperatures will shorten winters, lengthen summers, shift spring to start earlier and shift fall to start later. Even slightly higher air temperatures will have disproportionately strong physical and ecological effects when baseline air and water temperatures ordinarily would be close to the freezing point, as they are in spring and fall (Mayhood 2009).

Climate change is both creating and interacting with other changes in watersheds in ways that will negatively impact westslope cutthroat trout habitat. Warming climate is expected to increase the frequency, intensity, and extent of wildfires, increase drought frequency, and is believed to be enabling (in part) the recent outbreak of mountain pine beetle infestations in Alberta (British Columbia Forest Practices Board 2007; Sauchyn and Kulshreshtha 2008). Major effects of these changes are to increase runoff and soil erosion from affected watersheds (Beschta *et al.* 1995; Karr *et al*. 2004; Rhodes 2007). A current policy to salvage log and pre-emptively remove beetle-infested lodgepole pine on Alberta's east slopes is likely to exacerbate this issue with increased peak runoff and soil erosion (fine sediment deposition) from the killed forests (Beschta *et al.* 1995; Karr *et al.* 2004; British Columbia Forest Practices Board 2007; Rhodes 2007). Differences in effects may occur between fire-killed stands (if under severe burning conditions that burn off all lesser vegetation and duff) and beetle-killed stands that still retain all the lesser vegetation and duff that can filter out silt from surface flow.

The climate model scenarios examined for the prairies (Lemmen *et al.* 2008; Sauchyn and Kulshreshtha 2008) suggest that there will be substantial changes in the near future to basin hydrology, channel morphology, riparian physical structure and streamflows in westslope cutthroat trout native range in Alberta, particularly in the 2050s to at least the 2080s, and probably well beyond. Since trout are poikilotherms ("cold-blooded"), higher temperatures will directly affect every biological function of westslope cutthroat trout, including their physiology, behaviour, life history functions, interactions with invasive species, responses to habitat features, and exploitation. These changes may already have been initiated, and are now unavoidable. Uncertainty exists as to how westslope cutthroat trout will adapt to these changes. Land use planning requires informing land users how to make westslope cutthroat trout habitats more resilient to climate change.

## 4.0 CRITICAL HABITAT

Habitat that is important for the survival and recovery of westslope cutthroat trout in Alberta is referred to in this document as "critical" habitat. Although not a requirement for imperiled species listed pursuant to the Alberta *Wildlife Act*, the identification of critical habitat for *Threatened* and *Endangered* species is a requirement of the federal *Species at Risk Act* (SARA).

For the Alberta population of westslope cutthroat trout, critical habitat was discussed in detail by the recovery team and has been identified to the extent possible, using the best information currently available. The approach taken by the recovery team to identify critical habitat was an area of occupancy approach which means that all areas currently occupied by pure-strain populations within historic range would be considered critical habitat (see section 2.5.2.2). The decision was based primarily on the small number (of both individuals and populations) and the small size and limited distribution of areas still occupied by pure-strain westslope cutthroat trout. However, the current areas identified will be insufficient to achieve the recovery goal for this species. As such, a schedule of studies will be included in the federal document that is consistent with the associated research items in the action plan. Critical habitat for this species would be further discussed and refined as part of the federal recovery strategy for the Alberta population of westslope cutthroat trout.

An important component of critical habitat is the absence of hybridization. Muhlfeld *et al.* (2009b) indicated that the timing and location of spawning is critical in determining the potential for hybridization. Their study provided evidence that hybridization increases the likelihood of reproductive overlap in time and space, promoting extinction by introgression. Pure-strain populations are not currently subject to genetic swamping by rainbow trout, therefore, the areas occupied by pure-strain populations are critical to the survival and recovery of this species.

# 5.0 KNOWLEDGE GAPS AND RESEARCH NEEDS

## 5.1 Biology

Populations chosen for recovery and restoration work require careful life history studies to identify potential problems with the proposed conservation activity, and to serve as a baseline for monitoring to determine the success of the project. This will include collecting information on population structure (e.g., size and age distribution, size at maturity, number of adults, survival of early life stages), as well as life history characteristics such as determining the existence of remnant populations of fluvial and adfluvial fish.

