Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

Central and Artic Region

Canadian Science Advisory Secretariat
Science Advisory Report 2013/063

RECOVERY POTENTIAL ASSESSMENT OF WESTERN SILVERY MINNOW (*Hybognathus argyritis*) IN CANADA

Western Silvery Minnow (Hybognathus argyritis) © *J.R. Tomelleri*

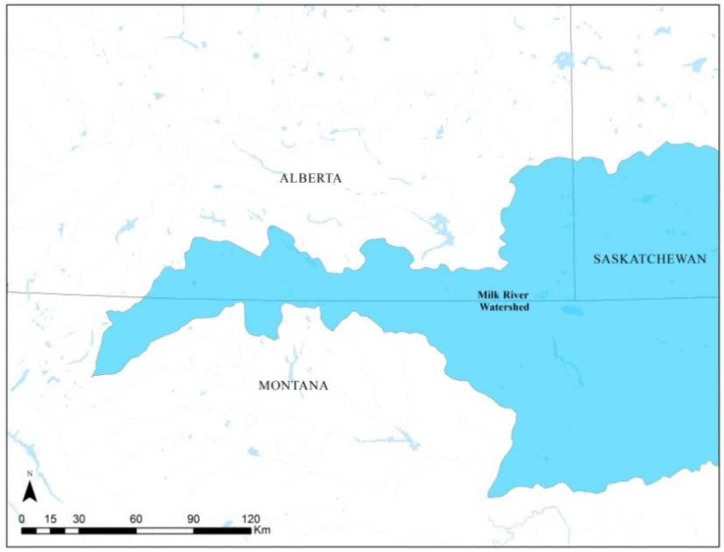

Figure 1. Shading delineates the Milk River watershed in Alberta, Saskatchewan and Montana. In Canada, Western Silvery Minnow is found only in Alberta.

Context:

*The Western Silvery Minnow is a small freshwater minnow found in the Milk River system of Alberta. In 2003, this species was listed as Threatened on Schedule 1 of Canada's Species at Risk Act (SARA). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) re-examined Western Silvery Minnow (*Hybognathus argyritis*) in April 2008 and designated it Endangered.*

A species Recovery Potential Assessment (RPA) was conducted by DFO Science to provide the information and scientific advice required to meet various requirements of the SARA and assess the recovery potential of Western Silvery Minnow in Canada. This Science Advisory Report is from the March 25-26, 2011, Recovery Potential Assessment of Western Silvery Minnow. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Western Silvery Minnow is known to occur in the Milk River system, in Alberta, a tributary of the Missouri River in Montana.
- In the Milk River system, adult Western Silvery Minnow inhabit small to large low-gradient rivers, with backwater areas, and shallow flat and run habitats. Little is known about overwintering habitat requirements. Spawning occurs in turbid, sediment-laden water of moderate flow.

- The abundance of this species in the Canadian portion of the Milk River generally increases (from Low to High) with distance downstream but population trend is Unknown, thus overall population status is currently Unknown.
- A Western Silvery Minnow population with persistence probability of about 0.01 over 100 years and extinction threshold of two adults, experiencing a 0.15 probability of catastrophic (≥ 50%) decline per generation, would require a Minimum Viable Population (MVP) of 12,000 adults and 25 ha of suitable habitat. Using an extinction threshold of 50 adults, would require a MVP of 236,000 adults and 497 ha of suitable habitat.
- In the absence of additional harm, recovery efforts or habitat limitations, it would take a growing Western Silvery Minnow population approximately nine years to reach the MVP of 12,000 adults if starting from a population of 1,200 adults.
- Western Silvery Minnow is particularly sensitive to perturbations to early life survival, and to fecundity of first time spawners, thus the best strategy for recovery is to improve survival of immature individuals.
- The greatest threats to the survival and persistence of Western Silvery Minnow in Alberta are those that alter the natural flow regime of the river causing habitat loss or impairment. Drought and anoxic conditions in combination with water regulation and extraction have the potential to significantly reduce the quantity and quality of minnow habitat.
- There remain numerous sources of uncertainty related to Western Silvery Minnow: life history and biological characteristics including population growth rate and abundance; habitat requirements, including the distribution and extent of suitable habitat, overwintering requirements, and spawning requirements; the frequency and magnitude of catastrophic events and true extinction thresholds; and an understanding of the environmental factors that limit their existence.

BACKGROUND

The Western Silvery Minnow is a small freshwater minnow of the genus *Hybognathus* that is restricted to the Milk River in southern Alberta (Figure 1). In 2003, this species was officially listed as Threatened under the *Species at Risk Act* (SARA) and similarly listed as Threatened under Alberta's *Wildlife Act*. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) re-examined Western Silvery Minnow in April 2008 and designated it Endangered.

This Recovery Potential Assessment (RPA) focuses on the Western Silvery Minnow in Canada, and is a summary of the peer-review meeting that occurred on March 25-26, 2011, in Lethbridge, Alberta. This Science Advisory Report summarizes the main conclusions and advice from the science peer review. Two research documents provide an in-depth account and the full list of references for information summarized in this report. One presents background information on the species biology, habitat preferences, current status, threats and mitigations and alternatives (Watkinson 2013), and the other presents information on allowable harm, population-based recovery targets, and habitat targets (Young and Koops 2013). The proceedings report summarizes the key discussions of the meeting (DFO 2013).

