Alberta

Milk and St. Mary River At-Risk Fish Species

Alberta Species at Risk Recovery Plan No. 45

DECEMBER 2020

alberta's species at risk program

Alberta

Alberta Recovery Plan for At-Risk Fish Species in the Milk and St. Mary Rivers.
Published by Alberta Environment and Parks

Cover photos: western silvery minnow (Karen Scott); Rocky Mountain sculpin, stonecat (Shane Petry)_

[December 2020]
ISBN:
ISSN: 1702-4900

This publication is available online at https://open.alberta.ca/publications/9781xxxxxxxxx

For more information regarding this content visit: https://open.alberta.ca/documentation/pubguidedraft

This publication may be cited as:
Alberta Environment and Parks. 2021. Alberta Recovery Plan for At-Risk Fish Species in the Milk and St. Mary Rivers..
Alberta Species at Risk Recovery Plan No. [45]. Edmonton, AB. 53 pp.

Table of Contents

List of Figures

List of Tables

Acknowledgements

Recovery of fish species at risk in the Milk River has been ongoing since 2004. There is a long history of dedicated individuals from varied backgrounds coming together to plan for the recovery of fish in both the Milk and St. Mary river systems. Alberta Environment and Parks extends sincere appreciation to the many organizations and individuals that supported the development of this recovery strategy and to the people who contributed their knowledge and hard work. The original recovery team was co-chaired by Fred Hnytka (retired) of Fisheries and Oceans Canada (DFO) and Terry Clayton (retired) of Alberta Environment and Parks (AEP). Emma Hulit represented the Counties of Cardston, Forty Mile and Warner, the Villages of Coutts and Warner, and the Town of Milk River. They made many worthwhile contributions to this plan and their efforts are appreciated. The original recovery plans were largely drafted by D.B. (Bruce) Stewart of Arctic Biological Consultants (Winnipeg, MB) and by Sue Pollard (currently with the BC Ministry of the Environment). Sections were written by Terry Clayton, Shane Petry and Doug Watkinson (DFO). Funding to support recovery team meetings was provided by DFO and AEP. Shane Petry (then with DFO) and Terry Clayton (AEP) later co-chaired the recovery team and provided facilities for recovery team meetings in Lethbridge. Currently, recovery planning for Milk River and St. Mary River drainage species for Alberta is led by Shane Petry (AEP). The recovery team also thanks Blair Watke for creating basin maps, Karen Scott for providing the photo composite of the western silvery minnow, and the Town of Milk River for providing facilities for a meeting and workshop in their community.

Recovery Planning in Alberta

Albertans are fortunate to share their province with an impressive diversity of wild species. Populations of most species of plants and animals are healthy and secure. However, a small number of species are either naturally rare or are now imperiled because of human activities or natural processes. Alberta Species at Risk 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 of Albertans.

Alberta has a robust provincial recovery program to support its commitment to the federal/ provincial *Accord for the Protection of Species at Risk* and the *National Framework for the Conservation of Species at Risk*, and its requirements established under Alberta's *Wildlife Act* and the federal *Species at Risk Act*. An overall goal of the program is to restore species identified as *Threatened* or *Endangered* to viable, naturally self-sustaining populations within Alberta.

Alberta Environment and Parks is committed to providing opportunities for Indigenous communities, stakeholders, and the Alberta public to provide their perspectives and influence plan content during the recovery planning process. The process for how Albertans are engaged can vary based on the socio-economic and conservation issues and the level of interest expressed. Draft recovery plans undergo a review by the Fish and Wildlife Stewardship Branch and are then posted online for public comment for at least 30 days. Following public review, Alberta's Endangered Species Conservation Committee reviews draft plans and provides recommendations on their acceptability to the Minister of Environment and Parks. Plans accepted and approved for implementation by the Minister are published as a provincial government recovery plan. Approved plans are a summary of the Ministry of Environment and Park's commitment to work with involved stakeholders to coordinate and implement conservation actions necessary to restore or maintain vulnerable species.

Recovery plans include two main sections: (1) a situational analysis that highlights the species' distribution and population trends, threats, and conservation actions to date; and (2) a recovery section that outlines goals, objectives, associated broader strategies, and specific priority actions required to maintain or recover *Threatened* or *Endangered* species. Each approved recovery plan undergoes regular review and at that time progress on implementation is evaluated. Implementation of each plan is subject to internal and external resource availability.

Recovery plans will be systematically reviewed every five years. Where there are large changes in the goals, objectives, or strategy sections due to a new understanding or circumstance, a plan may need to be redrafted, consulted on, reviewed by the Endangered Species Conservation Committee, and the changes approved by the Minister.

Executive Summary

In June 2003, the Alberta government approved the listing of western silvery minnow (*Hybognathus argyritis*) as *Threatened* in Alberta. This designation was based upon the species' occurrence in only one location in Alberta and its limited potential for dispersal and exchange with adjacent populations. The western silvery minnow is also listed as *Threatened* pursuant to the federal *Species at Risk Act* (SARA). In September 2004, stonecat (*Noturus flavus*) was provincially listed as *Threatened* under Alberta's *Wildlife Act,* because of its limited distribution in Alberta.

In August 2006, Rocky Mountain sculpin (*Cottus* sp.) populations in the St. Mary and Milk rivers of Alberta were listed as *Threatened* pursuant to SARA, following a review by the Committee on Endangered Wildlife in Canada (COSEWIC) in 2005. In December 2007, Rocky Mountain sculpin was similarly listed under Alberta's *Wildlife Act*. In 2019, Alberta populations of Rocky Mountain sculpin were reassessed by COSEWIC and the populations were split into two separate units given that one population was part of the Hudson's Bay drainage and the other part of the Missouri (Mississippi) drainage. Both sculpin populations are currently listed as Threatened pursuant to SARA.

While the distribution and abundance of these fish species at risk in Alberta appear to have remained relatively stable since the species were first identified in the Milk and St. Mary drainages, all three species continue to be at risk of decline due to their extremely limited ranges in both Alberta and Canada. The Milk River Fish Species at Risk Recovery Team (MRSRRT) has been actively engaged in developing recovery plans for western silvery minnow, Rocky Mountain sculpin and stonecat. This multi-species recovery plan in Alberta describes the three fish species and their ecological requirements. It incorporates a threats assessment and outlines a broad recovery approach for the three species based on the best available information.

The primary threats to western silvery minnow, Rocky Mountain sculpin and stonecat include habitat degradation and loss due to water management activities (changes in flow), and the introduction of exotic and/or invasive species; as such, recovery actions are focused on these two threats. Additional threats that have been identified include poor water quality and pollution; accidental or targeted mortality (which can include scientific sampling); and climate change, drought and natural processes.

The recovery plan focuses on the protection and maintenance of the existing populations of these species within their current ranges. As such, a maintenance goal, rather than a recovery goal, is more appropriate.

As mentioned, only a subset of threats can be influenced by recovery management actions. These actions are ongoing and primarily collaborative in nature, consisting of actions relating to gaining and sharing knowledge, considering the effects of land and water management decisions, and the promotion of awareness of species at risk. Actions are focused under three main strategies:

1. Ensure that threats to habitat and individuals are considered in water and land use planning and management decisions.
2. Develop a science-based program to effectively monitor and report on the presence and distribution of the three species at risk.
3. Continue to collaborate with Fisheries and Oceans Canada (DFO) and other government and non-government organizations.

1.0 Introduction

1.1 Western Silvery Minnow

In July 2003, the Minister of Environment and Parks (the Minister) approved the listing of western silvery minnow (*Hybognathus argyritis*) as *Threatened* under Alberta's *Wildlife Act* based on a recommendation from Alberta's Endangered Species Conservation Committee (ESCC). This designation was due to the species' occurrence in only a single location in the province (the Milk River), and because of its limited potential for dispersal and exchange with adjacent populations. Along with this listing the Minister endorsed an Initial Conservation Action Statement for western silvery minnow that specified that a recovery plan should be prepared within 24 months of the species' listing.

Nationally, western silvery minnow was designated *Threatened* and placed on Schedule 1 of the *Species at Risk Act* (SARA) in June 2003.

1.2 Rocky Mountain Sculpin

Similar to western silvery minnow, Rocky Mountain sculpin (*Cottus* sp.; previously referred to as "St. Mary sculpin" and "Eastslope sculpin") has a very restricted area of occupancy in Canada, confined to the Milk River basin and the upper St. Mary River basin of southern Alberta. Dispersal and exchange with adjacent populations was assessed by the ESCC as being limited. As such, in 2007, a *Wildlife Regulation* amendment was made to list Rocky Mountain sculpin as a *Threatened* species. One year previous to that, in 2006, Schedule 1 of the federal *Species at Risk Act* was amended to add Rocky Mountain sculpin as a *Threatened* species, however this has not yet been updated to reflect the taxonomic split of the population in 2019.

1.3 Stonecat

In September 2004, stonecat was listed as *Threatened* pursuant to Alberta's *Wildlife Act* due to the rarity of the species, its presence in Alberta being limited to just the Milk River, and its limited potential for dispersal and exchange with adjacent populations.

Stonecat is not considered at risk elsewhere in Canada and has not had a status review by COSEWIC.

2.0 Process for Plan Development

In 2004, a joint federal/provincial recovery team was formed with the intention of producing a recovery plan for western silvery minnow that met the needs of both Alberta and Canada. The scope of the team was later expanded to include Rocky Mountain sculpin and stonecat. The Milk River Fish Species at Risk Recovery Team (MRSRRT) comprised representatives from:

1. Alberta Environment and Parks (AEP),
2. Fisheries and Oceans Canada (DFO),
3. The Milk River Ranchers' Association (MRRA),
4. The Milk River Watershed Council Canada (MRWCC),
5. The Southern Alberta Group for the Environment (SAGE),
6. The Counties of Cardston, Forty Mile and Warner, and
7. The Villages of Coutts and Warner and the Town of Milk River.

Between 2004 and 2010 twelve recovery team meetings were held to discuss recovery strategies for the three species. Individual Alberta species recovery plans were subsequently published for western silvery minnow (MRSRRT 2008), Rocky Mountain sculpin (Alberta Rocky Mountain Sculpin Recovery Team 2013) and stonecat (MRSRT 2014). AEP discussed the development of these plans with First Nations.

Because all three Milk River fish species face similar threats and distribution, one multi-species recovery plan has been created rather than updating the three individual plans. This plan was contracted to a species expert, and the draft was subsequently circulated for review among members of the original MRSRRT, as well as additional stakeholders, internal biologists and regulators, and federal counterparts.

3.0 Implementation Progress Review

Many actions supporting the maintenance of all three species have already been completed. Actions beneficial to all species are listed first, followed by actions beneficial to western silvery minnow and Rocky Mountain sculpin.