## 5.2 Habitat

Although general habitat requirements for this species are well described, information is required to describe habitat attributes and geographic locations that constitute critical habitat (e.g., spawning and overwintering areas). Planned recovery actions could involve manipulating habitat by placing barriers within stream sections. It would be particularly important to understand the target populations' use of the habitat being manipulated as well as any peripheral effects to other species (such as whether the population is going to be cut off from critical habitat). Baseline information needs to be collected on habitat use, as well as biophysical and chemical parameters of westslope cutthroat trout habitat.

A complete inventory of barriers to upstream fish passage is needed. This is important for two main reasons: 1) to know where pure populations might be secure from upstream invasion of non-natives and 2) to gain a better understanding of connectivity issues for future recovery actions. For example, there are a number of research questions which should be addressed including whether there are barriers (natural or man-made) that will prevent populations from being reconnected, and if it is desirable to try and eliminate some barriers if reconnecting populations means potential for invasion by non-natives.

One of the best opportunities to salvage critical westslope cutthroat trout populations at immediate risk may be to introduce them into secure, unoccupied habitat. Such locations (usually lakes and streams above barriers to dispersal) are becoming increasingly rare as the common Spray/Marvel/Job Lake stock is distributed into such locations by stocking. This activity should now stop, and a thorough and comprehensive inventory of the remaining secure habitats should be completed. These locations need to be reserved (a) as fish-free refuges for species unable to coexist with fish, such as many invertebrates (b) as benchmark ecosystems, and (c) as potential refuge sites for imperiled populations of westslope cutthroat trout and other threatened taxa.

## 5.3 Distribution and Abundance

The most urgent data requirement is to complete surveys to identify all remaining unhybridized populations of westslope cutthroat trout in Alberta. This will give managers a clear idea of what populations remain to work with, which populations need protection, and what type of protection

is required. Conservation of these populations has the highest priority because there is every reason to believe that most remnant stocks are at very high risk of extirpation, but have high value for future recovery of lost and at-risk populations. Baseline information is needed for these populations to evaluate population size and trends and evaluate the possibility of using some pure populations to aid in recovery. Based on recovery targets and modeling, the minimum viable population sizes required to persist over *x* generations needs to be defined.

Additional survey work is needed to identify and characterize the distribution and status of hybrid populations, the degree of hybridization, and its conservation implications. Surveys should also be conducted of the distribution and status of Alberta populations outside of native range. Surveys of these populations should be conducted to determine their origin, genetic and conservation status, their life histories and use of the occupied habitat. Some of these populations may prove to be of great value as the only remaining examples of certain stock types, such as fluvial migratory life-history types.

### 5.4 Threats

Some potential threats cannot be fully evaluated because information on stressors and the mechanisms by which they affect westslope cutthroat trout are not well understood. Insufficient information exists on the effects of the following on westslope cutthroat trout populations:

- Location of populations with respect to various land-use activities and their extent, including a measure of road density and an assessment of the number and condition of existing road and trail crossings and evidence of riparian damage;
- Impacts of angling-related mortality and illegal mortality (e.g., poaching) on the recovery of westslope cutthroat trout;
- Water quality and habitat effects from development (e.g., siltation at watercourse crossings), trail use, and natural events (e.g., fire, *D. geminata*);
- Extent and risk associated with various water withdrawals (e.g., hydrostatic testing);
- Impact of water impoundments (e.g., changes to water temperature and flow regime) on westslope cutthroat trout habitat;
- Effects of timber harvest on hydrologic response at fine scales, and responses of stream flows and potential sedimentation during various periods for westslope cutthroat trout;
- Cumulative effects;
- Analysis and trends on a landscape/watershed scale;
- Spatial variation of hybridization. For example, in the absence of an impassable barrier, why are some streams in similar geographical areas more hybridized than others? This would involve an assessment of differences in physical habitat, chemical parameters or biological characteristics of populations which may make some populations more or less susceptible to widespread hybridization; and
- Current status of threats. This needs to be evaluated specifically relative to each of the remaining pure populations, so populations can be prioritized for protection and the most pressing threats can be addressed.

### 5.5 Sources of Uncertainty

Sources of uncertainty were examined as part of the Recovery Potential Assessment conducted by Fisheries and Oceans Canada (Cleator *et al.* 2009). The main points are summarized below.

While a concerted effort has been made in recent years to obtain genetic information on westslope cutthroat trout to estimate the degree of introgression at the population level, there are still some uncertainties. Small sample sizes, limited spatial and temporal sampling and evolving genetics methods have contributed to this problem. There has been debate in the literature about what threshold is appropriate for deciding that an individual fish or population is pure versus hybridized. Also, advanced-generation backcross hybrids with introgression levels greater than 1% can look indistinguishable from pure westslope cutthroat trout, and past estimates of introgression levels are "snapshots" and can change with time.

