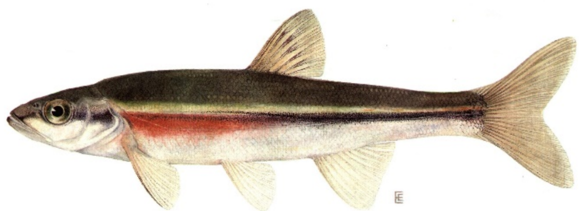
Fisheries and Oceans Canada / Pêches et Océans Canada
Ecosystems and Oceans Science / Sciences des écosystèmes et des océans

Central and Arctic Region

Canadian Science Advisory Secretariat
Science Advisory Report 2019/012

RECOVERY POTENTIAL ASSESSMENT OF REDSIDE DACE (*CLINOSTOMUS ELONGATUS*) IN CANADA



Redside Dace (Clinostomus elongatus). Illustration by © Ellen Edmonson, NYSDEC

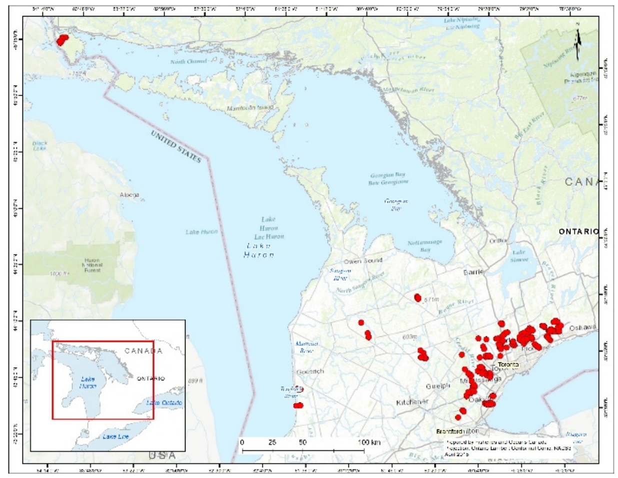


*Figure 1. Distribution of Redside Dace (*Clinostomus elongates*) in Canada.*

Context:

*In April 1987, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Redside Dace (*Clinostomus elongatus*) as Special Concern, and this status was re-assessed as Endangered in April 2007. A re-assessment by COSEWIC in November 2017 kept the species designation as Endangered. The reason given for this designation was "this small, colourful minnow is highly susceptible to changes in stream flow and declines in water quality, such as those that occur in urban and agricultural watersheds. The Canadian range of this species largely overlaps with the Greater Toronto Area (GTA), where urban land use is widespread and projected to increase in the future. The continued expansion of the GTA has led to ongoing habitat degradation, causing serious declines in range and number of individuals and populations" (COSEWIC 2017). In May 2017, Redside Dace was listed as Endangered under the *Species at Risk Act *(SARA).*

A species Recovery Potential Assessment (RPA) process has been developed by Fisheries and Oceans Canada (DFO) Science to provide the information and scientific advice required to meet the various requirements of the SARA, such as the authorization to carry out activities that would otherwise violate the SARA as well as the development of recovery strategies. The scientific information also serves as advice to the Minister of DFO regarding the listing of the species under SARA and is used when analyzing the socio-economic impacts of adding the species to the list as well as during subsequent consultations, where applicable. This assessment considers the scientific data available with which to assess the recovery potential of Redside Dace in Canada.