Conservation actions beneficial to all species include the following:

- A water conservation plan was developed by the Town of Milk River in 2004. The plan incorporates the economics of town planning while recognizing the need for water conservation in the Milk River basin. Generally, water conservation is addressed through timing of operations and water storage.
- Aerial photography was completed in October and November of 2004 to document key macro-habitat sections for the entire Milk and North Milk rivers. This survey geo-referenced and mapped key habitat features for evaluation. Some habitat analysis from the photography was also completed.
- Alberta Environment and Parks conducts regular water quality monitoring on the Milk River, and Environment and Climate Change Canada (ECCC) conducts water quality monitoring at the international border, both where the North Milk River enters Canada and where the Milk River flows out of Canada (W. Koning, pers. comm.).
- Temporary Diversion Licences (TDLs) are closely monitored, and licences are no longer issued if sufficient natural flows are not available in the Milk River.
- A moratorium on issuing any new water allocation licences for the Milk River or any of its tributaries has been in place since the late 1980s, and there is currently a plan in place to ensure water diversions that could impact species at risk do not occur during low flow periods.
- An advisory committee (MRWCC) was created as part of the Alberta Water for Life Strategy to support watershed planning. It has completed the *Milk River Integrated Watershed Management Plan* (MRWCC 2015), which speaks to water quality and quantity, as well as to species at risk and aquatic habitat.
- The MRWCC is working with Alberta Environment and Parks and other agencies to monitor water chemistry bi-weekly at ten locations in the Milk River watershed. These data are supplemented with temperature data collected at Aden Bridge by Alberta Environment and Parks (K. Miller, pers. comm.). Monitoring is ongoing, and summary reports are produced

each year. Monitoring sets the direction for stewardship work and supports local community groups such as the Red Creek Watershed Group and municipal extension programming.

- In 2010, the MRWCC completed a Habitat Suitability Curve for the Milk River project; including River 2D Habitat modelling to determine Environmental Instream Flow needs.
- The MRWCC has looked at overwintering habitat for western silvery minnow and continues work with stewardship project implementation (Phase 1 and Phase 2).
- Water Survey of Canada sites are well established and monitoring flows (via HYDAT).
- The *Action Plan for the Milk River and the St. Mary River Drainage Basins in Canada* was produced by DFO (Fisheries and Oceans Canada 2017a). It covers action plans for both Rocky Mountain sculpin and western silvery minnow.
- Collaboration with the Multiple Species at Risk (MULTISAR) program is ongoing.
- Species at risk interpretive signs have been placed at Writing-on-Stone Provincial Park to promote awareness and subsequent conservation of these species at risk.

Actions relating to the recovery of western silvery minnow include the following:

- In 2002, western silvery minnow was removed as an eligible baitfish from the Alberta Fishery Regulations, 1998 (SOR/98-246).
- In June 2004, an early-summer habitat survey was conducted on the lower Milk River (Highway 880 bridge to Pinhorn Ranch) to identify possible spawning and early rearing habitat. This habitat was described but fish sampling was not conducted to confirm minnow presence.
- Fall fish and habitat surveys were conducted opportunistically at selected sites on the lower Milk River in October and November 2004 to sample for western silvery minnow presence in potential overwintering habitat.
- DFO sampled fish populations in the Milk River in the summer (July) of 2005 and spring (May), summer (August) and fall (October) of 2006 (D. Watkinson, pers. comm.). New data were collected on the diet, population age structure, population size structure, juvenile and adult habitat use, and distribution of western silvery minnow in the Milk River.
- DFO has verified the taxonomic identity of western silvery minnow throughout the species' known Canadian distribution.

- A Master's thesis completed in 2016 determined that habitat availability for western silvery minnow is reduced by flow augmentation (in Canada) during the irrigation season when river flow is managed (Neufeld 2016).
- In 2017, DFO published the *Amended Recovery Strategy for the Western Silvery Minnow (*Hybognathus argyritis*) in Canada* (Fisheries and Oceans Canada 2017b), which identified critical habitat for the species.

Actions relating to the recovery of Rocky Mountain sculpin include the following:

- Water Survey of Canada hydrometric sites are well established and recording flows in Lee Creek, the St. Mary River and Milk River. Data are available at the National Water Data Archive HYDAT database and Real-time Hydrometric Data site (WSC 2017).
- DFO sampled fish populations in the Milk River system at numerous times from 2005–2008. Populations in the St. Mary River system were sampled 2006–2009 (D. Watkinson, pers. comm.). New data were collected on the diet, population structure and density, juvenile and adult habitat use, and distribution of Rocky Mountain sculpin.
- Genetic testing for a comprehensive taxonomic assessment (genetic and morphological comparisons) of sculpin populations in the St. Mary and Milk rivers in Alberta and British Columbia was undertaken. Taylor and Gow (2008) have undertaken a similar smaller-scale study to compare the genetics of Rocky Mountain sculpin in Alberta with sculpins in the Flathead River.
- In 2012, DFO published the *Recovery strategy for the Rocky Mountain sculpin (*Cottus sp.*), eastslope populations, in Canada* (Fisheries and Oceans Canada 2012), which identified critical habitat for the species.
- A Master's thesis completed in 2016 examined movement distances and swimming speeds for Rocky Mountain sculpin and provided evidence of both the restricted range of most individuals and a density-dependent dispersal response to local abundance for other individuals (Veillard 2016). Veillard (2016) concluded that management and recovery of Rocky Mountain sculpin populations requires consideration of environmental factors at the local and regional scale.
- A genetic analysis comparing Rocky Mountain sculpin from the North Milk River, St. Mary River, Lee Creek and Flathead River drainage (British Columbia) was completed. It showed that all of these sculpins were distinct sub-populations and suggested that they should be managed by drainage basin (Ruppert et al. 2017).

4.0 Situational Analysis

4.1 Background

Both the St. Mary and Milk rivers originate in Montana (MT) along the eastern slopes of the Rocky Mountains, and flow north and northeast, respectively, into Alberta (Halliday and Faveri 2007). The St. Mary River discharges into the Oldman River near Lethbridge, forming part of the Hudson Bay drainage system. The North Milk River flows about 90 km through southern Alberta before its confluence with the Milk River, which continues east parallel to the international boundary for another 235 km before crossing back into United States. The Milk River is a tributary of the Missouri River and eventually drains into the Gulf of Mexico via the Mississippi River. Both the St. Mary and Milk rivers are intensively managed for agricultural use. The Town of Milk River is one of the few communities in the upper Milk River basin, and the only town adjacent to the river in Canada.

Water management within the St. Mary and Milk rivers is governed by the 1909 Boundary Waters Treaty (the Treaty) between the United States and Canada, which is administered by the International Joint Commission (IJC) (ISMMRAMTF 2006; see also Dolan 2007; Rood 2007). The Treaty provides principles and mechanisms to resolve disputes over shared waters. Subsequent to the Treaty, the US completed construction on the Saint Mary Canal in 1917. The canal delivers water from the St. Mary River near Babb, MT, to the North Milk River approximately 7 km south of the western international boundary. Its purpose is to convey irrigation water from western Montana to the eastern part of the state. Both countries agreed that for irrigation and power purposes they would treat the management of water in the Milk River as one stream. The main mechanism for defining apportionment (i.e., who is entitled to water) is listed in the 1921 Order of the IJC, which can best be understood seasonally in the context of augmented (i.e., diversion of water from the St. Mary) versus natural flow (i.e., no canal diversion). The augmented period, often called the irrigation season, generally runs from April 1 to October 31. During the non-augmented period, both countries share the natural flow equally. During the irrigation season, it was agreed that Canada was entitled to three-quarters of the natural flow. However, the natural flow is only a small proportion of the total flow in the Milk River during the irrigation season, because of diversion from the St. Mary River (i.e., the augmenting flow) that is conveyed to eastern Montana. There are numerous rules governing water use (e.g., calculation of flow, natural flow, timing, record keeping), and these are periodically reviewed by the IJC.

At present, the operating capacity of the St. Mary Canal is about 18.4 m^3/s (650 ft^3/s), significantly less than its original design capacity of 24.1 m^3/s (850 ft^3/s). Flow augmentation of the Milk River is actively managed at the St. Mary Diversion Dam in Montana in response to major runoff

events, to prevent or reduce erosion, scouring and risk of canal failure, and to optimize use of the water for irrigation. Montana plans to replace or rehabilitate the aging canal infrastructure and thereby return the canal to its original capacity (K. Miller, pers. comm.; see also Alberta Environment 2004; U.S. Bureau of Reclamation 2004). The increased capacity would only be used during the period of peak runoff each year. Over the past two decades, the St. Mary Canal has transported an average of about 2.08 x 10^8 m^3 of water annually into the north fork of the Milk River (U.S. Bureau of Reclamation 2004). The average annual flow entering Alberta is 1.06 x 10^8 m^3 and leaving Alberta is 1.67 x 10^8 m^3.

The Milk River has been severely affected by changes in its seasonal flow regimes. Water diverted from the St. Mary River in Montana augments flow in the Alberta portion of the Milk River from late March or early April until late September or mid-October (ISMMRAMTF 2006). Under natural pre-diversion conditions, summer flows in Canada ranged from 1.0 to 2.0 m^3/s (35 to 71 ft^3/s) in the North Milk River and from 2.0 to 10 m^3/s (71 to 353 ft^3/s) at the Milk River's eastern crossing of the international border (McLean and Beckstead 1980). Since the diversion, flows in the Milk River at the town of Milk River have ranged from 10 to 20 m^3/s (353 to 706 ft^3/s) from May to September, and have averaged 15 m^3/s (530 ft^3/s) between June and August. The effects of flow augmentation are much greater in the North Milk River, which has a relatively small drainage area (238 km^2 at the North Milk River gauge 11AA001), than downstream at the eastern crossing of the international border, where the river receives runoff from a much larger area (6 800 km^2 at gauge 11AA031; McLean and Beckstead 1980). As the Milk River flows through Alberta, the concentration of suspended sediment in the water increases, and with it the turbidity (Spitzer 1988). These levels tend to decline over the augmentation period despite flows that remain relatively constant. The MRWCC has completed some work on sedimentation and erosion in the Milk River which further speaks to this issue as well as channel migration (www.mrwcc.ca).

In 2020, diversion infrastructure in Montana failed at Drop 5 which prevented water from being diverted form the St Mary River into the Milk River. Subsequently no water was diverted into the Milk River until October of 2020 following repairs.

In order to improve monitoring, standardized species sampling protocols have been developed for each fish species at risk in the Milk and St Mary river watersheds. These standardized sampling protocols were published in 2020 as technical documents (Macnaughton et al, 2019, Macnaughton et al., 2019; Macnaughton et al., 2020) via the peer reviewed process established by the Canadian Science Advisory Secretariat and will guide field sampling in the future.

4.2 Biology

4.2.1 Western Silvery Minnow

Western silvery minnow (Figure 1) is a small fish belonging to the minnow family (Family Cyprinidae). It is native to the large plains streams of the Missouri and Mississippi drainages in midwestern North America.