Taxonomy

The genus *Hybognathus* contains seven species in North America, of which four are found in Canada: the Western Silvery Minnow (*H. argyritis*), the Plains Minnow (*H. placitus*), the Eastern Silvery Minnow (*H. regius*) and the Brassy Minnow (*H. hankinsoni*).

Species Biology and Ecology

The Western Silvery Minnow is an elongated fish and is moderately laterally compressed. The average adult measures 90–130 mm total length. The head is bluntly triangular and short and the eyes are somewhat large in in comparison to other *Hybognathus* species in Canada. The origin of the dorsal fins is slightly in front of the pelvis fin origin and for the anal fins; the origin is behind the posterior margin of depressed dorsal; the pelvic fins originate slightly posterior to dorsal fin origin. Scales are cycloid, with a slightly decurved complete lateral line.

Western Silvery Minnow coloration is silvery and brownish-yellow dorsally. The lateral band is absent but dusky spots may be present. The pelvic and anal fin rays have no melanophores.

Based on the rivers that Western Silvery Minnow inhabit, this species appears to be very tolerant of high turbidity, high water temperatures (as high as 29.1°C have been recorded in the Milk River, AB), and low dissolved oxygen levels.

The Western Silvery Minnow has no direct economic importance but it is of scientific interest. It does have intrinsic value as a contributor to Canada's biodiversity. As a peripheral population at the northwestern limit of its distribution range, the Western Silvery Minnow in Alberta may be unique and provide evidence of local adaptation to their habitat, and genetic differentiation from other conspecific populations. This population may represent a significant component of the genetic diversity of the species.

Age, Growth, and Maturity

Little is known about the spawning biology of Western Silvery Minnow. During the breeding season, males have fine nuptial tubercles on the top of the head and nape, as well as on the medial side of the pectoral fin which is absent in females. They are pelagic broadcast spawners that produce non-adhesive, semi-buoyant eggs that remain in suspension as long as there is current. This species requires adequate flow in un-impounded stretches of river to passively disperse eggs to downstream habitats while they develop. Western Silvery Minnow collected in the Milk River at the end of May with water temperatures as high as 21.2°C had well-developed ovaries and had not begun spawning. Fecundities varied in accordance with size with the smallest mature female examined (81 mm fork length (FL) having 2,924 eggs and a large female (127 mm FL) having 19,573 eggs.

The Western Silvery Minnow lives to 5.5 years, with both sexes becoming sexually mature at age 2. Females are a minimum of 81 mm FL before becoming sexually mature. This species reaches a maximum size of about 140 mm FL.

Diet

The length of the intestine and the elaborate pharyngeal teeth structures, unique to *Hybognathus*, suggest an herbivorous or detritivorous diet.

ASSESSMENT

Historic and Current Distribution and Trends

The Western Silvery Minnow is found throughout the Missouri River basin in the United States and in the Mississippi River only downstream of the confluence of the Missouri River as far south as the confluence with the Ohio River. The distribution of this species has declined extensively in areas of the United States over the past century. In Canada, this species is known only from the Milk River, Alberta, a tributary of the Missouri River in Montana. As there are no barriers to movement in the Milk River within Canada, Western Silvery Minnow in the Milk River is considered to be one population.

The Milk River is a northern tributary of the Missouri-Mississippi Basin. It flows north from Montana into Alberta, eastward through the southern portion of the province, and then south back into Montana. From late March or early April through late September or mid-October water diverted from the St. Mary River in Montana augments flows in the Alberta portion of the North Milk and Milk rivers. 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. Upstream from its confluence with the North Milk River, to the Montana Border, surface flow in the Milk River occasionally stops from July or August until March resulting in isolated pools.

Western Silvery Minnow was first collected in Alberta in 1961 from the eastern portion of the Milk River. Sampling in the 2000s expanded its known distribution to include the lowermost 220 river km of the Milk River in Canada, likely as a result of improved sampling techniques and increased sampling effort rather than a recent change in the species' distribution (Figure 2). The Western Silvery Minnow has not been found in the North Milk River or the Milk River upstream of its confluence with the North Milk River, however sampling has not been conducted in all areas year round. Water diversion through the Saint Mary Canal since 1917 has significantly altered the flow regime in the North Milk and Milk rivers. It is not known whether this has altered their distribution. Western Silvery Minnow may occur in Saskatchewan.

The potential for re-colonization from upstream in the Milk River system is unlikely. Rescue effect may be possible from U.S. populations above the Fresno Reservoir.

Historic and Current Abundance and Trends

Overall abundance of Western Silvery Minnow was low in fall surveys of the Milk River conducted in 2000 and 2001. However, directed surveys completed by DFO in the Milk River in July 2005, May 2006, August 2006 and July 2007 found that Western Silvery Minnow was the second most abundant fish species collected downstream of the confluence of the North Milk and Milk rivers. Electrofishing surveys conducted yielded a catch-per-unit-effort (CPUE) value of 0.3 fish/minute and 35 seine hauls in Canadian waters yielded a CPUE of 36.3 fish/haul (see Watkinson 2013 for details). Numbers of Western Silvery Minnow in the Milk River generally increase with distance downstream, likely related at least in part to finer substrates and a lower gradient than farther upstream. No information is available on historic and current trends in abundance.