SUMMARY

- Historically, Redside Dace was found in 25 watersheds but has since been extirpated from nine (Pringle Creek, Petticoat Creek, Highland Creek, Mimico Creek, Etobicoke Creek, Clarkson Creek, Morrison Creek, Wedgewood Creek, and Welland Canal) and may be extirpated from 3 more drainages (Don River, Spencer Creek, Irvine Creek). Population status is poor for 9 other watersheds (Lynde Creek, Duffins Creek, Rouge River, Credit River, Sixteen Mile Creek, Bronte Creek, Holland River, Gully Creek, Saugeen River).
- The species prefers cool, clear streams and adults are found in pool and riffle habitats over a variety of substrates but most commonly gravel. Important habitat features include overhanging riparian vegetation (grasses, forbs, and shrubs), meander belt, and in-stream structures such as boulders and woody debris.
- To achieve 99% probability of persistence, given a 15% chance of catastrophic decline (50% reduction in abundance) per generation, the minimum viable population (MVP) ranged from ~18,000 adults to ~75,000 adults depending on the meta-population structure that exists as well as the MVP simulation criteria. The minimum area required to support an MVP population size (MAPV) ranged from ~3.2 ha for a population with 4 sub-populations affected by catastrophes independently to ~13 ha for a population where the entire population was impacted by catastrophes simultaneously.
- The greatest threats to the survival and persistence of Redside Dace in Canada are residential/commercial development, intensive agricultural practices, pollution, natural systems modification, and introduced species (i.e., Brown Trout [*Salmo trutta*], Rainbow Trout [*Oncorhynchus mykiss*]). Lesser threats that may be affecting the survival of the species include human intrusion and biological resource use such as bait harvesting.
- The dynamics of Redside Dace populations are particularly sensitive to perturbations that affect survival of immature individuals (from hatch to age-2) and population-level fecundity. Harm to these portions of the life cycle should be minimized to avoid jeopardizing the survival and future recovery of Canadian populations.
- Sources of uncertainty include knowledge gaps in distribution, abundance, biology, and threats. Further research is required to address the key factors associated with urban development and agriculture that cause declines, the impacts of introduced species, and climate change effects.

BACKGROUND

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that Redside Dace (*Clinostomus elongatus*) be designated as a species of Special Concern in April 1987. This status was re-assessed as Endangered in April 2007 due to its sensitivity to stream alterations that affect flow rate, increase water temperatures, and siltation. In May 2017, Redside Dace was listed as Endangered on Schedule 1 of Canada's *Species at Risk Act* (SARA). A second re-assessment by COSEWIC in November 2017 reconfirmed that Redside Dace should have an Endangered designation. This was deemed an appropriate designation as Canada's Redside Dace population largely overlaps the Greater Toronto Area (GTA) where urban development continues to impact water quality and flow regimes. When COSEWIC designates an aquatic species as Threatened or Endangered and the Governor in Council decides to list it, the Minister of Fisheries and Oceans Canada (DFO) is required by SARA to undertake a number of actions. Many of these actions require scientific information such as the current status of the population, the threats to its survival and recovery, and the feasibility of its recovery. This scientific advice is developed through a Recovery Potential Assessment (RPA). This allows for the consideration of peer-reviewed scientific analyses in subsequent SARA processes, including permitting on harm and recovery planning. This RPA focuses on Redside Dace in Canada and is a summary of the conclusions and advice from a Canadian Science Advisory Secretariat peer-review meeting that occurred on 21-22 February 2018 in Burlington, Ontario. Two research documents, one providing background information on the species' biology, habitat preferences, current status, threats and mitigations and alternatives (Lebrun et al. 2019), and a second on allowable harm, population-based recovery, and habitat targets (van der Lee et al. 2019) provide an in-depth account of the information summarized below. Proceedings that document the key discussions of the meeting are also available (DFO 2019).

Species Description and Identification

Redside Dace is a colourful member of the minnow (Cyprinidae) family that reaches a maximum total length of 12 cm. The body shape is very slender, elongated, and laterally compressed. Individuals are known to have relatively short lifespans. Adults only live around 3-4 years with maturation occurring between the ages of 2-3. Redside Dace grows quickly, achieving 50% of its total growth within the first year, with females growing faster and reaching a larger size than males. The species is easily identifiable due to its extremely large, upturned mouth coupled with a distinctly protruding lower jaw. It also displays a recognizable colouration during the breeding season. Males, in particular, will display a distinctive bright red or orange band that extends along the front half of the body. A vivid yellow or gold stripe spanning the fish's entire body runs above the red band while the back of the fish is generally dark green. Throughout the year, adults generally maintain their vibrant hue showing iridescent colouration ranging from blue to green.

ASSESSMENT

Current Species Status

Sampling has been adequate in most watersheds to qualitatively identify trends in Redside Dace abundance. Many historical records from 1946 to 1959 were a result of extensive surveys by the Ontario Department of Planning and Development (ODPD) using seine nets and traps. Since 1979, targeted surveys have been conducted at new and historical sites by various agencies including the Ontario Ministry of Natural Resources and Forestry (OMNRF), Royal Ontario Museum (ROM), various conservation authorities, DFO, and Ontario Streams to evaluate the distribution and abundance of Redside Dace in Ontario. There are a total of 1,128 historic and current records of Redside Dace in Canada.