In the Milk River, western silvery minnow occurs in transitional areas characterized by elevated velocity and turbidity, an unstable streambed with shifting sand and silt substrates, and flows that fluctuate through the year (Burr and Page 1986, ASRD 2003).

Figure 1. Western silvery minnow (photo credit: Karen Scott, DFO).

4.2.2 Rocky Mountain Sculpin

Rocky Mountain sculpin (Figure 2) has previously been referred to as St. Mary shorthead sculpin (ASRD 2004a) and Eastslope sculpin (COSEWIC 2005).

Figure 2. Rocky Mountain sculpin (photo credit: Shane Petry, AEP).

In Alberta, Rocky Mountain sculpin are associated with cool, clear headwaters (Willock 1969). They tend to be more common in silt-free rock substrates near stream margins with low to moderate water velocities than in mid-stream areas where velocities are higher (Paetz 1993). As such where rocky cover is absent, such as near the town of Milk River, these fish use instream sedges and bank-side shrubs for cover during the augmentation period.

4.2.3 Stonecat

Stonecat (Figure 3) is the only native catfish species (Family: Ictaluridae — the bullhead catfish family) found in Alberta (Nelson and Paetz 1992). This relatively small catfish rarely exceeds 203 mm in total length (Scott and Crossman 1973).

Figure 3. Milk River Stonecat (photo credit: Shane Petry, AEP).

Stonecats occur in a variety of riverine habitats ranging from mid-sized to large streams, as well as wave-exposed rocky areas of large lakes that mimic stream conditions (ASRD 2004b). Stonecats have been observed in deep boulder-lined pools, cobble- and boulder-dominated sections of riffle or rapids, and over sand bars and gravel bars in lakes (Scott and Crossman 1973). Stonecats remain hidden under cobble and boulder substrates during the day and forage on the bottom at night (ASRD 2004b).

More detailed descriptions of the life history and habitat requirements for western silvery minnow, Rocky Mountain sculpin and stonecat in Alberta are provided in their respective status reports (ASRD 2003, 2004a, 2004b).

4.3 Population Status and Distribution

Figure 4 shows the Milk River and St. Mary River basins in Alberta.

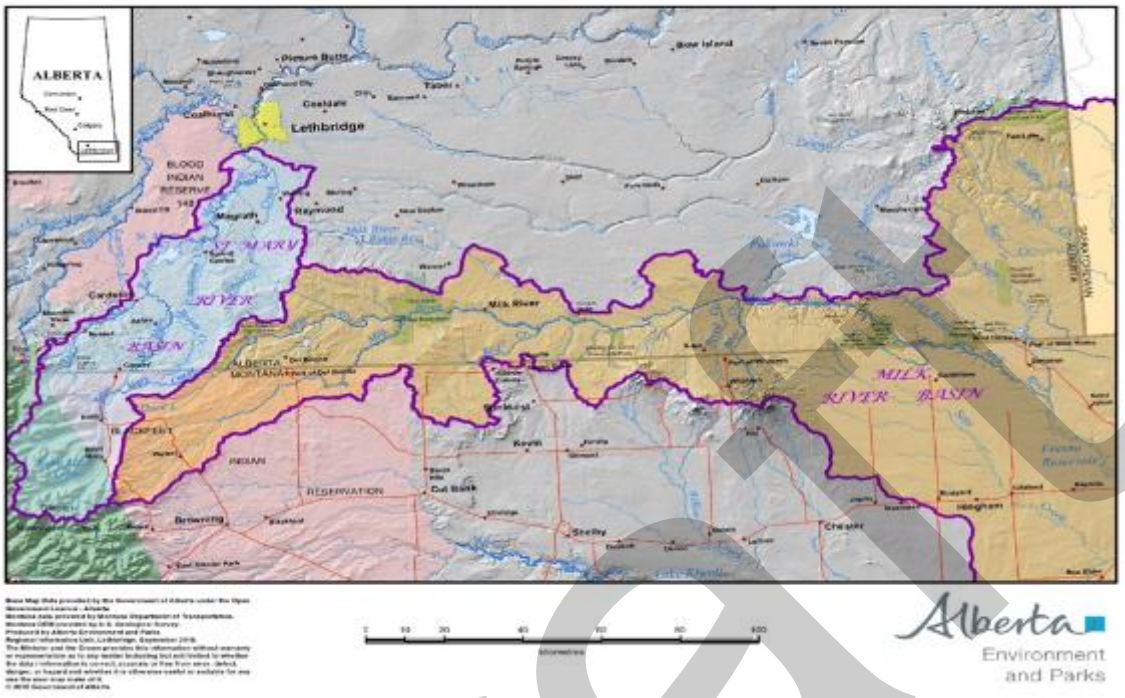

Figure 4. Location of the Milk and St. Mary river basins in Alberta.

4.3.1 Western Silvery Minnow

Western silvery minnow was first documented in Canada in 1961 from the lower Milk River, Alberta, and its presence has not been verified in any other Canadian river system since that time (Nelson and Paetz 1992). It is found in the lower reaches of the Milk River in Alberta and Montana upstream of the Fresno Reservoir. Very little information is available on population size or trends in abundance of this species in Alberta, though some recent work was conducted in the lower Milk River (Neufeld 2016). Since 1961, the species has remained common in small, local areas of the river from downstream of Writing-on-Stone Provincial Park to the Montana border (S. Petry, pers. comm.; Figure 5). It was one of the more abundant species caught in 2001 and 2002 fall surveys of the Milk River, where its abundance was highest downstream of Pinhorn Ranch, probably reflecting the increased availability of preferred habitat. It was the second most abundant fish species captured in mid-July 2005 by a DFO survey of the Milk River downstream of its confluence with Breed Creek (D. Watkinson, pers. comm.).

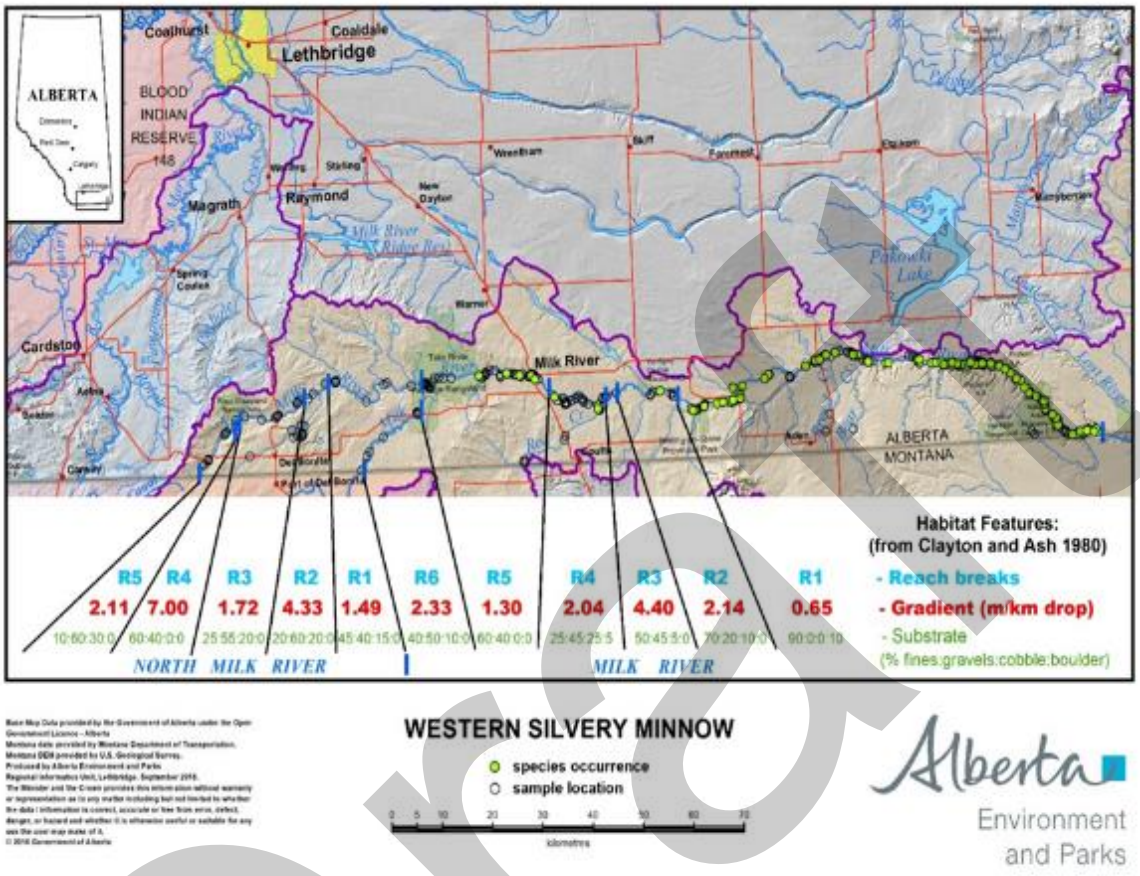

Figure 5. Distribution of western silvery minnow in Alberta. Sample sites are illustrated and the green dots illustrate sites where western silvery minnows were captured (Clayton and Ash 1980).

The species' winter distribution is unknown. Some fish likely overwinter in the same areas they occupy in summer, while others may move elsewhere to find suitable habitat that does not freeze or become anoxic.

4.3.2 Rocky Mountain Sculpin

An overall population estimate is not available for Rocky Mountain sculpin in Alberta, but the species is present in the St. Mary River, and in the Milk River from Deer Creek upstream to the North Milk River international boundary (Figure 6; D. Watkinson, pers. comm.; R.L. & L. Environmental Services Ltd. 1987, 2002; Paetz 1993; P & E Environmental Consultants Ltd. 2002).

Veillard (2016) did not calculate population estimates for Rocky Mountain sculpin in Lee Creek, where she studied movement of sculpins. She tagged 884 individuals over the course of the summer and fall seasons (July–October) of 2013, and recaptured 182 individuals fitted with passive integrated transponder (PIT) tags and 83 individuals marked with visible implant elastomer (VIE) tags at least once. Dispersal of some individuals indicated that sculpins were locally abundant.