## 6.0 RECENT CONSERVATION AND MANGEMENT EFFORTS

A number of activities related to conservation and recovery of westslope cutthroat trout have already been completed or are ongoing, and are described below:

- 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;
- As part of the above studies, habitat data have been collected, including habitat limitations such as degraded riparian areas or water quality issues;
- Catch-per-unit-effort statistics have been generated for those populations sampled;
- Population estimates have been conducted at several sites using removal-depletion or mark-recapture methods;
- Barrier surveys have been conducted at a subset of streams to locate barriers to upstream fish passage, particularly where barriers are preventing upstream migration of non-native species;
- Thermographs have been used to collect temperature data at several sites found to be fishless during surveys and which may have potential as refuges;
- A non-native brook trout suppression project on Quirk Creek has been ongoing (since 1995) to monitor changes in fish composition and abundance in attempt to restore native cutthroat trout and bull trout;
- 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 populations; and
- A fact sheet describing the westslope cutthroat trout has been completed by Fisheries and Oceans Canada and is available to the public.
- In 2009 seventy-six sites were sampled for *D. geminata* in the seven mountain national parks. The study included sites that were expected to be near pristine as well as a number of focal or test sites. Most sites (67 of the 76) were positive for *D. geminata* presence. Additional genetic work for the samples is underway at the University of Calgary.

- Genetic sampling of pure individuals in certain areas is being followed up with a genome-wide approach to characterize 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 in a recovery colonization strategy.
- The upper Corral Creek watershed in Banff National Park will be the site of a pilot multi-year restoration proposed to commence in 2011. The project will have three objectives: 1) secure a downstream westslope cutthroat trout population that is at risk of brook trout invasion from a headwater lake and stream, 2) re-establish westslope cutthroat trout in the headwater lake and stream above a natural waterfall barrier, and 3) test feasibility of new genetic tools to salvage genetically pure fish from a high density stream resident population with low levels of introgression.
- The genetic integrity of westslope cutthroat trout in the Cascade River watershed, Banff National Park, is being restored following their hybridization with rainbow trout. The Cascade watershed contains a viable population of westslope cutthroat trout, but with varying degrees of introgression. The source of rainbow trout genes is a small headwater lake that creates the potential for these fish to disperse downstream and further compromise westslope cutthroat trout genetics. A multi-year project has begun to remove the rainbow trout and hybrids. The specific objectives of this project are: 1) secure pure westslope cutthroat trout downstream of Rainbow Lake from further risk of hybridization, 2) develop phenotypic tools to identify rainbow trout x cutthroat trout hybrids, and 3) create a new population of westslope cutthroat trout by stocking Rainbow Lake with pure westslope cutthroat trout from a neighbouring lake.
- A second location in the front country of Banff National Park is also being restored. Cascade Creek is a small creek that flows out of Minnewanka Dam. This creek contains exclusively brook trout. These brook trout are confined to Cascade Creek by an upstream dam and a downstream barrier. However, their removal and subsequent replacement with pure westslope cutthroat trout will secure an additional population of cutthroat trout in Banff National Park.
- In 2011 and 2012, riparian health inventories were conducted by the Alberta Riparian Habitat Management Society (Cows and Fish) on several reaches of streams containing westslope cutthroat trout. These inventories form key benchmarks for physical habitat condition.

# 7.0 RECOVERY STRATEGY

## 7.1 Core, Conservation and Sportfishing Populations

It is clear that genetic considerations are a major issue to be addressed as part of the recovery strategy. The number of pure populations in Alberta is exceptionally small and the strategy has to address the role of hybridized, introduced pure and hatchery-sustained populations in recovery efforts. In order to adopt a consistent approach to describe the status, priority and management options for populations, the recovery team has decided to use three categories for classifying populations of westslope cutthroat trout. A similar approach has been adopted for cutthroat trout subspecies in the United States (MCTSC and MCTTC 2007 and RYCTCT 2009). While genetic status is one of the criteria used to determine the class of a population, it is not the sole

determinant and populations may be classed as *Conservation* populations (see below) provided they are considered potentially recoverable.