Lake Ontario Drainage

Pringle Creek

Redside Dace has not been collected from Pringle Creek since 1959 despite sampling attempts in 1985 and 1999. It is presumed to be extirpated from this tributary (COSEWIC 2017).

Lynde Creek

Redside Dace was first reported in Lynde Creek in 1959 when it was captured at five sites in the upper half of the east and west branches. However, intensive sampling in 1999 and 2001 detected Redside Dace at only one of the five historical sites. More recent surveys in 2009 and 2014 captured seven Redside Dace at a new site in the lower west branch and four Redside Dace at a historical site where 13 individuals were caught in 2001. Despite being found at new sites in the west branch at that time, the Redside Dace population underwent a range contraction in the east branch. In July of 2014 a major fish kill was observed in the west branch of the creek as a result of an agricultural spill. The spill, a combination of manure and a dairy cleaning agent, occurred just upstream of Watson's Glen Golf Course leading to a reduction of pH and dissolved oxygen for a 21 km-long portion of the stream. No dead Redside Dace were recovered but it was assumed that the majority of fish in the affected area were killed. Recent electrofishing surveys from 2014 to 2017 failed to detect any Redside Dace at 20 sites on Lynde Creek (COSEWIC 2017).

Carruthers Creek

Redside Dace was first reported in Carruthers Creek in 1978 and was subsequently caught at two sites 10 km upstream in 2001. Redside Dace continues to be found at new sites in relatively high numbers throughout Carruthers Creek. For example, extensive sampling from 2009-2015 resulted in the capture of 159 Redside Dace at five new sites and one historical site. At one of these sites a total of 56 specimens were caught in 2014. More recently, seven specimens were collected in 2016 at site upstream of Highway 7 (COSEWIC 2017).

Duffins Creek

Redside Dace has been recently collected in three tributaries of Duffins Creek: Mitchell Creek (2012), Brougham Creek (2009) and Ganatsekiagon Creek (2015). A total of 58 individuals were caught at two sites in Mitchell Creek during four sampling events from 2012-2015. In addition, sampling in 2015 yielded a total of 46 specimens at six sites throughout Ganatsekiagon Creek. Despite being found at new sites, Redside Dace has not been reported from the main channel of Duffins Creek and two other tributaries (Reesor Creek and Urfe Creek) since 1979 and 1954 respectively. As a result, it is presumed extirpated from these parts of Duffins Creek. This Redside Dace population is believed to range from 1,207 to 2,398 individuals. This is below the minimum viable population (18,226 – 74,687 individuals depending on meta-population structure and a 15% chance of catastrophic decline) estimated by van der Lee et al. (2019). Based on consensus at the Recovery Potential Assessment meeting, it is predicted that the development of a major airport in Pickering in the future may be detrimental to this population.

Petticoat Creek

Redside Dace has not been reported from Petticoat Creek since 1954, despite sampling attempts in 1975, 2003, 2005, 2010, 2013, and 2016. The lack of reports of Redside Dace over a 60-year period suggests that it is extirpated from Petticoat Creek (COSEWIC 2017).

Highland Creek

Redside Dace has not been collected from Highland Creek since 1952, despite five sampling attempts in recent years (2008, 2010, 2011, 2014, and 2015) and is presumed to be extirpated from this system (COSEWIC 2017).

Rouge River

Recent sampling (2006-2014) has continued to detect Redside Dace throughout the Rouge River in relatively high numbers. For example, in 2007 a total of 26 individuals were recorded from six different sites. Redside Dace has also recently been collected from a tributary of the Rouge River at new sites in Bruce Creek (2012) and its tributary Berczy Creek (2014). Sampling from 2007 to 2015, captured 98 Redside Dace during 15 different sampling events throughout Berczy Creek and one Redside Dace was captured at a new site in upper Bruce Creek. Although Redside Dace was still present in Morningside Creek in 2009, extensive sampling in 2011 at four new sites failed to detect any Redside Dace. Based on probability of capture, Poos et al. (2012) estimated the basin-wide population in the Rouge River to be between 4,499 to 9,180 individuals. This is below the minimum viable population (18,226 – 74,687 individuals depending on meta-population structure and a 15% chance of catastrophic decline) estimated by van der Lee et al. (2019).