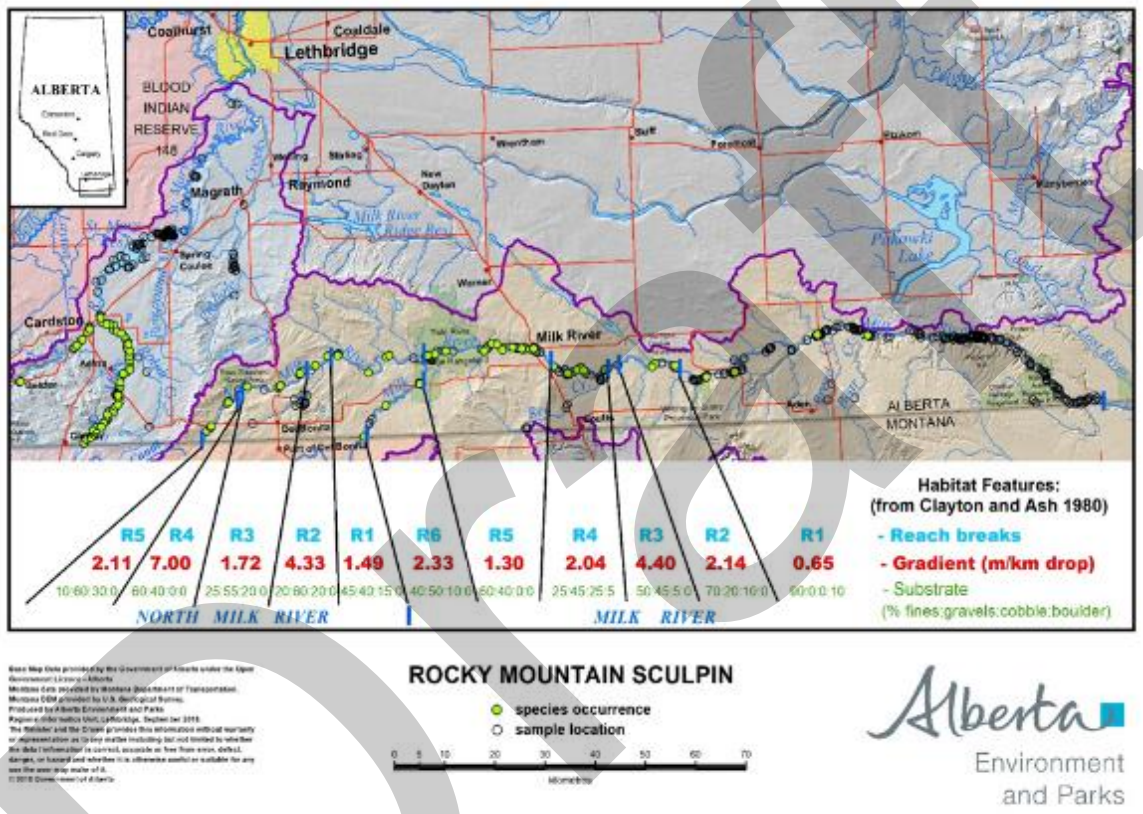

Figure 6. Distribution of Rocky Mountain sculpin in Alberta (Clayton and Ash 1980).

Recent genetic studies show little gene flow into the Milk River drainage from Rocky Mountain sculpin in the St. Mary River drainage (Ruppert et al. 2017).

Rocky Mountain sculpin appear to have a small home range. Veillard (2016) found that 89% of sculpins moved less than 30 m over the four-month study period, while a few individuals moved up to 240 m. Most Rocky Mountain sculpins moved very little during the study period. In general, extent of movement is varied, but they do not cover great distances in a given year. There is no specific evidence of why some sculpin move more than others but it may be related to predators, foraging opportunities and/or avoidance of locations where higher densities of individuals occur.

In another study, approximately 50% of the sculpins moved less than 10 m (upstream or downstream) over a five-month period (Ruppert et al. 2017). Total distribution of Rocky Mountain sculpin is shown in Figure 6.

4.3.3 Stonecat

Similarly, no population estimates are available for stonecat in the Milk River; however, the population is considered to be low in abundance and stable based on comparisons of relative abundance over time (ASRD 2004b). It has always represented less than 2% of the total catch in Milk River surveys (ASRD 2004b), but past sampling efforts have likely underestimated abundance of this species given its nocturnal lifestyle (B. McCulloch, pers. comm.). Trends in abundance have not been documented elsewhere, although it is considered at risk in several American states.

Stonecats inhabit the North Milk River as well as portions of the mainstem Milk River in Alberta. Distribution in the Milk River (Figure 7) and the Red River in Manitoba suggests that this species is likely tolerant of a wide range of turbidity levels (Stewart and Watkinson 2004).

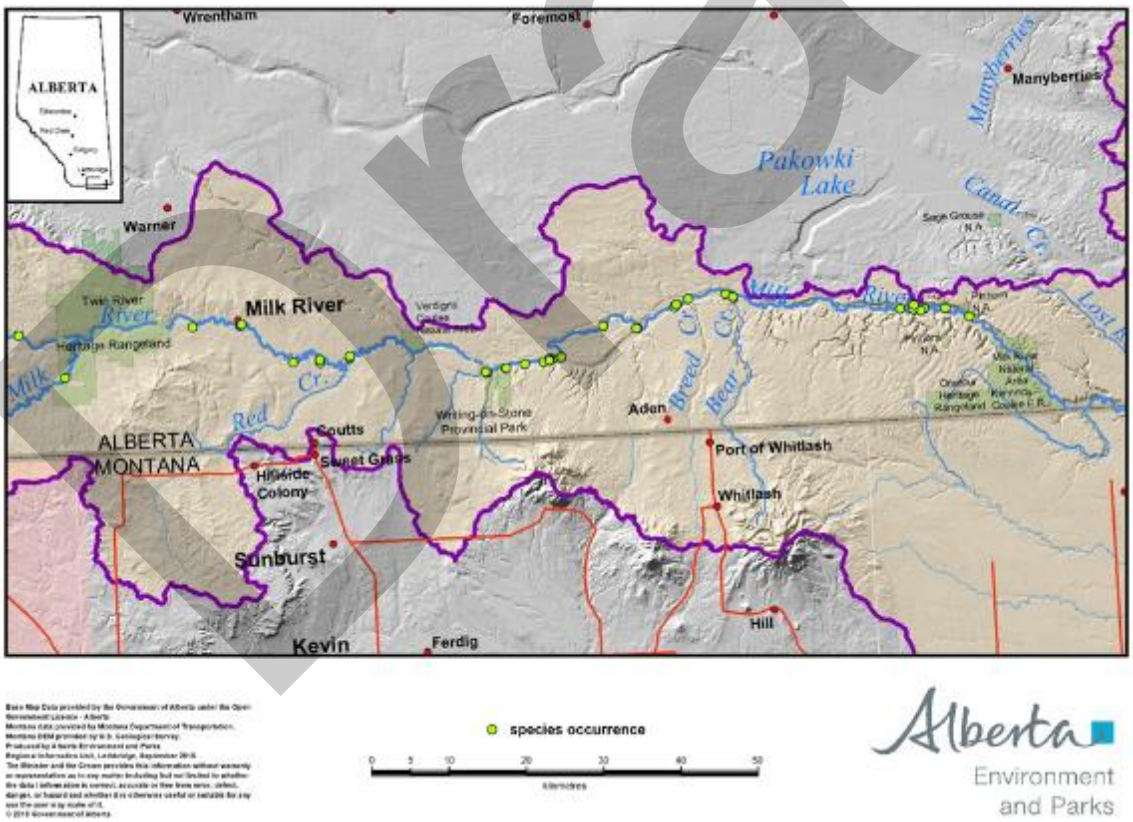

Figure 7. Distribution of stonecat in Alberta.

4.4 Threats

The three fish species of concern in the Milk River (western silvery minnow, stonecat and Rocky Mountain sculpin) have several threats in common:

- Habitat degradation and loss due to:
  - water management activities (changes in flow), and
  - livestock use of flood plain;
- Exotic and/or invasive species;
- Poor (or low) water quality and pollution;
- Accidental or targeted mortality; and
- Climate change, drought and natural processes.

4.4.1 Habitat Degradation and Loss

4.4.1.1 Changes in Flow Regime

The most significant threats for all three species are those that alter the flow regime and result in habitat loss or degradation. When the diversion of water from the St. Mary River is terminated in late September to mid-October, the river reverts to natural flows for the remainder of the winter season, albeit within a somewhat modified river channel (McLean and Beckstead 1980; MRWCC 2008). Reduction of the diverted flow occurs over about a week, and flows in the river decline over the next several weeks. The decline in flow is most rapid in upstream reaches of the river. Under severe drought conditions (such as those of 2001–2002), there may be little or no surface flows in the Milk River in the fall and into the winter, such that the river appears to be reduced to a series of isolated pools until spring, although subsurface flows may continue (K. Miller, pers. comm.).

The natural hydrologies of both the Milk River and the St. Mary River have been altered by diversion and augmentation for over a century. Canal infrastructure failures or maintenance in Montana can cause a rapid and severe decreases in flows if there are no diversions from the St Mary River as was the case in 2020 which was discussed previously.. Additional changes in flow are possible in some years in the future, including increased flow augmentation when the St. Mary Canal in Montana is rehabilitated. During periods of high flow (augmented flows) western silvery minnow seek refuge in areas with lower velocities such as exposed sand bars. A major finding in Neufeld's study (2016) was that during augmented flow, habitat suitability for western

silvery minnow is reduced. Neufeld (2016) reported that the amount of available suitable habitat was lower during augmented or high flow in July 2014 than during natural flow in October 2014. This is due in part to exposed sandbars providing reduced flows downstream during periods of low (natural) flow. This may have important implications in the event of further alterations to flow in the Milk River, with additional augmentation unlikely to provide additional suitable habitat.

The feasibility of constructing a dam in the Milk River basin in Canada has been assessed on multiple occasions (Klohn-Crippen 2003; MPE 2016), and the project could be reconsidered in the future. Construction of another dam on the St. Mary River in Canada has also been assessed, as part of a strategic approach to manage future water supply challenges as climate change occurs (AMEC 2014). Dam construction would not only further alter the natural hydrology of the Milk and St. Mary rivers but would also form reservoirs that would inundate river habitat, impose barriers to migration, and alter water temperature and water quality downstream from the dams.

All three of these fish species are habitat specialists in that they are adapted to thrive in relatively specific conditions and habitats, and are therefore sensitive to flow changes which impair or alter natural processes and physical habitat. For example, alterations that result in a reduction of seasonal fluctuations of discharge and declines in turbidity related to channelization and impoundment correlate with precipitous declines of western silvery minnow in the lower Missouri River (Pflieger and Grace 1987). Rocky Mountain sculpin is well-adapted to survive in cool, clear streams with clean, rocky substrates, and loss of habitat because of flow regulation and increased sedimentation could reduce its competitive advantage over sympatric fish species or increase its vulnerability to predators. Stonecat and western silvery minnow do not effectively adapt to survive in lentic habitat when streams are impounded, although the reasons for this are unclear (Peden 2000). Formation of a reservoir could potentially exclude stonecat and western silvery minnow from the reservoir footprint. Cold water temperature may already limit the range of stonecat and western silvery minnow in the Milk River in Alberta, and hypolimnetic dam release could extend cold water habitat in the Milk River, further marginalizing both species in this system (MRSRRT 2008, 2014).

Water management practices in the Milk River and St. Mary River drainages have likely contributed to the current risk status of western silvery minnow, stonecat and Rocky Mountain sculpin. Further impoundment and diversion of water in both basins could result in dramatic decreases of habitat availability and suitability for western silvery minnow and stonecat in the Milk River, and Rocky Mountain sculpin in both rivers.