These data indicate that the Relative Abundance Index for Western Silvery Minnow in the Alberta portion of the Milk River ranges from Low to High (Table 1). As past and recent sampling was not conducted in a manner that allows for comparison, there is no information on trend for the population so Population Trajectory is Unknown. These ratings would result in a Population Status of Poor or Fair but a more accurate reflection of current knowledge is Unknown.

Table 1. Relative Abundance Index, Population Trajectory and Population Status of Western Silvery Minnow in Canada. The level of Certainty associated with the Relative Abundance Index and Population Trajectory rankings is based on quantitative analysis (1), CPUE or standardized sampling (2) or expert advice (3). Population Status results from an analysis of both the Relative Abundance Index and Population Trajectory. Certainty assigned to each Population Status is reflective of the lowest level of certainty associated with either initial parameter (Relative Abundance Index, or Population Trajectory).

Stock	Relative Abundance Index	Certainty	Population Trajectory	Certainty	Population Status	Certainty
Milk River	Low-High	3	Unknown	3	Unknown	3

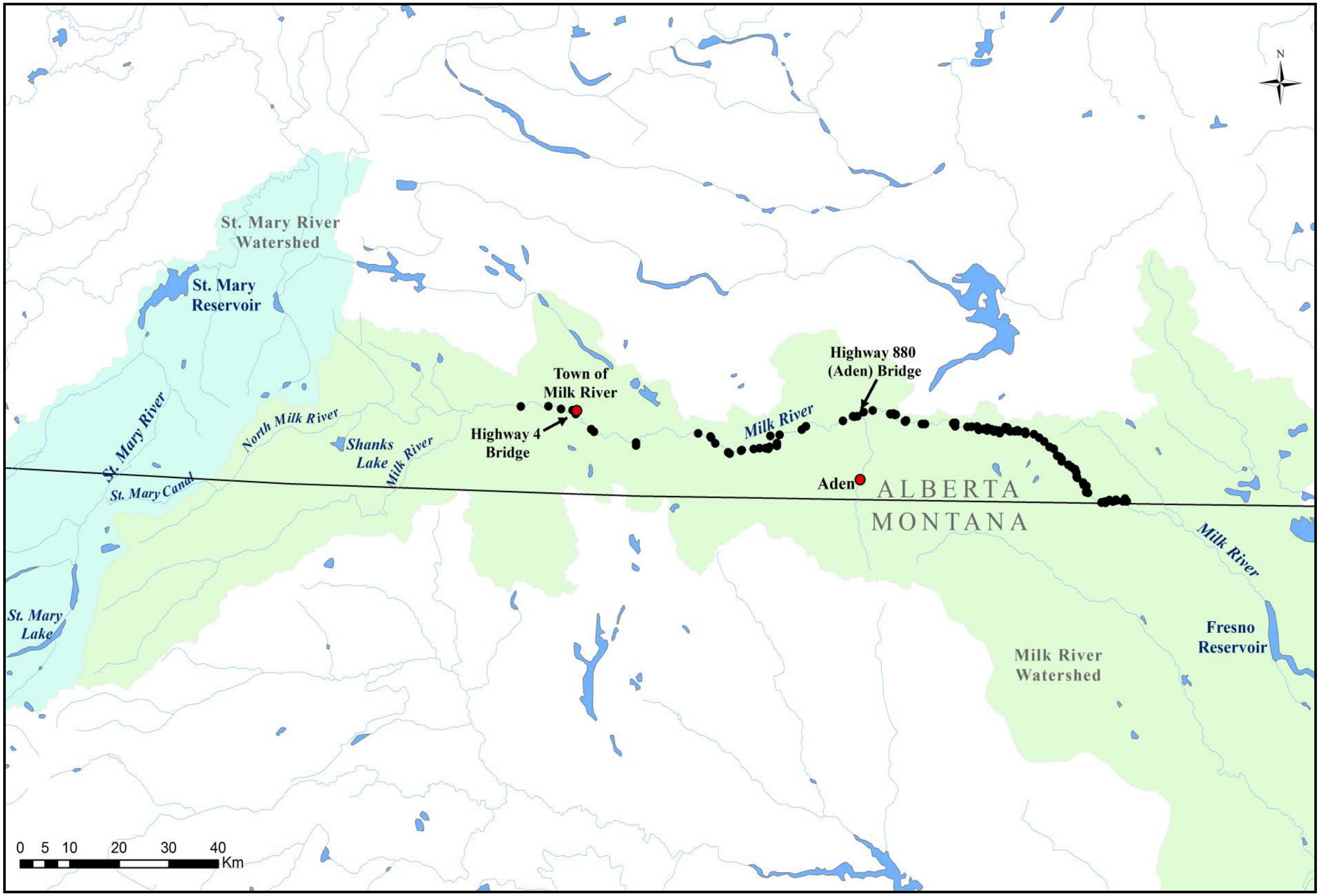

Figure 2. Distribution of Western Silvery Minnow in Canada.