Don River

Redside Dace has undergone a dramatic range contraction in both the east and west branches of the Don River. In 1949, it was widespread throughout the upper half of both branches where it was found at 23 sites. However, recent extensive sampling has yielded both a decrease in the number of individuals captured and the number of sites they have been recorded from. Despite considerable sampling attempts, Redside Dace has not been captured from the Don River west branch since 1998 and is believed to no longer occupy this reach. Poos et al. (2012) estimated the population size in the Don River to be between 402 to 1,607 individuals. This is below the minimum viable population (18,226 – 74,687 individuals depending on meta-population structure and a 15% chance of catastrophic decline) estimated by van der Lee et al. (2019). Recent sampling by the OMNRF in October 2017 yielded no Redside Dace from the two pools where Poos et al. (2012) captured large numbers in 2008. This suggests that Redside Dace may be extirpated from the Don River.

Humber River

Redside Dace was first reported in the East Humber River in 1937. Since then, the species has also been detected in the main and West Humber branches. In the 1980s it was more widespread in the West Humber but the species can still be found in both east and west branches. Recent sampling efforts (2010-2015) have yielded 64 Redside Dace during eight of 10 sampling attempts at nine sites in the West Humber River and five Redside Dace from two of five attempts at five sites in East Humber River from 2010 to 2014. The basin-wide population estimates for Reside Dace in the Humber River is much higher than the minimum viable population estimated by van der Lee et al. (2019) (18,226 – 74,687 individuals depending on meta-population structure and a 15% chance of catastrophic decline) ranging from 21,530 to 38,582 individuals (Poos et al. 2012).

Mimico Creek

Redside Dace has not been collected from Mimico Creek since 1949 despite several sampling attempts and is presumed extirpated (COSEWIC 2017).

Etobicoke Creek

Despite considerable effort, surveys in the lower half of Etobicoke Creek have failed to detect Redside Dace since 1935. It is likely extirpated from this creek (COSEWIC 2017).

Clarkson Creek

Redside Dace has not been collected in the creeks near the town of Clarkson, Ontario since 1927. Multiple sampling attempts in Sheridan and Turtle Creeks from 1985 to 2004 have failed to capture any Redside Dace. It is presumed that Redside Dace has been extirpated from this creek (COSEWIC 2017).

Credit River

Redside Dace has been documented from the main branch of the Credit River and several of its tributaries: Roger’s Creek, Silver Creek and three of its tributaries (Black, Nichols and Snows creeks), Caledon Creek, Huttonville Creek, Fletcher’s Creek, Levi’s Creek, and more recently Springbrook Creek. Repeated sampling has yielded no Redside Dace in Levi’s Creek since 1954 and Redside Dace is presumed extirpated from this tributary. It has also not been collected in Roger’s or Caledon creeks since 1988 and 1995, respectively. Although it has undergone a reduction in range in the Credit River system, Redside Dace have recently been observed at sites in Silver Creek (2014 and 2016), Fletcher’s Creek (2014), Springbrook Creek (2011) and Huttonville Creek (2008). More specifically, over 50 individuals have been spotted annually at a new site in Silver Creek since 2014, 17 Redside Dace were captured in

Springbrook Creek in 2011, one individual was observed in Huttonville Creek at a new site in 2008, and Redside Dace were visually observed at two sites in Fletcher's Creek in 2014.

Morrison Creek

Redside Dace was widespread in both branches of Morrison Creek in 1954. However, extensive sampling from 2000-2003 failed to detect the species at five historical sites. Two specimens were found at a new site in 2000 which was the last collection for this creek. Surveys conducted by OMNRF in 2015 and 2016 failed to detect live specimens despite a single positive eDNA detection from the east branch of Morrison Creek in 2015. Redside Dace has likely been extirpated from this tributary.