4.4.1.2 Livestock Use of Flood Plain

The threat to the three at-risk species and their habitat from livestock overuse within the flood plain is considered to be low. The Alberta Riparian Habitat Management Society has been

actively engaged in the issue of livestock management in the flood plain. Several riparian and grazing management workshops have been held, involving many ranchers operating along the river. There is a growing understanding of the value and vulnerability of the riparian area, and a greater understanding and uptake of management solutions by ranchers, including the development of off-stream watering options (L. Fitch, pers. comm.). Several riparian benchmark inventories have been completed, but no follow-up monitoring has been done to date. Two formal demonstration sites have been established, both of which have shown riparian vegetation recovery, especially of woody vegetation. Reduction of livestock use and recovery of riparian habitat requires time. Firsthand experience with riparian restoration informs us that often the first signs of recovery take about three to five years after the first management changes are made, and more time may be necessary in a highly erosive and sandy system such as the Milk River (S. Petry, pers. comm.). This may vary to some degree in the St. Mary River system.

4.4.2 Exotic and/or Invasive Species

The introduction of invertebrates such as zebra mussels (*Dreissena polymorpha*), the New Zealand mud snail (*Potamopygrus antipodarum*), quagga mussel (*Dreissena bugensis*), and crayfish (*Orconectes* sp.) could disrupt native invertebrate populations and might affect Rocky Mountain sculpin as well. There have been recent detections (2016) of invasive mussels in the Milk River watershed (Tibor and Canyon Ferry reservoirs) in Montana (Montana Fish, Wildlife and Parks News Release 2016).

The provincial government does not plan to introduce sportfish species into the Milk River and is unlikely to do so in the future (S. Petry, pers. comm.). However, the State of Montana continues to stock predatory sportfish in Fresno Reservoir which could move upstream.

4.4.3 Poor Water Quality and Pollution

The likelihood of point source and non-point source pollution entering the Milk River at levels that could threaten western silvery minnow, stonecat or Rocky Mountain sculpin survival is considered to be low. Point sources of pollution include any storm water and sewage releases, as well as accidental spills and gas leaks, particularly at river and tributary crossings. The Town of Milk River has not released raw sewage into the Milk River for 20 years, and storm water is surface run-off (K. Miller, pers. comm.). While treated effluent is discharged, these collective inputs likely represent a minimal risk, although further investigation would be necessary to quantify this threat. An inadvertent release of a toxic substance at any one of the river crossings, including bridges or pipelines, could have serious consequences. The extent and severity of any damage to the aquatic community would depend on the substance released, the location of the spill, the time of year (during flow augmentation or not), and the potential to mitigate the impacts. To date, no such spills have been documented for the Milk River. However, the possibility for such incidents does exist because traffic flow is significant at some crossings. A small number of gas leaks have occurred in recent years at abandoned well sites (S. Petry, pers. comm.). Contamination of water from seismic or drilling activities is also possible. Uncapped groundwater wells may also pose a problem, although licensing and well-capping programs help to minimize this threat (Alberta Environment 2002).

Non-point sources of pollution in the vicinity of the Milk River are mainly limited to the runoff of agricultural pesticides and fertilizers. Overall, this threat is considered to be low. Most of the approximately 8 000 acres of cropland that is irrigated in the Milk River basin is located within 50 km of the Town of Milk River, along with another small section located upstream on the North Milk River near Del Bonita (K. Miller, pers. comm.). The growth period for most crops also coincides with the diversion period. Flows are usually at their highest during this time, creating a significant dilution effect. Leaching of fertilizer residues has declined significantly in recent years due to the

high costs of fertilizing and pumping of water (K. Miller, pers. comm.), but nutrient concentrations can become elevated at downstream sites such as the Highway 880 crossing (W. Koning, pers. comm.). Water quality in the mainstem also changes seasonally in response to flow augmentation, with increases in the total dissolved solids, conductivity, and salt (sodium) concentrations when water diversion is shut off in the winter months (W. Koning, pers. comm.).

4.4.4 Accidental or Targeted Mortality

Mortalities can occur accidentally from numerous sources including development projects, low flows (isolation), and scientific sampling. Sampling may occasionally occur in multiple locations within the species' range, but only affects small areas of habitat in any given year. Most fish caught are released alive, but some are killed intentionally or accidentally. The severity and level of concern attached to this threat are low because scientific sampling is regulated through the issuance of permits pursuant to the federal SARA legislation for western silvery minnow and Rocky Mountain sculpin. Stonecat sampling is regulated by Alberta because this species is listed only provincially as *Threatened*. As a result of status and legislative protection for these species, there is considerable evaluation of the possible impacts of scientific sampling and the potential for mitigation of this risk is high.

4.4.5 Drought/Climate Change

4.4.5.1 Drought

Southern Alberta is susceptible to extreme drought conditions, particularly during the summer and early fall. The significance of this threat depends on the severity and duration of drought conditions, but overwintering habitat is the habitat most likely to be affected. Drought conditions, in combination with water regulation, canal maintenance and extraction practices, significantly reduce the amount of summer and overwintering habitat available to these species. In 1988 and 2001, the surface flow of the Milk River was virtually eliminated in the fall and winter due to severe drought conditions, and the lower reach of the river in Alberta was reduced to a series of standing pools (WSC 2017). Natural drought conditions alone may seriously stress fish populations, but when combined with other anthropogenic stressors the severity of drought effects may be compounded.

4.4.5.2 Climate Change

Climate change has the potential to affect water availability, temperature and water clarity. All of these changes would affect fish habitat and, consequently, the suitability of habitat to support the three species at risk. Potential shifts in fish communities may result. The outcomes of these processes are unknown, but could favour competing different species and/or increased predation. The overall extent of these impacts on western silvery minnow, stonecat and Rocky Mountain sculpin is unknown.

Table 1. Threats assessment table for stonecat (black), western silvery minnow (blue) and Rocky Mountain sculpin (red) in Alberta.

Note that sources of threats were evaluated based on a number of factors, including likelihood of occurrence, extent of occurrence (spatial scale), severity of threat (where H, M, L, U = high, medium, low or unknown, respectively) and immediacy of threat (where C, F, P = current, future or past, in descending order of importance, respectively). The overall threat significance (high, medium or low) was then assigned based on these four factors. Finally, the feasibility of mitigation or restoration associated with these sources was evaluated (high, medium or low) to assist in prioritizing activities in the implementation plan. In most cases, it is impossible to provide a complete evaluation because of the lack of information regarding the species and/or the source of the threat, and evaluation was often based on professional opinion and discussion by the recovery team. Please refer to Section 4.0 for more detailed explanations of threats to survival and habitat.

Threat	Source of Threat	Likelihood of Occurrence (H,M,L,U)	Extent of Occurrence (H,M,L,U)	Severity of Threat (H,M,L,U)	Immediacy of Threat (C,F,P)	Overall Threat Significance (H,M,L,U)	Mitigation or Restoration Feasibility (H,M,L,U)	Comments
Habitat Loss or Degradation	Dam construction	M M M	H H H	U H H	F F F	U H H	L L L	Very complex issue and impossible to fully evaluate until proposal details are available; however, general problems associated with dams elsewhere are recognized here.
	Changes in flow regulation (canal)	H H L	H H H	M-H H M	F F F	M-H H L	U L L	Possible canal options include achieving current design capacity, capacity increase (24–28 m^3/s) or abandonment.

Threat	Source of Threat	Likelihood of Occurrence (H,M,L,U)	Extent of Occurrence (H,M,L,U)	Severity of Threat (H,M,L,U)	Immediacy of Threat (C,F,P)	Overall Threat Significance (H,M,L,U)	Mitigation or Restoration Feasibility (H,M,L,U)	Comments
	Canal maintenance	H H H	H H H	H H H	F F F	H H H	M M M	Canal maintenance can pose a threat when rapid increases or decreases in diversion discharge substantially alter river flow. The threat can be mitigated if maintenance or repair work can be delayed until the non-augmented period. In 2020 a large infrastructure failure resulted in no augmentation until October of that year.
	Groundwater extraction	L H L	L H L	L,U L,U L,U	F C F	L,U L,U L,U	U L L	Could be significant during non-augmented period, but difficult to evaluate due to inability to quantify natural losses and needs of fish.
	Surface water extraction — irrigation	H H H	M M M	L L L	C C C	L L L	M M M	Irrigation only occurs during augmentation period (April–Sept.) (based on current extraction levels).

Threat	Source of Threat	Likelihood of Occurrence (H,M,L,U)	Extent of Occurrence (H,M,L,U)	Severity of Threat (H,M,L,U)	Immediacy of Threat (C,F,P)	Overall Threat Significance (H,M,L,U)	Mitigation or Restoration Feasibility (H,M,L,U)	Comments
	Surface water extraction — non-irrigation	H H H	M-H H M	H H H	C C C	H H H	M M M	Fish most vulnerable during non-augmented period. Restriction of TDL during critical low flows could help mitigate impacts.
	Livestock use of flood plain	M M M	M M M	L L L	P mainly P mainly P mainly	U U U	H H H	Overgrazing can degrade riparian habitat condition. The Alberta Riparian Habitat Management Society is operating and has had positive results elsewhere (e.g., upland watering); agricultural practices along river are generally conservative but some cattle access still occurs and impacts are unknown.
Exotic/ Invasive Species	Authorized or illegal stocking	M M H	M H M	U L-H L-H	F C,F C,F,P	U L-H M	L L L	Severity of threat depends on the introduced species; unless species is known it is difficult to assess.

Threat	Source of Threat	Likelihood of Occurrence (H,M,L,U)	Extent of Occurrence (H,M,L,U)	Severity of Threat (H,M,L,U)	Immediacy of Threat (C,F,P)	Overall Threat Significance (H,M,L,U)	Mitigation or Restoration Feasibility (H,M,L,U)	Comments
Poor/Low Water Quality and Pollution	Pollution — point source	M M M	H H U	H H U	F F F	M M M	L L U	Includes accidental spills associated with road/rail and pipeline crossings, depends in part on substance released, location of spill and potential to mitigate the impacts; gas leaks are known to have occurred at river crossings in recent years.
	Pollution — non-point source	L L L	L L L	L L U	C C C,F,P	L L L	M M M	Generally thought to be low threat except if occurs during non-augmented period because mitigation would be difficult. It has not been measured but it is thought that threat from agricultural run-off is low..
	Reduced dissolved oxygen	L H L	L U H	L U L	C C F	L U L	U L L	Extent and severity unknown, but could be significant during the winter depending on availability of open water areas.

Threat	Source of Threat	Likelihood of Occurrence (H,M,L,U)	Extent of Occurrence (H,M,L,U)	Severity of Threat (H,M,L,U)	Immediacy of Threat (C,F,P)	Overall Threat Significance (H,M,L,U)	Mitigation or Restoration Feasibility (H,M,L,U)	Comments
Accidental or Targeted Mortality	Scientific sampling	L L L	L L L	L L L	C,F C,F C,F	L L L	H H H	Sampling is regulated by permit.
Climate Change and Natural Processes	Drought	H H H	H H H	H H H	C,F C,F C,F	H H H	M L M	Depends on the length and severity of drought.
	Climate change effects on Milk River	U U U	H H H	U U U	U U U	U U U	0 0 0	Difficult to evaluate at this time; mitigation not possible at local level.
	Algal blooms	U U U	L L L	U U U	U U U	U U U	M M M	Altering flow regime might restore conditions.