In the context of this document it should be clarified that the term *Sportfishing* population applies to those populations that are managed primarily for the benefit of recreational fisheries. This is not to imply that the other categories of populations will not be open to angling opportunities, but this will be determined on a population specific basis.

The criteria used to define the three categories of populations are described below:

- **Core population** - a population that has no evidence of recent or contemporary introgression as determined by genetic testing (i.e. ≥0.99 pure on average). Populations should be within native range (i.e., did not originate from stocking) and be self-sustaining. These populations can potentially serve as donors of fish or gametes for restoration efforts. These populations should not receive genetic material from other population sources unless there is evidence that loss of fitness, reduced reproduction, or reduced survival has put the population in jeopardy. As stocking records are unclear or ambiguous in many instances, professional judgment will also be considered for some populations, (i.e., where stocking has occurred on top of pure, native populations or where a stocking location is unclear such as above or below a barrier).

- **Conservation population** – a naturally self-sustaining population of native westslope cutthroat trout that is managed to preserve the unique ecological and behavioural traits of the subspecies. This may include populations with limited hybridization, ideally just below that of *Core* populations but ones which suggest high conservation value with various criteria making it potentially recoverable (e.g., habitat conditions, barriers, status of non-native species). These populations may have migratory or adfluvial life history forms, be adapted to unique environments, be the least introgressed populations within a geographic area, or have distinctive phenotypes or behaviours that local experts deem important enough to conserve. This category may include introduced pure populations both inside and outside of native range if they do not fit under *Sportfishing* populations but have high conservation value. In some circumstances *Conservation* populations may be managed through periodic stocking for the purpose of maintaining a genetic refugium, or when "genetic swamping" is being attempted to increase the purity level of the population.

- **Sportfishing population** – a wild or hatchery-sustained westslope cutthroat trout population that is managed primarily for the benefit of recreational fisheries and only stocked into waters where they cannot negatively affect *Core* or *Conservation* populations. However, populations classified as *Sportfishing* populations, especially extant wild populations, may have conservation value, but their value is uncertain or of lower priority than the *Core* or *Conservation* populations based (for example) on level of hybridization. This category could include pure stocked populations in previously fishless areas (such as lakes) and hybridized populations. Populations may or may not be self-sustaining and as such, may be supplemented or maintained solely by stocking. This category may include populations both inside and outside of native range.

## 7.2 Biological and Technical Feasibility

It must be realized that neither this recovery plan nor any other regulatory or voluntary planning effort will result in complete restoration of westslope cutthroat trout throughout their historical range. Many of the threats that have led to the current status of westslope cutthroat trout in Alberta are irreversible. For example habitat loss, through dams and flow controls and introductions of non-native species, have eliminated westslope cutthroat trout from portions of their range (especially in mainstem rivers) or compromised their genetic integrity due to introgression. Because of the size and complexity of the waters where these introduced species have become established it may not be technically possible to remove non-native species from many of them. For some waters it may not be socially acceptable to remove non-native fish even if their removal is technically feasible. Therefore, this recovery plan strives to reduce threats to the viability of westslope cutthroat trout by concurrently protecting, restoring, establishing, and expanding westslope cutthroat trout populations to ensure their long-term persistence in Alberta. A similar approach has been proposed for the state of Montana and this preamble is borrowed from a recent Conservation Agreement (MCTSC and MCTTC 2007).

Notwithstanding the above commentary, the following criteria are considered to form the basis from which the recovery team made a recovery feasibility determination.

**1. Individuals of the species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.**

Although specific population numbers have not been obtained, it is likely that there are sufficient individuals available that are capable of successful reproduction to improve abundance in core populations of fish that exist. These core populations mostly contain a small number of adults and the size of adult fish is very small compared to fluvial or adfluvial fish. Therefore it can be expected that smaller females equate to fewer and smaller eggs. Ideally, increasing reproductive potential would be achieved by increasing the number of adults, provided that habitat is not a limiting factor. Mortality rates are not known but early life stages are highly sensitive to environmental disturbance, especially sedimentation. As a result, protection from environmental disturbance could increase population numbers. It is important to recognize that this species exhibits three life history strategies – stream resident, fluvial, and adfluvial. Currently, the last two types are largely absent in native range. Opportunities to re-introduce fluvial and adfluvial populations are limited and the feasibility is uncertain.