Sixteen Mile Creek

Redside Dace was widespread in the upper half of all three branches of Middle Sixteen Mile Creek. However, sampling from 1995-2003 failed to detect Redside Dace at the most upstream sites of all three branches. Despite this apparent range contraction, Redside Dace continue to be found at historical sites in relatively high numbers. For example, a total of 354 Redside Dace were recorded from 2008 to 2015 during 11 sampling events across seven stations in the West, Upper West, and Middle East branches. One of these sites yielded 48 individuals in 2015 compared to two individuals in 1973. Despite presence in some locations, range reductions in the Upper West and West Branch are evident.

Fourteen Mile Creek

Sampling attempts in 1985 detected Redside Dace at only one of three historical sites. However, more recent sampling from 2010 to 2016 yielded significant numbers of Redside Dace. For example, 582 individuals were caught at 14 sites in 2012. This indicates a healthy population persists in Fourteen Mile Creek (COSEWIC 2017).

Bronte Creek

Redside Dace was detected at six sites in the main branch of Bronte Creek and at five sites in Mountsberg Creek, a tributary of Bronte Creek, in the 1970s. Extensive sampling from 1995-2000 at seven of these 11 sites yielded only one Redside Dace in the main branch. Redside Dace has not been collected from Bronte Creek since 1998 despite extensive survey efforts since 2008 (COSEWIC 2017).

Wedgewood Creek

At least one Redside Dace was captured near Lakeshore Road in 1957. This is the only record from this creek and the species is presumed extirpated.

Spencer Creek

In the 1970s, Redside Dace was widespread in the upper half of Spencer Creek and one of its tributaries, Flamborough Creek. However, extensive sampling at historical sites between 1997 and 2001 detected only a single individual suggesting a population decline. Despite several sampling attempts, it has not been collected from Spencer Creek since 1998 and Flamborough Creek since 1984.

Niagara Peninsula

Redside Dace was last observed from a stream in the Niagara Peninsula in the 1960s and is presumed to be extirpated (COSEWIC 2017). This stream was located on an island in the Welland Canal near Lock 7 that no longer exists.

Lake Simcoe Drainage

Holland River

Redside Dace were captured from three sites on Kettleby Creek (Holland River tributary) from 1976 to 1980. It was also recorded from one site in another Holland River tributary (Sharon Creek) in 1994 as well as from Four Hundred Creek (South Holland Canal tributary) in 1991. Extensive sampling from 1988 to 2003 in both Kettleby Creek and Sharon Creek yielded only a single specimen from one site on Kettleby Creek. Sampling in 2006 yielded 10 Redside Dace from one site in Kettleby Creek. However, Redside Dace was absent from five other sites sampled in Kettleby Creek in 2011 and 2013. From 2012-2013, 35 individuals were collected for a genetic variation study by Serrao (2016). Although Redside Dace eDNA was detected in Kettleby Creek in 2014, it is unknown whether this tributary still supports a population.

Lake Erie Drainage

Irvine Creek

In the Grand River watershed, Redside Dace was widely distributed in Irvine Creek in the 1970s. Extensive sampling from 1997-2005 in Irvine Creek failed to yield Redside Dace from three of the five historical sites. Although relatively high numbers were caught at three new sites from 2001 to 2003, sampling in 2003 yielded just two specimens at a site where 25 Redside Dace were captured in 2001. Recent surveys at seven historical sites in 2016 failed to find Redside Dace. This suggests Redside Dace may be extirpated from Irvine Creek.

Lake Huron Drainage

Gully Creek

A total of 312 individuals were captured at two historical sites and a new site during 10 sampling events in Gully Creek from 2001 to 2010. At one of these sites, five repeated bag seine hauls conducted by DFO in 2007 yielded a total of 282 specimens. This high-localized abundance may have been due to low water levels in 2007 (COSEWIC 2017). Poos et al. (2012) estimated the population to be between 462-741 individuals. This population size is well below the minimum viable population estimated by van der Lee et al. (2019) (18,226 – 74,687 individuals depending on meta-population structure and a 15% chance of catastrophic decline).

Saugeen River

Abundance of Redside Dace in Meux Creek, a tributary of the Saugeen River, was relatively high in 1985 with over 100 individuals caught at four sites. However, extensive sampling in 2004 resulted in the capture of a single individual. Failed attempts to capture Redside Dace in the South Saugeen River, most of the upper Saugeen River, and in Meux Creek suggest that its range has declined dramatically in the Saugeen River system since the 1960s. Since 2000, only 20 individuals have been captured from the 26 historical sites. Ten new sites have been identified since 2000 (three in Meux Creek and seven in the Upper Saugeen River) where at least 34 individuals have been captured.