5.0 Recovery Goals and Objectives

Some *Threatened* and *Endangered* species within Alberta are designated as such because of factors that cause them to be naturally rare on the landscape, such as existing at the northern periphery of their range in North America. No empirical evidence to date suggests that the Milk River populations of western silvery minnow, stonecat or Rocky Mountain sculpin (and the populations in the upper St. Mary River drainage for the latter) have suffered serious population declines or that their ranges have been reduced significantly since first identified in the watersheds. Given their limited distribution, all three species are unlikely to expand their distribution or increase their population; it is therefore unlikely that they would be down-listed, and they may always persist at some level of risk. In such cases, a recovery goal is not warranted; rather, a maintenance goal is more appropriate. While the terms “recovery” and “maintenance” will both be used herein, it is important to clarify that the goal for this species has a maintenance intent. Recovery planning for these species is focused on protecting and maintaining current populations by monitoring their habitat and by eliminating, reducing or mitigating identified threats.

Goal:

To protect and maintain current populations and ranges of western silvery minnow, stonecat and Rocky Mountain sculpin within the Milk River and upper St. Mary drainage in Canada.

Indicator:

Presence/absence of all three species within their currently occupied ranges during five-year population surveys.

6.0 Habitat Needed to Support Recovery

The recovery goal for these three fish species at risk is one of maintenance and the ongoing persistence of these populations of fish within the current areas of distribution in these heavily modified watersheds. As such, the associated actions relating to this plan focus on protecting and monitoring these fish species.

The purpose of this section is to help prioritize areas in the watersheds for the implementation of recovery actions and management of the species. In this case (Milk and St. Mary watersheds), the circumstances are unique given the seasonal inter-basin transfer of water from the St. Mary River to the north fork of the Milk River as per the international water sharing agreement between Canada and the United States. This transfer of water (augmentation), which allows Montana to transfer water to reservoirs in other parts of the state, greatly affects habitats in the Milk River in Canada from March through October in any given year.

The seasonal diversion of water from the St. Mary River into the Milk River affects both systems, although the greatest changes occur in the Milk River given the dramatic increase in flows from natural rates (can be orders of magnitude). Flows in the Milk River originate as snowpack in Montana, and snowmelt accounts for approximately 50–80% of natural flows with precipitation accounting for the remaining 20–50% of natural flows (MRWCC 2013). Once the spring run-off ends, flows tend to drop dramatically during the summer, and discharge can range from 1–3 m^3/s, whereas augmented flows are often greater than 15 m^3/s. Flow augmentation generally occurs from March through October in most years, and some of this water is used by Canada (municipalities, agriculture) while the majority is used in Montana.

Augmentation to the Milk River causes numerous changes to the Milk River, including increases in suspended sediments as well as erosion and higher velocities. Generally, the effects of augmentation are likely both positive and negative in terms of affecting fish species at risk. The increases in volume and velocity can affect the ability of small-bodied fish such as western silvery minnow to occupy certain habitats in portions of the Milk River during augmentation, which may limit the availability of usable habitat (Neufeld 2016). However, from a broader perspective, the additional flows provide needed recharge to groundwater aquifers that help stabilize flows and water levels in this semi-arid watershed.

In order to help determine how best to ensure habitat needs for western silvery minnow, stonecat and Rocky Mountain sculpin are met, Alberta has characterized habitats in the Milk River at a macro-habitat level, based on the distribution of these species, changes in gradient and substrate

composition (Figures 5, 6). A similar habiutat characterization was unnecessary for the St. Mary River upstream of the St. Mary Reservoir to the international border as well as for Lee Creek since both are both mainly uniform cold-water gravel–cobble substrate streams that are generally well suited to the needs of Rocky Mountain sculpin. As such, this species is locally abundant in portions of both of these waterbodies.

Notwithstanding the change in natural flows in the Milk River resulting from seasonal augmentation, sampling by AEP and DFO over the years has not shown indications of large changes to the populations of these three species since they were first assessed by COSEWIC in 2005. There are no population estimates although the same species have been captured in the same or similar locations over time. It is thought that current habitat supports all the life requisites needed to maintain these species. This includes the idea that these fish have undergone some forms of adaptation associated with habitat use during the period of augmented flows in the Milk River, given that all three species still persist and augmentation has been ongoing for many decades.

The north fork and mainstem of the Milk River to approximately just downstream of the Town of Milk River are characterized by slightly higher gradients and predominantly larger substrate types (i.e., boulder, cobble and gravel). These habitat types have increased velocities (0.1–1.1 m^3/s), and are well suited to the life history needs of Rocky Mountain sculpin. This is indicated by capture records of this species in the Milk River as well as in both the upper St. Mary River and Lee Creek. Preferred habitats for all life stages of this species include clear, cold water as well as riffle and run type habitats. Since Rocky Mountain sculpin are nest builders during spawning periods, instream features such as woody debris can help with spawning success (Fisheries and Oceans Canada 2017b).

As the Milk River continues to the southeast, it begins to resemble a prairie stream with lower gradients and finer substrate materials of gravel, sand and silt. These habitats are characterized by runs, flat water and back water areas. These types of habitats are generally slower velocity and barrier free, and have higher turbidity levels due to the fine substrate materials. The western silvery minnow prefers these types of habitats (Fisheries and Oceans Canada 2017b).

Important habitats in the Milk River for stonecat are less well understood. From the capture locations (Figure 7), it appears as though stonecat may prefer lower-gradient habitats but may be able to succeed in more diverse habitats. A habitat analysis for stonecat in the Milk River indicated that the species generally uses run and flat habitat types (generally defined by moderate depths and unbroken surface) with low to moderate water velocities (0.0 to 0.29 m^3/s maximum velocities) and low silt depth (0.0 to 0.10 m; R.L. & L. Environmental Services 2002). Substrates were mixed, ranging from small to large rocky material, but mean substrate size (0.21 to 0.57 m in diameter) was represented by larger cobble and boulders (R. L & L. 2002).

Furthermore, all stonecats captured were in close association with cover, predominantly cobble and boulder (R.L. & L. Environmental Services 2002). Of interest, observations from the Milk River and Manitoba demonstrate stonecat's ability to adapt to human-induced changes in habitat; in particular, the addition of angular substrates and boulders in the channel are used for cover (Alberta Sustainable Resource Development 2004b).

7.0 Recovery Strategies and Actions

Strategies have been designed to specifically address all medium- and high-ranking threats listed in Table 1, and to address key knowledge gaps.

7.1 Ensure that Threats to Habitat and Individuals are Considered in Water and Land Use Planning and Management Decisions

The threats analysis (Table 1) identified five medium- to high-ranking threats that apply to all three species, related to the water and land use management of the Milk River watershed. Addressing many of these threats can be accomplished by ensuring that regulatory agencies are aware of the presence and range of the three listed fish species and have Best Management Practices (BMPs) in place to mitigate the potential impacts of specific activities. The future threat of river impoundment is not addressed by this recovery plan, but would be considered when a proposal is submitted for regulatory review and approvals. The threat of non-native stocking has been significantly reduced by the implementation of a new Government of Alberta non-native stocking policy (Alberta Environment and Parks 2016).

Desired Outcome

- Water managers and regulators are aware of the habitat needs of and potential threats to the Milk River species at risk, and receive support from fisheries biologists to develop and implement appropriate mitigations and BMPs to protect and conserve these species at risk.

Progress Measures

- The number of development project files that could negatively affect any or all of these species that are referred to fisheries staff for advice, including opinions on uncertainty regarding the potential impacts of the projects.
- The development and implementation of a formal process to determine minimum flow thresholds in the Milk River; these thresholds would inform suspension of TDLs during periods of drought.

Recovery Actions

- Collaborate with water managers and regulators to discuss future development projects and to assess whether BMPs are effective. Identify opportunities to mitigate negative impacts of development projects and water diversions on Milk River species at risk.

- Work with water managers to develop a formal process to determine minimum thresholds in the Milk River to suspend TDLs.
- Support government and non-government extension programs that promote awareness of the threat of invasive species introductions, such as the “Don't let it loose” program.

7.2 Develop a Science-based Monitoring Program to Allow Effective Monitoring of and Reporting on the Presence and Distribution of the Three Fish Species at Risk

Recent studies for western silvery minnow and Rocky Mountain sculpin have demonstrated that obtaining an absolute population estimate is difficult. Neufeld (2016) showed that insufficient numbers of recaptured (i.e., previously tagged) western silvery minnow resulted in an inability to calculate acceptable population estimates. Difficulties sampling the North Milk River and St. Mary River resulted in these rivers not being regularly sampled during a Rocky Mountain sculpin study (Veillard 2016).

The recovery of these species requires collaboration with external partners to help develop efficient and meaningful methods to monitor populations throughout their known distributions. Work will also include determining whether abundance information should be collected along with additional life history information. Sampling methods will vary, as specific capture techniques are not necessarily appropriate for all three species — a consequence of the different habitats occupied by each.

Unless there is an unanticipated event (change in flow, spill, etc.), sampling to monitor these populations will occur over one or more sampling seasons every five years. The monitoring process will also consider actions that could be taken should monitoring show a negative change to a species at risk.

Desired Outcomes

- Regular surveys monitor the presence and distribution of the Milk River fish species at risk, and allow for timely management responses to any significant changes detected.

Progress Measures

- Robust methods for monitoring these species at risk are implemented and refined, allowing future indicators to be population- or density-based.

- A framework for action is developed, and used if monitoring reveals negative changes to the distribution or abundance of any of the species at risk.

Recovery Actions

- In collaboration with stakeholders and regulators such as DFO, develop monitoring methods, and subsequently test and implement a monitoring program, for the three species at risk in the Milk and St. Mary river systems. Populations of all species will each be monitored at least once every five years.
- Report on the results of the monitoring activities following periodic surveys. If negative trends are detected, work with regulators to identify which threats might have changed and, if necessary, trigger a management response to mitigate the threat.
- Continue to work with stakeholders to review techniques and develop or enhance sampling protocols as necessary.

7.3 Continue to Collaborate with DFO and other Government and Non-Government Organizations

Alberta has been working with stakeholders and partners for many years to conduct sampling, develop recovery plans and promote the overall conservation of species at risk in the Milk and St. Mary river systems (examples in Sec. 3.0). These opportunities allow individuals and organizations to get involved in the recovery of these species at risk. It has included working with graduate students to support answering specific questions about individual species, the development of interpretive materials and signage for the public and non-government groups (e.g., the Milk River Watershed Council), and undertaking projects to help determine winter habitat use by western silvery minnow.