Habitat requirements

Milk River

Habitat in the Milk River from the Montana border downstream to the confluence with the North Milk River is dominated by gravel with a moderate gradient. Surface flow in that portion of the Milk River occasionally dries up from July or August until March. In the 100 km of river downstream of its confluence with the North Milk River, the Milk River transitions to a system characterized by silt and sand substrate and a low gradient.

Spawning

The Western Silvery Minnow is thought to be a pelagic broadcast spawner that produces non-adhesive, semi-buoyant eggs that remain in suspension as long as there is current, based on information inferred from other *Hybognathus* species. *H. amarus* and *H. placitus* require significant stretches of connected habitat with turbid, sediment-laden water of moderate flow velocity for spawning. The distance that larvae are displaced, the habitat where displaced larvae are deposited, and their ability to move unimpeded to upstream reaches of sustained flow are important determinants of spawning success in these species. It has been hypothesized that in the Canadian portion of the Milk River adult Western Silvery Minnow spawn upstream (below the confluence), after which the eggs drift downstream and hatch. There are insufficient data currently available to test this hypothesis.

Young-of-the-Year (YOY) and Juveniles

In the Canadian portion of the Milk River nearly all young-of-the-Year (YOY) and juveniles were collected in the lower 82 river km. This reach is low gradient with backwater areas and is dominated by fine sediments. Fish were collected at sites with a mean depth of 0.2 m, a mean water velocity of 0.05 $m \cdot s^{-1}$, and a substrate dominated by silt (82%) and some sand (18%). The habitat requirements were similar to adult Western Silvery Minnows, selecting shallower and slower velocity habitats which have fine substrates.

Adults

Adult Western Silvery Minnow inhabit small to large low-gradient rivers, with backwater areas, and shallow flat and run habitats. In the Canadian portion of the Milk River the majority of adults were collected in the lower 82 river km at sites with a mean depth of 0.35 m, a mean water velocity of 0.20 $m \cdot s^{-1}$, and a substrate dominated by silt (51%) and sand (44%). The Milk River typically is turbid in spring and summer months. On the basis of available data, it is likely that Western Silvery Minnow requires highly-connected habitat (i.e., continuous river) more than 100 km in length to complete its life cycle.

Overwintering

There is little known about the characteristics or availability of overwintering habitat for the Western Silvery Minnow in the Milk River. When diversion of water from the St. Mary River ends in the fall, the river reverts back to its natural flow conditions until spring. In normal years, flow is maintained within a reduced channel. Under severe drought conditions, the river may be reduced to a series of isolated pools suggesting that these may be important to the species survival. Alternatively, the species may seek refuge in areas where flowing water is still available.

Residence

The SARA 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". Residence is interpreted by DFO as being a constructed place (e.g., a spawning redd). The Western Silvery Minnow does not change its physical environment or invest in a structure during any part of its life cycle; therefore no biological feature of this species meets the SARA definition of residence as interpreted by DFO.

Allowable Harm

Allowable harm was assessed in a demographic framework with the assessment involving perturbation analyses of population projection matrices and including a stochastic element. Outputs of the analyses included calculation of a population growth rate and its sensitivity to changes in vital rates. (See Young and Koops (2013) for complete details of the model and results.) Based on the mean vital rates, the population growth rate of Western Silvery Minnow was estimated to be λ = 2.3. Modelling indicated that population growth of this species is sensitive to perturbations of both survival in the first and second years (s_1 and s_2, Figure 3) and fecundity of first time spawners (f_2, Figure 3). Uncertainty in sensitivity is driven primarily by uncertainty in the estimate of juvenile survival. Maximum allowable harm should be limited to 60% in juvenile survival (ages 0 and 1) or 50% in survival of all ages. If human activities are such that harm exceeds just one of these thresholds, the future survival and recovery of individual populations is likely to be compromised. In addition, any level of harm will delay time to recovery. It is possible that the population growth rate for Western Silvery Minnow was overestimated; allowable harms should be reduced considerably if new evidence suggests a population growth rate below 2.3. For example, if catastrophic decline occurs every two years (due to drought, or some other factor), allowable harms for survival of juveniles or of all ages is reduced to 45% and 37%, respectively. Scientific research to advance the knowledge of population data should be allowed.