**2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.**

Suitable habitat for westslope cutthroat trout itself is not likely limiting in terms of biophysical parameters; however, limits exist relative to the presence of non-native fish in these habitats. As a result, finding suitable habitat for re-introduction will be difficult and will include examining areas where non-natives are present at low enough levels that it might be feasible to suppress them and re-introduce westslope cutthroat trout, or supplement existing populations. It may also be feasible to introduce westslope cutthroat trout into barren waters as refuges, but this will have

to be carefully examined in each case. Reconnecting habitat will also be examined but will have to consider allowing access to non-natives. As cold-water salmonids, westslope cutthroat trout are sensitive to changes in water temperature. Climate change may further limit the species' distribution in the future by rendering some habitat unsuitable (Robins 2009).

**3. The primary threats to the species or its habitat can be avoided or mitigated.**

The potential for mitigating threats identified for the westslope cutthroat trout ranges from low to moderate, except for a small number of threats for which mitigation potential is high. There is uncertainty surrounding the mitigation of some threats such as climate change. The potential impact from many of the habitat related threats may be reduced, or eliminated, if appropriate regulatory reviews and management actions are exercised, and using current best management practices (e.g., standards in the Enhanced Approval Process (EAP), operating conditions in Operating Ground Rules (OGR) for forestry) as applied to existing or proposed projects. However, some threats cannot be easily mitigated (i.e., presence of dams) and this puts severe constraints on the species recovery in some areas. Non-native invasive species and hybridization are also a major problem. The potential for successfully eradicating these threats is low to moderate in most systems where they already exist. In most cases where pure populations exist, the threat mitigation will be to ensure non-native species do not invade systems where they are not already present. Targeted removal of non-native species (complete removal or suppression) will be evaluated in systems which might have some chance of success.

**4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.**

Many of the techniques likely to be contemplated for the conservation of westslope cutthroat trout populations are well-founded in current science and management practices. The focus of recovery efforts should be on protecting habitat of existing pure populations, augmenting the size of these populations (e.g., through transfers of fish or increasing available habitat quality and quantity or implementing catch-and-release regulations), and preventing non-native species introductions where they do not already exist, or managing non-natives where possible through reduction or elimination.

In considering recovery of westslope cutthroat trout it is necessary to make the distinction between population maintenance and population recovery. The reality is that maintenance will be the objective for some populations, while for other populations, the objective will be recovery. Given the above analysis, maintenance and recovery of the westslope cutthroat trout is deemed to be biologically and technically feasible across parts of its native range and for some life history types, but restoration of westslope cutthroat trout throughout their historical range is not feasible.

## 7.3 Guiding Principles

The recovery and management of westslope cutthroat trout in Alberta will be guided by the following principles:

- A cooperative approach with stakeholders (e.g., anglers, land managers, landowners, industry, and other agencies) is essential to the success of the recovery plan. It is recognized and acknowledged that all stakeholders have a role to play in protecting and restoring westslope cutthroat trout.
- It is necessary to prevent the further loss of habitat or individuals.
- Actions necessary to achieve the goals of the recovery plan should not be impeded by lack of information or scientific certainty.
- The recovery process will be guided by the concept of adaptive management, wherein specific actions are implemented, evaluated, and altered to ultimately improve the outcome. This process should include recovery actions and projects that are designed using scientific principles with peer-reviewed proposals and monitoring programs.

## 7.4 Recovery Goal

As discussed in the preceding section, complete restoration of westslope cutthroat trout throughout their entire historical range is not considered feasible. The recovery goal and objectives reflect that for some populations the focus will be on maintenance, while for others, a recovery or restoration approach will be pursued. As such, the recovery goal for westslope cutthroat trout is as follows:

*Protect and maintain the existing ≥ 0.99 pure populations (currently believed to be approximately 51) at self-sustaining levels, and re-establish additional pure populations to self-sustaining levels, within the species' historical range in Alberta.*

## 7.5 Recovery Objectives

A number of objectives are proposed to meet the maintenance and recovery goal and address threats to the survival of the species. The recovery objectives are as follows:

1. Identify and protect critical habitat for remaining pure populations.

2. Improve knowledge of population genetics, size, distribution, and trends.

3. Identify opportunities to help recover pure and near-pure populations 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.

4. Increase education and awareness of westslope cutthroat trout for their conservation.

5. Re-establish pure populations of westslope cutthroat trout in sites within their historical range that recognizes the diversity of their life history strategies in Alberta. While the recovery team discussed a target number of populations, it was decided that too many unknowns currently exist (e.g., feasibility of recovering populations in areas with non-natives and success of suppression efforts) to provide a realistic number at this time.