South Gully Creek

Redside Dace was first reported from South Gully Creek in 2008 when a single individual was caught from a minnow trap. In 2011, six specimens were found at the initial capture site and an additional 36 were found at three additional sites. Additional sampling at one site in 2016 captured 60 Redside Dace (COSEWIC 2017).

Two Tree River

A total of four individuals were captured during two of four sampling events at Two Tree River in 1997 and 2002. More recent sampling attempts from 2009 to 2015 yielded 232 Redside Dace from 22 new sites throughout the river suggesting a healthy population of Redside Dace exists throughout Two Tree River (COSEWIC 2017).

Population Assessment

To assess the population status of Redside Dace in Ontario, each population was ranked in terms of its abundance (Relative Abundance Index) and trajectory (Population Trajectory) (Table 1). The Relative Abundance Index was assigned as Extirpated, Low, Medium, High, or Unknown. The Population Trajectory was assessed as Decreasing, Stable, Increasing, or Unknown for each population based on the best available information about the current trajectory of the population. Trends over time were classified as Increasing (an increase in abundance over time), Decreasing (a decrease in abundance over time), and Stable (no change in abundance over time). If insufficient information was available to identify the trajectory, the Population Trajectory was listed as Unknown. Certainty has been associated with the Relative Abundance Index and Population Trajectory rankings and is listed as: 1=quantitative analysis; 2=catch per unit effort (CPUE) or standardized sampling; 3=expert opinion. Refer to Lebrun et al. (2019) for detailed methods used for the assessment of Population Status.

Table 1. Population Status for Redside Dace in Ontario resulting 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).

Population	Population Status	Certainty
Pringle Creek	Extirpated	3
Lynde Creek	Poor	2
Carruthers Creek	Fair	2
Duffins Creek	Poor	2
Petticoat Creek	Extirpated	3
Highland Creek	Extirpated	3
Rouge River	Poor	2
Don River	Poor	2
Humber River	Fair	2
Mimico Creek	Extirpated	3
Etobicoke Creek	Extirpated	3
Clarkson Creek	Extirpated	3
Credit River	Poor	2
Morrison Creek	Extirpated	2
Sixteen Mile Creek	Poor	2
Fourteen Mile Creek	Fair	2
Bronte Creek	Poor	3
Wedgewood Creek	Extirpated	3
Spencer Creek	Poor	2
Niagara area stream	Extirpated	3
Holland River	Poor	2
Irvine Creek	Poor	3
Gully Creek	Poor	2

Population	Population Status	Certainty
Saugeen River	Poor	2
South Gully Creek	Unknown	3
Two Tree River	Fair	2

Habitat Requirements

Redside Dace inhabits slow-moving sections of relatively small headwater streams containing both pool and riffle habitats and a moderate to high gradient. It has been captured over substrates of boulders, gravel, sand, clay, silt, mud, and detritus, but is most often associated with gravel. Redside Dace seek overhanging riparian vegetation such as grasses, forbs, and small shrubs as well as undercut banks and in-stream structure such as boulders and large woody debris which are, a source of cover and food. The headwaters of streams and presence of a meander belt (including the riparian zone) are also important features that help maintain riffle-pool morphology and suitable baseflow as well as provide coarse sediment for spawning, cover, and terrestrial insects for feeding. For these reasons, the Ontario habitat regulation for the species under the Endangered Species Act 2007 (O.Reg 242/08) includes a minimum of 30 m of vegetated area adjacent to the stream's meander belt to ensure that riparian habitat can provide these ecosystem functions to support Redside Dace populations.

Redside Dace spawn when water temperatures reach 18 °C (usually May) in riffle areas with gravel substrate. In one study, the majority substrate particle size at Redside Dace riffle sites was less than 6 cm (Parish 2004). The species has commonly been observed spawning in or near the nests of Creek Chub (*Semotilus atromaculatus*) and Common Shiner (*Luxilus cornutus*) (Scott and Crossman 1973) but it is unclear if this is an obligate relationship. Catch per unit effort of Creek Chub, Common Shiner, and White Sucker (*Catostomus commersoni*) were important factors influencing movements of Redside Dace between stream reaches as were habitat variables such as stream depth, volume, width, and distance to a reach.