Desired Outcomes

- Meaningful projects that promote the awareness and conservation of these species are pursued individually and/or with partners.

Progress Measures

- Annual meetings held with DFO and academic institutions.
- Ongoing input on development projects and water management decisions.

Recovery Actions

- Continue discussions, including an annual meeting with DFO (and possibly other stakeholders), to discuss recovery progress and identify and prioritize science and/or extension needs.
- Continue to promote awareness and conservation of the three fish species at risk in the Milk and St. Mary river systems, including the development of extension materials, if warranted.
- Continue to provide expert advice to regulators and water managers to ensure that decisions include consideration of fish species at risk in the Milk and St. Mary river drainages.

8.0 Implementation Plan

Actions described in the *Alberta Recovery Plan for At Risk Fish Species in the Milk and St. Mary Rivers* will be implemented based on priority and consideration of the risks and consequences of implementation.

8.1 Identify Priorities

Strategies 7.1 and 7.3 are immediate and ongoing priorities that will continue throughout the span of time for which the current recovery goal is relevant. This timeframe could be extended in perpetuity, with consideration of relationships with regulators, water managers and stakeholders. These two strategies include developing, reviewing, and improving mitigation measures as necessary, the ongoing promotion of research to answer specific questions, and the use of extension materials to promote the protection and conservation of these species at risk. These strategies also advocate working with partners and in collaboration with other stakeholders to ensure that actions are meaningful. If these strategies are successfully implemented many of the known significant threats could be effectively mitigated.

Strategy 7.2 — developing and implementing monitoring protocols to report on the status of these populations — is a longer-term priority. The development and testing of protocols should begin immediately and continue through one or two sampling seasons depending on need and limitations of sampling methods. Once this is complete a full monitoring program should be implemented (within five years of approval of this plan) and continue at least once every five years.

8.2 Implementation Risks

It is anticipated that the recovery actions will be generally supported by all directly affected stakeholders. However, given that waters of both the Milk and St. Mary rivers are heavily regulated and limited with regard to water availability, there are potential risks to species at risk associated with development and water use:

1. Surface water diversions during drought periods (ensuring that appropriate steps are taken to prevent harm to these species at risk); and
2. Development proposals to create water storage in either the Milk or upper St. Mary river drainages.

8.3 Responsibility for Major Strategies

Table 2. Primary agencies or individuals responsible for implementing or monitoring identified recovery actions.

Strategy	Action	Lead Agency or Staff Member
7.1	Collaborate with water managers and regulators to discuss future development projects and to assess whether BMPs are effective. Identify opportunities to mitigate negative impacts of development projects and water diversions on Milk River species at risk.	AEP Species Lead
7.1	Work with water managers to develop a formal process to determine minimum thresholds in the Milk River at which to suspend TDLs.	AEP Species Lead;
7.1	Support government and non-government extension programs that promote awareness of the threat of invasive species introductions, such as the “Don't let it loose” program.	AEP
7.2	In collaboration with partners such as DFO, develop, test and implement a monitoring program for the three species at risk in the Milk and St. Mary river systems. Monitor populations at least once every five years.	Senior Fisheries Biologist, DFO, and other groups (eg., academic institutions)
7.2	Report on the results of the monitoring activities following periodic surveys and, if negative trends are detected, work with regulators to identify which threats might have changed and, if necessary, trigger a management response to mitigate the threat.	Senior Fisheries Biologist, DFO, other groups
7.2	Continue to work with stakeholders to review techniques and develop or enhance sampling protocols as necessary	Senior Fisheries Biologist, DFO, academia

7.3	Continue discussions and an annual meeting with DFO (and possibly other stakeholders) to discuss recovery progress and science and/or extension needs.	Senior Fisheries Biologist, DFO, academia
7.3	Continue to promote awareness and conservation of the three fish species at risk in the Milk and St. Mary river systems, including the development of extension materials if warranted.	Senior Fisheries Biologist, DFO, academia

8.4 Progress Reporting and Work Plan

The AEP species lead will develop a work plan as necessary and summarize recovery progress with support from staff with provincial Species at Risk program. Some actions may be reported annually, while reporting for other actions can only occur following a sampling event that takes place over one or two sampling seasons every five years.

9.0 Socio-economic Scan

The protection of species at risk can have both benefits and costs. The federal *Species at Risk Act* recognizes that Canadians value wildlife in and of itself (Species at Risk Act 2002). Self-sustaining and healthy ecosystems, including the conservation and protection of species at risk, contribute positively to the quality of life of all Canadians.

Western silvery minnow has no direct economic importance (Scott and Crossman 1973). The species does have intrinsic value as a contributor to Canada's biodiversity and as a forage fish.

Most anglers do not specifically target stonecat, although a few individuals do so that they can include them in their list of Alberta species caught. As such, there is limited recreational fishing, harvest or industrial value associated with this species. Landowners and lessees will not be unduly affected by costs associated with conserving the species or maintaining habitat. Stonecats have intrinsic value as a contributor to Canada's biodiversity and as a forage fish.

The Rocky Mountain sculpin has no direct economic importance, but does have intrinsic value as a contributor to Canada's biodiversity. Because of its preference for cool waters and clean substrates, this fish may serve as a bioindicator of environmental conditions in the rivers it inhabits (ASRD 2004a).

The recovery team has considered the socio-economic impacts of mitigating threats described in the Threats section. The primary threat identified was habitat loss through altered water regulation or changes to flow regimes. Since surface water extraction for irrigation purposes occurs during the augmented flow period, there will not be a socio-economic impact associated with the recommended actions. However, if a restriction were to be imposed on the number of TDLs available for surface water extraction during a non-augmented flow period or canal shutdown event (e.g., siphon repairs), this could have a minor impact on the oil and gas industry. Current and future life history data collected on western silvery minnow, stonecat and Rocky Mountain sculpin will influence decisions to approve, modify or reject proposed large-scale infrastructure developments, such as a dam on the Milk River.

Table 3. Anticipated socio-economic impacts of implementation of the *Alberta Recovery Plan for At Risk Fish Species in the Milk and St. Mary Rivers*.

Strategy	Action	Socio-economic Impacts (-) is a cost, (+) is a benefit
7.1	Have periodic discussions and/or meetings with water managers and regulators to discuss any future development projects and to assess whether BMPs are effective. Identify opportunities to mitigate negative impacts of development projects and water diversions on Milk River species at risk.	(+) reduce impacts or mitigate effects of harmful changes to habitat (+) increase knowledge exchange between stakeholders and regulators that promotes the design and implementation of better wildlife protection policies (-) conflicts could arise if difficult management decisions are contemplated in response to restricted water use
7.1	Support government and non-government extension programs that promote awareness of the threat of invasive species introductions, such as the “Don't let it loose” program.	(+) reduce predation and negative species interactions (+) improve knowledge extension that promotes positive behaviours and cultural change in the consumption of ecosystem services (-) costs for design and preparation of extension materials
7.2	In collaboration with stakeholders such as DFO, develop, test and implement a monitoring program for the three species at risk in the Milk and St. Mary river systems	(+) improve our ability to effectively monitor and report back to the public on the status of these species at risk (+) increase knowledge and understanding of the dynamics of each fish species and its habitat, as well as their interactions with other animal and plant species (-) costs associated with testing methods and periodic sampling
7.2	Report on the results of the monitoring activities following periodic surveys and, if negative trends are detected, work with regulators to identify which threats might have changed and, if necessary, trigger a management response to mitigate the threat.	(+) improve our ability to effectively monitor and report back to the public on the status of these species at risk (+) collect new data on the fish species and their habitat that would improve the understanding of their population dynamics and enable the design and implementation of better wildlife protection policies. (-) there could be costs associated with a management response to mitigate a threat(s)

7.2	Continue to work with stakeholders to review techniques and develop or enhance sampling protocols as necessary	(+) working with other governments, academia and other non-government groups for the conservation and protection of these species (+) increase knowledge exchange among stakeholders and regulators that promotes the design and implementation of better wildlife protection policies
7.3	Ongoing discussions and an annual meeting with DFO (and possibly other stakeholders) to discuss recovery progress and science and/or extension needs	(+) working with other governments, academia and other non-government groups for the conservation and protection of these species (+) increase knowledge exchange between stakeholders and regulators that promotes the design and implementation of better wildlife protection policies
7.3	Ongoing promotion of awareness and conservation of the three species at risk in the Milk and St. Mary river systems, including the development of extension materials if warranted.	(+) working with other governments, academia and other non-government groups for the conservation and protection of these species through various promotional materials (+) improve knowledge extension that promotes positive behaviours and cultural change in the consumption of ecosystem services (-) there could be costs associated with developing and publishing extension materials, although they could be shared with other vested stakeholders such as DFO

10.0 Effects on Other Species at Risk

This recovery plan for the Milk and St. Mary river systems at risk fish species has changed in its approach to meeting the goal of protecting and conserving these fish populations. Recovery actions are more focused on periodic but comprehensive population sampling (a minimum of once every five years) throughout the ranges of each species. Primary threats to these species have not changed; thus, emphasis will remain on working with water managers and regulators to protect fish and fish habitat as well as maintaining relationships with stakeholders to promote the conservation and protection of these species at risk.

In spring 2017, the Government of Canada added mountain sucker (*Catostomus platyrhynchus*) populations in the Milk River and Battle Creek watersheds (Designatable Unit 2) to Schedule 1 of the federal *Species at Risk Act* as *Threatened*. It is anticipated that actions recommended in this recovery plan will not negatively affect mountain sucker populations in the Milk River and Battle Creek populations (Cypress Hills). Alberta will work with DFO to ensure that resources are shared and appropriate data are collected to support the recovery of mountain sucker as well as that of western silvery minnow, stonecat and Rocky Mountain sculpin. Recovery planning and actions led by DFO could lead to positive results for stonecat, Rocky Mountain sculpin and western silvery minnow, as mountain sucker habitat overlaps with that of the three species in this plan.

11.0 Literature Cited

Alberta Environment. 2002. Frequently asked questions on the remediation and reclamation of soil and groundwater. Workshops were held June 18–19 and June 28–29, 2001, in Red Deer, AB. Alberta Environment, Edmonton, AB. Report No. SSB/LM/02-2, Publication No. I/915. 51 pp.

Alberta Environment. 2004. Alberta's submission to the International Joint Commission respecting a review of the IJC's 1921 order on the measurement and apportionment of the St. Mary and Milk rivers. Edmonton, AB. 33 p. Available online: https://open.alberta.ca/dataset/5e5d664a-e1ae-4530-bc84-f16c83fab499/resource/c3774aee-cc55-4b62-acfc-320ffe634772/download/2004-albertasubmissionijc-review-aug2004.pdf. [Accessed 04 November 2020].

Alberta Environment and Parks. 2016. Fish stocking operational policy. Unpublished internal document. 7 pp.