6. Determine the role that introduced pure westslope cutthroat trout may play in the recovery effort.

## 7.6 Recovery Approaches and Strategies

Strategies proposed to address the identified threats, and to guide appropriate research and management activities to meet the recovery goal and objectives, are discussed under the broader approaches of:

**1. Research;**
**2. Monitoring;**
**3. Management and regulation; and**
**4. Education and outreach.**

Each strategy has been designed to assess, mitigate, or eliminate specific threats to the species; to address information deficiencies that might otherwise inhibit species recovery; or to contribute to the species' recovery in general.

### 7.6.1 Research

Sound scientific knowledge must form the basis of any recovery efforts for the westslope cutthroat trout. Information gaps regarding life history, biology, genetics, habitat requirements, population structure and abundance, and threats exist and need to be addressed to refine the recovery strategy and ensure that the species is adequately protected in Alberta. It is implicit in strategies R1-R3 that they may include populations which exhibit some degree of hybridization. To address the need for scientific research, the following strategies are recommended:

**R1. Elucidate life-history requirements and characteristics:** Conduct studies to understand the life history, ecology, current distribution within native range, population dynamics and population structure (e.g., number of mature fish) of westslope cutthroat trout.

**R2. Elucidate habitat requirements:** Conduct studies to determine biophysical attributes of habitat required seasonally by each life stage of the westslope cutthroat trout, with a specific focus on identifying habitat attributes and geographic locations that constitute critical habitat for the species. This will include habitat characteristics (e.g., barriers, temperature) that limit the intrusion of non-native species.

**R3. Improve knowledge of population genetics:** Complete surveys and genetic analyses to characterize genetic status of westslope cutthroat trout populations throughout native range. This should include consideration of the degree of population subdivision among pure populations.

**R4. Develop population models:** Conduct studies to establish reliable population models, including population viability estimates, as well as appropriate surrogate measures relying on relative abundance, presence/absence and population structure data.

**R5. Conduct feasibility studies of recovering populations within historical range:** Evaluate the feasibility of re-establishing populations of diverse life-history strategies, as well as increasing current population levels.

**R6. Identify and understand limiting factors:** Conduct studies to better understand the potential threats associated with human activities including water regulation, connectivity/fragmentation, land-use practices, resource extraction, species introductions, climate change, angling and cumulative effects.

**R7. Clarify distribution and status of introduced populations within and outside of native range:** Surveys of these populations should be conducted to determine their origin, genetic and conservation status, their life histories and use of the occupied habitat. Some of these populations may prove to be of great value as the only remaining examples of certain stock types such as fluvial migratory life-history types.

### 7.6.2 Monitoring

Regular monitoring, with appropriate frequency, intensity, and methodology is necessary to establish trends in abundance of westslope cutthroat trout, as well as to describe the availability and quality of habitats once identified. The following strategies are recommended to address monitoring needs:

**M1. Population monitoring:** Develop an appropriate monitoring protocol to track relative abundance, population estimates, population structure, distribution, genetic status, and habitat use for westslope cutthroat trout as well as non-native species.

**M2. Habitat monitoring:** Develop an appropriate protocol to monitor physical and chemical environmental parameters, including water temperature and habitat conditions.

**M3. Monitor effectiveness of mitigation and restoration measures:** Refine or develop protocols to monitor the effectiveness of applied mitigation and restoration measures for threats.

### 7.6.3 Management and Regulation

Management and regulatory actions are necessary to protect the westslope cutthroat trout and its habitat. Such actions will assist in reducing or eliminating identified threats, including habitat loss and degradation, and the introduction of non-native species. Because the recovery strategy is focused on both maintenance and recovery, approaches should focus on ways to maintain and protect the species, as well as recover populations in historic range. Recommended strategies include:

**MR1. Limit the spread of non-native species:** Where non-native species are negatively influencing remaining populations of westslope cutthroat trout, targeted removal or suppression of non-natives should occur where feasible. This strategy should also include evaluating the use of migratory barriers to protect the pure westslope cutthroat trout from invasion by non-native species.

**MR2. Apply mitigation measures for threats:** Evaluate current practices and associated threats to westslope cutthroat trout at both site and landscape/watershed scales, with a view to refining or developing mitigation measures as well as consideration of management and/or regulation changes. Avoidance of negative impacts is the first, best, (and sometimes only) option for mitigating impacts on westslope cutthroat trout.