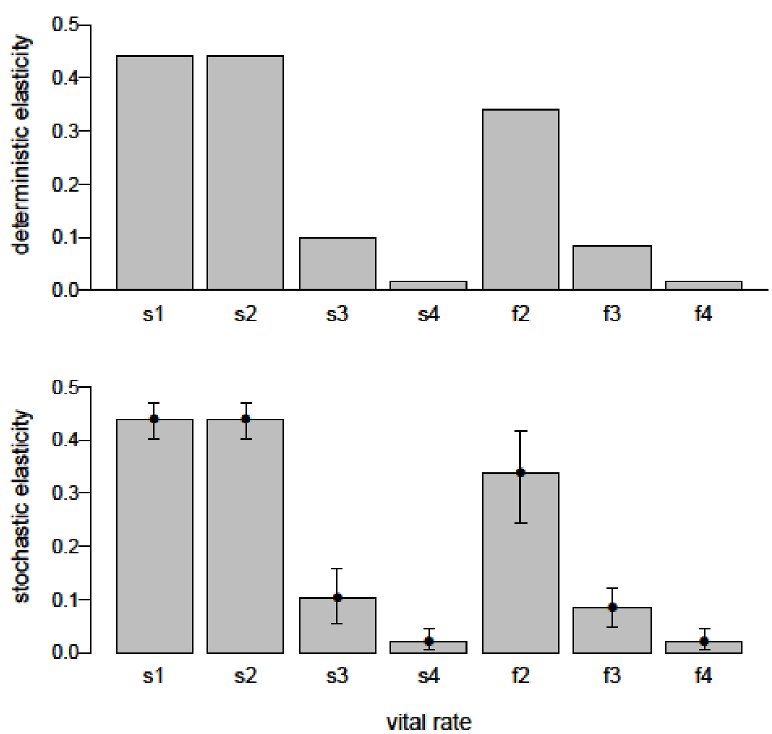

Figure 3. Results of the deterministic and stochastic perturbation analysis showing elasticities (ε_v) of the vital rates: annual survival probability of age j-1 to age j (s_i) and fertility (f). Stochastic results include associated bootstrapped 95% confidence intervals.

Recovery Targets

Recovery Targets and Times

Demographic sustainability was used as a criterion to set recovery targets for Western Silvery Minnow (Young and Koops 2013). Demographic sustainability is related to the concept of a minimum viable population (MVP), and was defined as the minimum adult population size that results in a desired probability of persistence over 100 years (approximately 77 generations of Western Silvery Minnow). MVP targets were chosen to optimize the benefit of reduced extinction risk and the cost of increased recovery effort, and resulted in a persistence probability of approximately 99% over 100 years. Catastrophic decline in population size, defined as a 50% reduction in abundance, was incorporated into the simulations, and assumed that the chance of catastrophic decline was 10% or 15% per generation.

When the extinction threshold was assumed to be two adults (one male and one female) and the probability of catastrophic decline was assumed to be 10% per generation, simulations indicated that MVP for Western Silvery Minnow was 1,800 adults aged 2-4 (range: 1,500-2,600 adults). If catastrophes occurred at 15% per generation (~6% annually), MVP was 12,000 adults (range: 7,000-21,600). In both scenarios, the probability of extinction for the respective MVPs were approximately 0.01 over 100 years (Figure 4). When the simulations assume an extinction threshold of 20 or 50 adults and the chance of catastrophe is 15% per generation, MVPs increase to 86,000 or 236,000 adults, respectively.

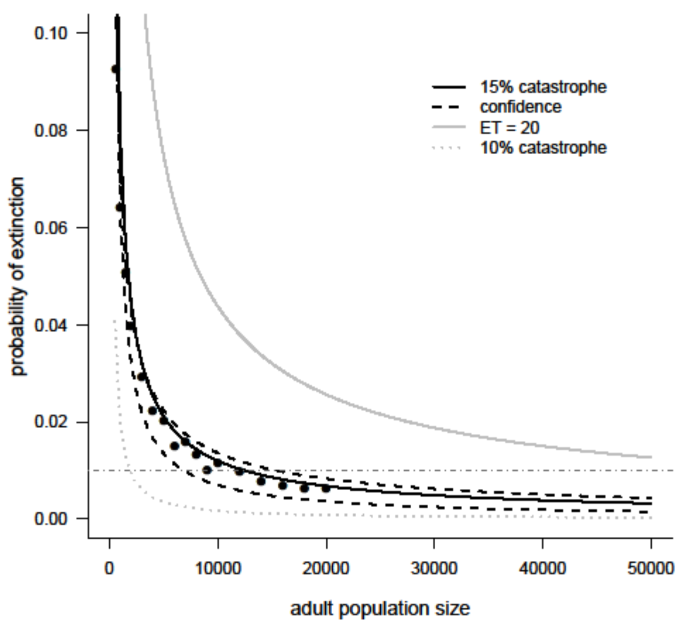

Figure 4. Probability of extinction within 100 years of 10 simulated Western Silvery Minnow populations, at equilibrium, as a function of population size. Black curves assume a 15% probability of catastrophic decline (solid = mean, dotted = max and min of 10 runs), and an extinction threshold of two adults. Grey curves represent a 10% probability of catastrophe (dotted) or a 15% probability of catastrophe and an extinction threshold of 20 adults (solid). Dashed horizontal reference line is at 0.01 and intersects curves at the associated MVPs.

Based on a population growth rate of 1.7 (assuming bi-annual catastrophic events) and in the absence of recovery efforts, additional harm or habitat restrictions a Western Silvery Minnow population was predicted to increase from ~1,200 adults to the MVP target of 12,000 adults in approximately nine years. Simulated recovery strategies decreased recovery times as much as three years. The most effective simulated strategy was an improvement to survival of immature individuals. Conversely, the time to recovery increased exponentially as harm was added to vital rates (Figure 5).