Alberta Rocky Mountain Sculpin Recovery Team. 2013. Alberta Rocky Mountain sculpin recovery plan: 2012–2022. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 27. Edmonton, AB. 61 pp.

Alberta Sustainable Resource Development (ASRD). 2003. Status of the western silvery minnow (*Hybognathus argyritis)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 47. Edmonton, AB. 24 pp.

Alberta Sustainable Resource Development (ASRD). 2004a. Status of the St. Mary shorthead sculpin (provisionally called *Cottus bairdi punctulatus)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 51. Edmonton, AB. 24 pp.

Alberta Sustainable Resource Development (ASRD). 2004b. Status of the stonecat (*Noturus flavus*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 52. Edmonton, AB. 22 pp.

AMEC Environment & Infrastructure. 2014. Water Storage Opportunities in the South Saskatchewan River Basin in Alberta. 105 pp. Available online: https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr15015/$file/ssrb-water-storage-main-report.pdf?OpenElement Accessed 04 November 2020.

Burr, B.M., and L.M. Page. 1986. Zoogeography of fishes of the lower Ohio–upper Mississippi Basin. Pp. 287–324 in Hocutt, C.H., and E.O. Wiley (eds.). The zoogeography of North American freshwater fishes. John Wiley & Sons, Toronto, Canada. 37 pp.

Clayton, T.B., and G.R. Ash. 1980. A fisheries overview study of the Milk River basin. Prepared for Alberta Environment, Planning Division, Edmonton, AB. by R.L. & L. Environmental Services Ltd., Edmonton, AB. 93 pp. + 5 app.

COSEWIC. 2005. COSEWIC assessment and status report on the “eastslope” sculpin (St. Mary and Milk river populations) *Cottus* sp. in Canada. Committee on the Status of Endangered Wildlife in Canada. Vi + 30 pp.

Dolan, L.S. 2007. Comments on "The St. Mary and Milk rivers: the 1921 order revisited" by R. Halliday and G. Faveri, Canadian Water Resources Journal 32(1):75–92. Canadian Water Resources Journal 32(4):335–338. Available online: https://www.tandfonline.com/doi/abs/10.4296/cwrj3204335 [Accessed 04 November 2020].

Fisheries and Oceans Canada. 2012. Recovery strategy for the Rocky Mountain sculpin (*Cottus* sp.), eastslope populations, in Canada. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa. x + 57 pp.

Fisheries and Oceans Canada. 2017a. Action plan for the Milk River and the St. Mary River drainage basins in Canada [Proposed]. *Species at Risk Act* Action Plan Series, Fisheries and Oceans Canada, Ottawa. iii + 22 pp.

Fisheries and Oceans Canada. 2017b. Amended recovery strategy for the western silvery minnow (*Hybognathus argyritis*) in Canada. *Species at Risk Act* Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa. viii + 48 pp.

International St. Mary–Milk Rivers Administrative Measures Task Force (ISMMRAMTF). 2006. Report to the International Joint Commission. 125 pp. Available online: http://www.ijc.org/rel/pdf/SMMRAM.pdf [Accessed 12 August 2017]

Klohn Crippen Consultants, Ltd.. 2003. Milk River Basin Preliminary Feasibility Study for Alberta Environment. Edmonton, Alberta. 569 pp.

Macnaughton, C.J., T. Rudolfsen, D.A. Watkinson, and E.C. Enders 2019. Standardized field sampling method for monitoring the occurrence and relative abundance of the Rocky Mountain Sculpin (Cottus sp.) in Canada. Can. Tech. Rep. Fish. Aquat. Sci. 3313: x + 54 p.

Macnaughton, C.J., T. Rudolfsen, D. A. Watkinson, and E. C.Enders. 2019. Standardized field sampling method for monitoring the distribution and relative abundance of the Western Silvery Minnow (Hybognathus argyritis) population in Canada. Can. Tech. Rep. Fish. Aquat. Sci. 3315: vii + 26 p.

Macnaughton, Camille & Watkinson, Douglas & Enders, Eva. 2020. Standardized field sampling method for monitoring the distribution and relative abundance of the Stonecat (*Noturus flavus*) Missouri population in Canada. Canadian Technical Report of Fisheries and Aquatic Sciences 3355 Canadian Technical Report of Fisheries and Aquatic Sciences https://waves-vagues.dfo-mpo.gc.ca/Library/4086683x.pdf. 10.13140/RG.2.2.22256.81929.

McLean, D.G., and G.R. Beckstead. 1980. Long term effects of a river diversion on the regime of the Milk River. Alberta Research Council, Edmonton, AB, Contribution No. 1054. 21 pp.

Milk River Fish Species at Risk Recovery Team (MRSRRT). 2008. Alberta western silvery minnow recovery plan, 2008–2013. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 16. Edmonton, AB. 54 pp.

Milk River Fish Species at Risk Recovery Team (MRSRRT). 2014. Alberta stonecat recovery plan 2013–2023. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 33. Edmonton, AB. 34 pp.

Milk River Watershed Council Canada (MRWCC). 2008. Milk River state of the watershed report 2008. Milk River Watershed Council Canada. Milk River, AB. 155 pp.

Milk River Watershed Council Canada (MRWCC). 2013. Milk River transboundary state of the watershed report, 2nd edition. Compiled by Palliser Environmental Services Ltd. and prepared for Milk River Watershed Council Canada (Alberta) in collaboration with the Milk River Watershed Alliance (Montana). Milk River, AB. 238 pp.

Milk River Watershed Council Canada (MRWCC). 2015. Milk River Watershed Management Plan. Compiled by Palliser Environmental Services for the Milk River Integrated Watershed Management Plan Team. Available Online: [Accessed 12 August 2020]. Milk River, AB. 117pp.

Montana Fish Wildlife and Parks, News release, November 09, 2016. Water samples positive for invasive mussel larvae in Tiber Reservoir. Available online: http://fwp.mt.gov/news/newsReleases/headlines/nr_4291.html [Accessed 04 November 2020].

MPE Engineering Ltd. 2016. Water Supply and Water Storage Mitigation Study. Town of Milk River, Alberta.33 pp.

Nelson, J.S., and M.J. Paetz. 1992. The fishes of Alberta. Second edition. The University of Alberta Press, Edmonton, AB. 437 pp.

Neufeld, K. 2016. Improving our ability to assess the impacts of hydrologic alteration on stream fishes: an interdisciplinary approach to assess the *Threatened* western silvery minnow *Hybognathus argyritis* in Canada. M.Sc. Thesis. University of Alberta, Edmonton, AB. 104 pp.

P & E Environmental Consultants Ltd. 2002. Fish species of concern survey on the Milk River. October 2002. Prepared for Alberta Sustainable Resource Development, Fish and Wildlife Division, Lethbridge and Alberta Conservation Association, Lethbridge. 12 pp. + app.

Paetz, M.J. 1993. A management plan for the St. Mary shorthead sculpin (*Cottus* sp.) in Alberta. Prepared for World Wildlife Fund Canada and Alberta Fish and Wildlife Division. 21 pp. + photo plates.

Peden, A.E. 2000. COSEWIC status report on the Columbia mottled sculpin *Cottus bairdi hubbsi* in Canada, in COSEWIC assessment and status report on the Columbia mottled *sculpin Cottus bairdi hubbsi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 57 pp.

Pflieger, W.L., and T.B. Grace. 1987. Changes in the fish fauna of the lower Missouri River. 1940–1983. Pp. 166–177 in Matthews, W., and D. Heins (eds.). Community and evolutionary ecology of North American stream fishes. University of Oklahoma Press, Norman, OK. 12 pp.

Halliday, R. and G. Faveri. 2007. The St. Mary and Milk Rivers: The 1921 Order Revisited, Canadian Water Resources Journal, 32:1(): 75-92. Available online: https://www.tandfonline.com/doi/abs/10.4296/cwrj3201075. [Accessed 04 November 2020].

R.L. & L. Environmental Services Ltd. 1987. An inventory of aquatic habitats and fish resources in the Milk River, Alberta. Prepared for Alberta Environment, Planning Division by R.L. & L. Environmental Services Ltd., Edmonton, AB. vi + 80 pp. + app.

R.L. & L. Environmental Services Ltd. 2002. Fish species at risk in the Milk and St. Mary drainages. Prepared for Alberta Sustainable Resource Development, Alberta Species at Risk Report No. 45. 82 pp. + app.

Rood, S.B. 2007. Comments on "The St. Mary and Milk rivers: the 1921 order revisited" by R. Halliday and G. Faveri, Canadian Water Resources Journal 32(1):75–92. Canadian Water Resources Journal 32(4):331–334.

Ruppert, J.L.W., P.M.A. James, E.B. Taylor, T. Rudolfsen, M. Veillard, C.S. Davis, D. Watkinson and M.S. Poesch. 2017. Riverscape genetic structure of a threatened and dispersal limited freshwater species, the Rocky Mountain sculpin (*Cottus* sp.). Conservation Genetics 18:925–937.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184. 966 pp.

Canada – Species at Risk Act, S.C. 2002, c. 29

Spitzer, M.O. 1988. Sediment data Milk River basin. Water Survey of Canada IWD-WNR (A)-WRB-SS-87-2. [Water Resources Branch Environment Canada, Edmonton]

Stewart, K., and D.A. Watkinson. 2004. The freshwater fishes of Manitoba. University of Manitoba Press, Winnipeg, MB. 276 pp.

Taylor, E.B., and J.L. Gow. 2008. Identification of species and evolutionary lineages in species-at-risk in Canada: DNA sequence variation in eastslope sculpin (*Cottus* sp.) and mountain suckers (*Catostomus platyrhynchus*). Unpublished report prepared by Department of Zoology, Biodiversity Research Centre and Native Fishes Research Group, University of British Columbia, Vancouver, BC for Department of Fisheries and Oceans, Winnipeg, MB. 25 pp.

U.S. Bureau of Reclamation. 2004. Regional feasibility report: North Central Montana. Montana Area Office, Billings, Montana. iv + 115 p.

Veillard, M.F. 2016. Investigating fine-scale movement patterns and comparative swimming performance of the newly identified and threatened Rocky Mountain sculpin (*Cottus* sp.) across its Canadian distribution. M.Sc. Thesis. University of Alberta, Edmonton, AB. 81 pp.

Water Survey of Canada (WSC). 2017. Archived hydrometric data, Milk River at Milk River (11AA005), monthly mean discharge, June 1909 to December 2015. Available online: https://wateroffice.ec.gc.ca/download/index_e.html?results_type=historical [Accessed 15 August 2017]

Willock, T.A. 1969. The ecology and zoogeography of fishes in the Missouri (Milk River) drainage of Alberta. M.Sc. Thesis, Carleton University, Ottawa, ON.

Personal Communications

Miller, K. Pers. Comm. Director, Milk River Watershed Council of Canada Board of Directors.

Petry, S., Pers. Comm. 2019. Seniors Fisheries Biologist, Fish and Wildlife Stewardship Branch, Alberta Environment and Parks.