**MR3. Stocking program rationalization:** Reduce or eliminate the potential for stocking-related impacts to westslope cutthroat trout.

**MR4. Sportfishing regulations:** Evaluate existing sportfishing regulations for effects on westslope cutthroat trout, as well as opportunities to permit angling, especially for the targeted removal of non-native species.

**MR5. Recover populations within historical range:** Based on the results of the feasibility studies, recover populations of diverse life-history strategies within historical range. This would include both re-establishing populations of diverse life-history strategies, as well as increasing current population levels, distribution and connectivity.

**MR6. Intergovernmental cooperation:** Work with federal and provincial agencies co-operatively to implement the recovery plan.

**MR7. Data conservation and management:** To provide continuity and the ability for future reference, all samples and information (historical, current and future) must be appropriately preserved and/or archived within known repositories.

**MR8. Manage and reduce footprint of human activities**: Apply cumulative effects considerations to manage effects of resource extraction, land and water use. Improve land-use planning through application of monitoring and evaluation results *(e.g., Land-Use Framework, Water for Life strategy, Cumulative Effects Management Framework, and Integrated Land Management).*

### 7.6.4 Education and Outreach

Educating anglers, the general public, industry, and governments is essential to gain acceptance of, and compliance with, the overall recovery strategy. Support can be gained through increased awareness of the westslope cutthroat trout and through involvement in stewardship programs. The following strategies are recommended:

**E1. Improve awareness of the species:** Develop and distribute information describing the species and its needs, as well as the need for the recovery strategy with a variety of forums and methods *(e.g., mandatory fish ID testing for a harvest license in the Eastern Slopes Region).*

**E2. Encourage stakeholder participation:** Promote and encourage stakeholder involvement in stewardship initiatives.

**E3. Facilitate information exchange:** The exchange of information with regard to research, recovery, and management activities related to the westslope cutthroat trout should be facilitated among researchers, stakeholders, and fisheries agencies from across the historic range of the sub-species.

**E4. Discourage species introductions:** To prevent species introductions that threaten existing populations of westslope cutthroat trout and recovery efforts, develop and support education programs that heighten awareness of this issue.

## 10.0 SOCIO-ECONOMIC CONSIDERATIONS

There will be costs and benefits associated with the recovery actions proposed as part of this plan. It is likely this recovery plan will result in some modifications to land use practices and possibly restrictions on some human activities. It is anticipated that some restrictions will result in higher costs to industry. These may be associated (for example) with increased planning costs and the inability to utilize resources in some instances. Restrictions on human activities may also result from limited access to some types of recreational activities such as off-trail motorized recreation. However, it is important to recognize the benefits to Alberta that accrue by protecting and restoring this once widespread and abundant trout. The trout angling community is economically valuable and this activity is sustainable if properly managed. Angling for true native trout has a premium value to many anglers (Smith 1984; Trotter 1987). Cutthroat trout are the near-perfect reusable fly fishing trout because of their surface-feeding tendencies, willingness to take flies, and durability (Gresswell 1985; Schill *et al*. 1986). These traits could translate to increased angling and increased tourism.

Westslope cutthroat trout also have intrinsic value as they contribute to species biodiversity. In December 1992, with the support of the provinces and territories, Canada became the first industrialized country to ratify the United Nations Convention on Biological Diversity. As required by the Convention, Canada developed the Canadian Biodiversity Strategy (CBS) to guide the conservation of Canada's biodiversity and sustainable use of biological resources. The Alberta government actively participated in the development of the CBS and signed a Statement of Commitment supporting the strategy in November 1995. This recovery program is an opportunity to significantly improve and enhance this asset by restoring at least a portion of native populations to something close to their original state.

## 11.0 PLAN REVIEW AND AMENDMENT

The life of this plan is five years. The recovery team may conduct an annual review of the plan to monitor its implementation and to determine the effectiveness of conservation actions. Progress reports will be made available through various means (e.g., annual Species at Risk reports, on-line project report). Recovery action plans are considered “living” documents and conservation actions can be amended during these reviews as new information becomes available, conditions change, or as circumstances warrant. At the end of five years, and at the discretion of the team lead in consultation with the Provincial Species at Risk Specialist, the recovery team may be reconvened to determine what amendments are required, prior to the plan being renewed for another five years. Decisions regarding amendments shall be based on the comparison of specific performance measures to the stated recovery objectives.