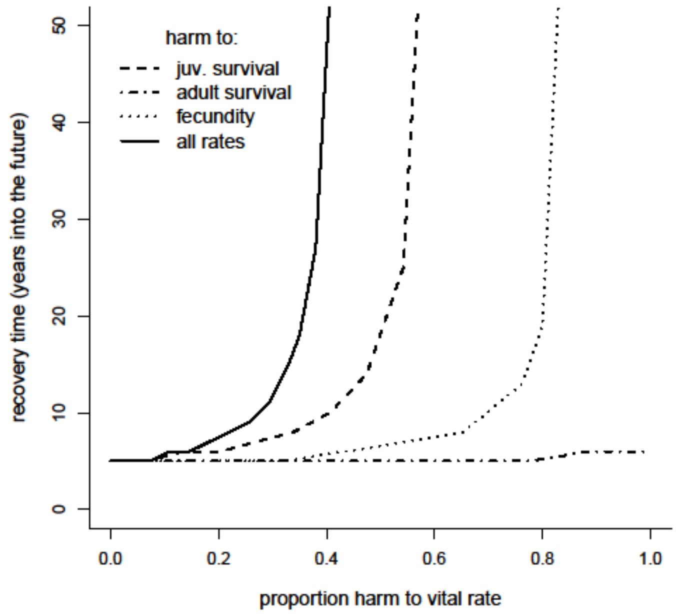

Figure 5. Predicted change in the time to 95% chance of recovery of a Western Silvery Minnow population that is experiencing increased harm to juvenile survival ($s_{1,2}$), adult survival ($s_{3,4}$), fecundity (f), or all vital rates simultaneously. Recovery times are shown as a function of the proportion reduction to each vital rate(s).

Minimum Area for Population Viability

Minimum area for population viability (MAPV) is a quantification of the amount of habitat required to support a viable population. Variables included in the MAPV assessment include MVP values and area required per individual (API values). API values were estimated from an allometry for river environments from freshwater fishes. An MAPV was estimated for each life stage and then an MAPV for the entire population was estimated by summing across all life stages. The stable stage distribution for Western Silvery Minnow is 99.81% YOY, 0.14% age-1, and 0.04% adult individuals (ages 2-4). With a target MVP of 12,000 (extinction threshold: two adults) or 236,000 adults (50 adults), under a 15% probability of catastrophe per generation, MAPV was 25.3 ha or 497.3 ha of suitable habitat, respectively. A population at the target size with this amount of suitable habitat had a 98% probability of persistence over 100 years. This is only slightly lower than the 99% probability of persistence observed in simulations that did not include habitat restrictions or density dependence. If the quality or quantity of resources was reduced below the minimum level, however, the risk of extinction increased exponentially (Figure 6). Using an average stream discharge of 20 $m^3 \cdot s^{-1}$ as a measure of suitable habitat there is approximately 700 ha of available habitat for Western Silvery Minnow in the Canadian portion of the Milk River system. During winter, when discharge rates are lower, this species is likely restricted to small pools. Note the MAPV estimates assume the required habitat per individual, not taking into account any overlapping of individual habitats (sharing) that may occur. In addition to this minimum area, Western Silvery Minnow likely require a minimum length of open river (unfragmented) for spawning.

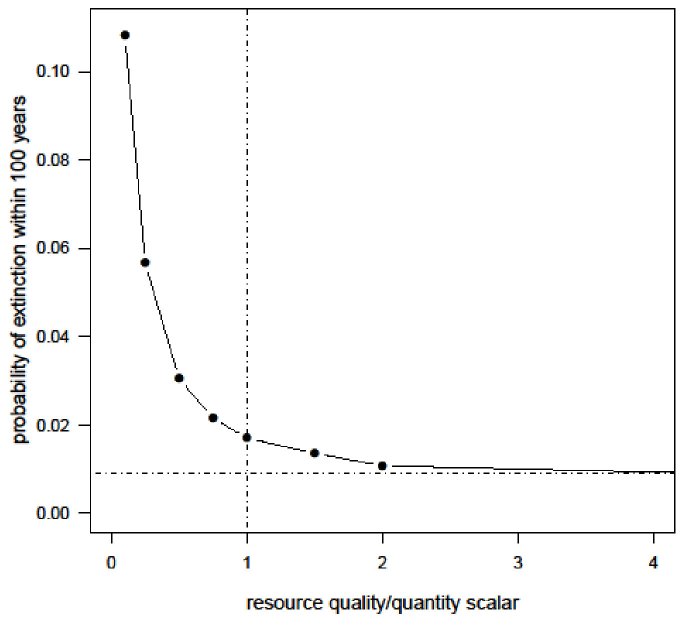

Figure 6. Probability of extinction within 100 years of 10 simulated Western Silvery Minnow populations at minimum viable population (MVP) size, and experiencing resource based density dependence, as a function of a resource availability or quality scalar. Simulations assume a 15% chance of catastrophe. Dashed reference lines show the probability of extinction in the absence of resource restrictions (0.01, horizontal), and the minimum resource quality/quantity (example: Minimum Area for Population Viability, MAPV; vertical).

Threats

A number of threats to the Western Silvery Minnow have been identified throughout its range, including those believed to be responsible for its extirpation from some systems. The most significant threats may be those that alter the natural flow regime of a river causing habitat loss or impairment. Such threats may include water removal (e.g., for irrigation and domestic use), impoundment, bank stabilization, channelization, changes in geomorphology and flow augmentation. Habitat alterations, particularly the reduction in seasonal fluctuations in discharge and declines in turbidity related to channelization and impoundment, have been correlated with the decline of the Western Silvery Minnow in the lower Missouri River. Other threats to the species' habitat and survival include species introductions, drought, anoxia, climate change, contaminants and toxic substances, and degradation of riparian areas. Some of the above threats may also act indirectly by altering faunal communities (e.g., species introduction) which in turn threaten the minnow's existence.