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## Personal Communications

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## 13.0 GLOSSARY

**Adfluvial** – fish that live in lakes and migrate into rivers or streams to spawn.

**Endangered Species** – a species facing imminent extirpation or extinction.

**Endemic** – a species or taxonomic group that is restricted to a particular geographic region because of restrictive factors such as isolation or habitat characteristics.

**Extinction** – when a species dies out or ceases to exist.

**Extirpation** – localized removal or extinction.

**$F_1$ hybrid** – A first-generation offspring of two closely related species or strains.

**Fish habitat** – areas which fish depend on (directly or indirectly) in order to carry out life processes.

**Fluvial** – fish that inhabit a river or stream.

**Habitat Loss** – the process in which natural habitat is rendered functionally unable to support the species present, this can represent complete disappearance, a decrease in amount, or degradation of habitat which does remain so that it can not support as many individuals as previously.

**Hybridization** – the act of mixing different species to produce hybrids.

**Indigenous** – a species that occurs naturally in an area; a synonym for native.

**Introduced species** – a species that has been transported by human activities, either intentionally or unintentionally, into a region in which it did not occur in historical time which is now reproducing in the wild; a synonym for non-native species.

**Introgression** – the transfer of genetic information from one species to another as a result of hybridization between them and repeated back crossing.

**Introgressive hybridization** – the spreading of genes of a species into the gene complex of another due to hybridization and extensive backcrossing. Introgression.

**Invasive species** – Species that spread beyond their native range or species introduced to a new range that establish themselves and spread (not necessarily harmful), alternately, species that displace native species and have the ability to dominate an ecosystem, or a species that enters an ecosystem beyond its natural range and causes economic or environmental harm.

**Iteroparous** – a life history adaptation where an organism is capable of breeding or reproducing multiple times over the course of a lifetime.

**Lacustrine** – of, relating to, or pertaining to lakes.

**Lentic** – of, pertaining to, or living in still fresh water.

**Lotic** – of, pertaining to, or living in moving fresh water.

**Native** – a species with respect to a particular ecosystem that historically occurred or currently occurs in that ecosystem rather than as a result of an introduction**;** synonym for indigenous.

**Redd** – a spawning nest made by a fish, especially a salmon or trout.

**Rescue effect** – the process whereby individuals from a different population emigrate to a small population, thereby preventing localized extirpation or extinction.

**Resident** – an individual who resides in a particular place permanently or for an extended period.

**Riparian Zone** – the part of a watershed immediately adjacent to a stream; i.e. the interface between land and water.

**Subpopulation** – a part or subdivision of a population, with common, distinguishing characteristics.

**Threatened Species** – a species likely to become endangered if limiting factors are not reversed.

**Trout** – any of various freshwater or anadromous food and game fishes of the family Salmonidae, usually having a streamlined, speckled body with small scales.

**Viable** – able to maintain an independent existence.

## APPENDIX A

### Threat Assessment Analysis

Knowledge of the threats to a species and potential to mitigate those threats is fundamental to a species' recovery.

The assessment of each potential threat was qualitative rather than quantitative, with each factor being rated as "low", "moderate" or "high". These assessments were based on the best professional judgement of the recovery team, and determined by consensus following discussions. For each potential threat the following factors were considered:

- **Likelihood of Occurrence** - The probability of a threat occurring. Those that presently affect the species were rated "high".

- **Extent of Occurrence** - The spatial range of each identified threat. Those that affect most or all of the area occupied by the species were rated "high".

- **Severity of Impact** - The severity of the direct or indirect impact of a threat on the survival or recovery of the species. Impacts with the potential to extirpate the species were rated "high".

- **Immediacy of Impact** - The immediacy of the anticipated impact from a threat was denoted with a "P" for past impacts; "C" for current, ongoing impacts; and an "F" for possible future impacts.

- **Threat Significance** - The risk of damage to the westslope cutthroat trout population from a particular threat, based on its likelihood and extent of occurrence and on the severity and immediacy of its impacts.

- **Mitigation Potential** - The biological and technical feasibility of mitigating a threat. Where there are no biological impediments and proven technology exists to successfully mitigate threats, the mitigation feasibility was rated "high".

In the tables, questions marks (?) denote uncertainty, and the need for research. Comments provide background on each threat or its assessment.