To assess the status of threats with respect to Western Silvery Minnow in the Milk River below the confluence, each threat was ranked in terms of its Threat Likelihood and Threat Impact. It is important to note that threats may not always act independently. One threat may directly affect another or the interaction between two threats may introduce an interaction effect. As it is quite difficult to quantify these interactions, each threat is evaluated independently. The Threat Likelihood and Threat Impact ratings were subsequently combined in the Threat Level Matrix resulting in the final Threat Level (Table 2). The Spatial Extent of each threat was categorized as Widespread or Local and the Temporal Extent as either Chronic or Ephemeral (Table 3). (See Watkinson 2013 for definitions of threats-related terms and a description of each threat and its potential impacts on Western Silvery Minnow.)

Table 2. The Threat Level for Western Silvery Minnow in Canada, resulting from an analysis of both the Threat Likelihood and Threat Impact. H=high, M=medium, L=low, UK=unknown.

Threats	Milk River below the confluence
Changes in flow (diversion)	H
Anoxia	H
Drought	H
Fish species introductions	L / M / H
Groundwater extraction	L / M / H
Surface water extraction: non-irrigation	L / M / H
Point source contamination	L / M / H
Non-point source contamination	L / M / H
Changes in habitat quality and availability	L / M
Changes in geomorphology	L / M
Surface water extraction: irrigation	L
Livestock use of flood plain	L
Scientific sampling	L
Dam construction and operation	UK

Table 3. Overall effect of threats on Western Silvery Minnow in Canada.

Threat	Spatial Extent	Temporal Extent
Changes in flow (diversion)	Widespread	Chronic
Anoxia	Widespread	Chronic
Drought	Widespread	Ephemeral
Fish species introductions	Widespread	Chronic
Groundwater extraction	Widespread	Chronic
Surface water extraction: non-irrigation	Widespread	Chronic
Point source contamination	Widespread	Ephemeral
Non-point source contamination	Widespread	Chronic
Changes in habitat quality and availability	Widespread	Chronic
Changes in geomorphology	Widespread	Chronic
Surface water extraction: irrigation	Local	Chronic
Livestock use of flood plain	Local	Chronic
Scientific sampling	Local	Ephemeral
Dam construction and operation	Unknown[1]	Unknown[2]

[1] Should this threat occur, its spatial extent would likely be widespread.
[2] Should this threat occur, its temporal extent would likely be chronic.

Mitigations and Alternatives

Habitat Loss/Degradation

Numerous threats affecting Western Silvery Minnow are related to habitat loss or degradation. Habitat-related threats have been linked to the Pathways of Effects developed by DFO Fish Habitat Management (FHM) (Table 4). Guidance on generic mitigation measures have been developed for 19 Pathways of Effects for the protection of aquatic species at risk in DFO's

Central and Arctic Region (Coker et al. 2010), some of which are relevant for the Milk River watershed. These mitigation measures should be referred to when considering mitigation and alternative strategies for habitat-related threats. They were developed to mitigate, limit or minimize threats, however since they were not developed to specifically consider species at risk so they may need to be modified for this purpose. Additionally, site-specific mitigations may be warranted and should be discussed with local conservation managers.

Contaminants and Toxic Substances

The DFO mitigation guide (Coker et al. 2010) also provides guidance on generic mitigation measures for Pathways of Effects related to contaminants and toxic substances from point and non-point sources. Table 3 shows the relevant Pathways of Effects for Western Silvery Minnow. These measures combined with legislative control/licensing at the provincial and federal levels, public education and developing plans to contain and clean up spills and other releases of pollutants have the potential to mitigate this threat. Alternative measures, such as reductions in pesticides, are market driven.

Table 4. Threats to Western Silvery Minnow in Canada and the Pathways of Effects associated with each threat as per Coker et al. 2010. 1 – Vegetation clearing; 2 – Grading; 3 – Excavation; 4 – Use of explosives; 5 – Use of industrial equipment; 6 – Cleaning or maintenance of bridges or other structures; 7 – Riparian planting; 8 – Streamside livestock grazing; 9 – Marine seismic surveys; 10 – Placement of material or structures in water; 11 – Dredging; 12 – Water extraction; 13 – Organic debris management; 14 – Wastewater management; 15 – Addition or removal of aquatic vegetation; 16 – Change in timing, duration and frequency of flow; 17 – Fish passage issues; 18 – Structure removal; 19 – Placement of marine finfish aquaculture site.

Threats	Pathways of Effects
Changes in flow	10, 16, 17
Surface water extraction: irrigation and non-irrigation	12, 16
Groundwater extraction	12, 16
Livestock use of flood plain	1, 8, 13
Dam construction and operation	1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 18
Non-point source contamination	1, 4, 7, 8, 11, 12, 13, 15, 16, 18
Point source contamination	1, 4, 5, 6, 7, 11, 12, 13, 14, 15, 16, 18

Pathways of Effects were not developed for species introductions or other threats like scientific sampling so the following specific mitigation measures and alternatives are provided for those types of threats.

Fish Species Introductions

Non-native fish species introductions and establishment could have negative effects on Western Silvery Minnow.

Mitigation

- Physically remove non-native species from areas known to be inhabited by Western Silvery Minnow.
- Monitor watersheds for exotic species that may negatively affect Western Silvery Minnow directly, or negatively affect their preferred habitat.

- Coordinate with Montana/U.S. agencies to evaluate all introductions of exotic species in the Milk River system.
- Develop a plan to address potential risks, impacts, and proposed actions if monitoring detects the arrival or establishment of an exotic species.
- Introduce a public awareness campaign and encourage the use of existing exotic species reporting systems.

Alternatives

- There are no alternatives to unauthorized introductions.
- When introduced species is authorized, use only native species of the same genetic stock.
- When introduced species is authorized, follow the National Code on Introductions and Transfers of Aquatic Organisms for all aquatic organism introductions (DFO 2003).

Scientific Sampling

Targeted and incidental harvest of Western Silvery Minnow may occur while undertaking scientific sampling. It was recognized as a low risk threat.

Mitigation

- Non-lethal sampling
- Sampling under a SARA permit

Sources of Uncertainty

The conservation or recovery of Western Silvery Minnow is hindered by lack of information on the species' life history and biology, including vital rates, reproductive strategy, population structure, movements and early life stages, as well as habitat requirements. In the Milk River, knowledge is needed of the specific habitat requirements of this species for overwintering, spawning, and the eggs and fry. No reliable estimates of abundance or trend are currently available for Western Silvery Minnow in the Milk River. Some potential threats cannot be fully evaluated because detailed information on the stressors and the mechanisms by which they might affect the minnow are not well understood. To accurately predict the effects of impoundment, for example, requires better knowledge of how changes in the physical conditions of the river, such as an altered flow regime, may interact with the species given its life history and habitat requirements. Further study of these relationships is warranted. Knowledge of the frequency and magnitude of catastrophic events and true extinction thresholds of Western Silvery Minnow in Alberta are needed for population modelling to assess allowable harm, determine population-based recovery targets and conduct long-term projections of population recovery.

OTHER CONSIDERATIONS

The 1909 Boundary Waters Treaty (the Treaty), which is administered by the International Joint Commission (IJC), provides principles for Canada and the United States to follow for the management of shared waters including the St. Mary and Milk rivers (ISMMRAMTF 2006; see also Dolan 2007; Halliday and Faveri 2007a,b; Rood 2007). In 1917, the United States constructed a canal to divert water from the St. Mary River in northwestern Montana through the Milk River system, across southern Alberta, to northeastern Montana for irrigation. An average of about 2.08 x 10^8 m^3 of water has flowed annually through the St. Mary Canal into the North Milk River over the past two decades (U.S. Bureau of Reclamation 2004). In 2003, Montana requested that the treaty be re-opened to reconsider how the diverted water is apportioned.

However, at the time of writing, this issue had not yet been resolved. At present the operating capacity of the St. Mary Canal is about 18.4 $m^3 \cdot s^{-1}$, significantly less than its original design capacity of 24.1 $m^3 \cdot s^{-1}$. Montana is considering whether to rehabilitate the aging canal infrastructure and return the canal to its original capacity, or whether to increase its capacity to 28.3 $m^3 \cdot s^{-1}$.

Additionally, there may be implications of species introductions by U.S. jurisdictions to Western Silvery Minnow in Canadian waters as there is no joint agreement currently in place between Alberta and Montana regarding species introductions in the Milk River.

SOURCES OF INFORMATION

This Science Advisory Report is from the March 25-26, 2011, Recovery Potential Assessment of Western Silvery Minnow. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Coker, G.A., Ming, D.L., and Mandrak, N.E. 2010. Mitigation guide for the protection of fishes and fish habitat to accompany the species at risk recovery potential assessments conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904. vi + 40 p.

COSEWIC. 2008. COSEWIC assessment and update status report on the Western Silvery Minnow *Hybognathus argyritis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 38 p.

DFO. 2003. National code on introductions and transfers of aquatic organisms. Ottawa, ON. 53 p.

DFO. 2013. Proceedings of the recovery potential assessment of Western Silvery Minnow (*Hybognathus argyritis*); March 23-24, 2011. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2013/036.

Watkinson, D.A. 2013. Information in support of a Recovery Potential Assessment of Western Silvery Minnow (*Hybognathus argyritis*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/083. iv + 23 p.

Young, J.A.M., and Koops, M.A. 2013. Recovery potential modelling of Western Silvery Minnow (*Hybognathus argyritis*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/084. iv + 18 p.

THIS REPORT IS AVAILABLE FROM THE:

Centre for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB
R3T 2N6

Telephone: (204) 983-5131
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

Correct Citation for this Publication:

DFO. 2013. Recovery potential assessment of Western Silvery Minnow (*Hybognathus argyritis*) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/063.

Aussi disponible en français :

MPO. 2013. Évaluation du potentiel de rétablissement du méné d'argent de l'Ouest (Hybognathus argyritis) au Canada. Secr. can. de consult. sci. du MPO, Avis sci. 2013/063.