Residence

Residence is defined in SARA 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 constructed by the organism. In the context of the above narrative description of habitat requirements during spawn-to-hatch, young of the year (YOY), juvenile, and adult life stages, Redside Dace does not occupy residences.

Functions, Features, and Attributes

Essential functions, features, and attributes associated with Redside Dace habitat have been described to guide the future identification of critical habitat for this species (Table 2). The habitat required for each life stage has been assigned a function that corresponds to a biological requirement of Redside Dace (e.g., spawning, nursery). In addition to the habitat function, a feature has been assigned to each life stage which is considered to be the structural component of the habitat necessary for the survival or recovery of the species. Habitat attributes have also been provided which describe how the features support the function for each life stage. Optimal habitat attributes from the literature for each life stage have been combined with habitat attributes from current records (records from 1996 to present) to show the range in habitat attributes within which Redside Dace may be found (see Table 2 and references therein). It should be noted that habitat attributes associated with current records may differ from those presented in the scientific literature as Redside Dace may be currently occupying areas where optimal habitat is no longer available.

Table 2. Summary of the essential functions, features, and attributes for each life stage of Redside Dace. Habitat attributes from published literature and those measured during recent Redside Dace surveys (records since 1996) have been combined to derive the habitat attributes required for the delineation of critical habitat (see text for a detailed description of categories).

Life Stage	Function	Features	Habitat Attributes		
			Scientific Literature	**Current Records**	**For Identification of Critical Habitat**
Spawn to Hatch (usually May)	Spawning Cover Nursery	Reaches of streams containing both pool and riffle habitats	• Spawning observed in late May in New York when water temperatures reach 18 °C (Koster 1939) • Captured in pre-spawning condition in early May in East Humber, at temperatures of 16 –19 °C (McKee and Parker 1982) • Observed spawning in gravel nests of Creek Chub and Common Shiner in New York (Koster 1939) • The majority of occupied riffle sites had substrate particles less than 6 cm (Parish 2004)	• Redside Dace observed in riffle habitat in Fletcher's Creek in May 2014. Likely spawning with Creek Chub, Blacknose Dace (*Rhinicthys atratulus*), and Common Shiner (OMNRF RSD Database) • Nesting activities of Redside Dace were filmed in 2001 at Fourteen Mile Creek with Common Shiner (DFO unpubl. data) • Multiple individuals photographed and filmed in early May from 2014 – 2018 in Silver Creek along with spawning Creek Chub, Common Shiner and Blacknose Dace (J. Clayton, CVCA, pers. comm. 2018)	• Riffle areas with gravel substrates (<60 mm) • Presence of Creek Chub, or Common Shiner (Redside Dace typically spawn over nests constructed by these species) • Late spring water temperatures 16-18 °C (spawning activities initiate when these temperatures are reached; COSEWIC 2017)
Young-of-Year (YOY)	Feeding Cover Nursery	Same as above	• Unknown	• YOY have been caught in similar habitats as adults (DFO unpubl. data)	• Same as adult
Juvenile (age 1 until sexual maturity)	Feeding Cover	Same as above	• Unknown	• Juveniles have been caught in similar habitats as adults (OMNRF RSD database)	• Same as adult

Life Stage	Function	Features	Habitat Attributes		
			Scientific Literature	Current Records	For Identification of Critical Habitat
Adult	Feeding Cover Winter refugia	Same as above	• Prefers clear water but has been found in streams with moderate turbidity (Holm and Crossman 1986) • Prefers temperatures of less than 24 °C and dissolved oxygen levels of at least 7 mg/L (McKee and Parker 1982) • Substrates vary from silt to boulder, but often associated with gravel (McKee and Parker 1982; Becker 1983; Holm and Crossman 1986) • Typically found in streams with open meadows, pasture or shrub overstory (Andersen 2002; Parish 2004) • Found in smaller stream segments ranging from 1 – 10 m in width and at depths ranging from 0.1 – 2.0 m (McKee and Parker 1982; Becker 1983) • An overwintering site in the West Humber River had instream vegetation providing refuge Turbidity at this site ranged from 1.23 – 3.65 NTU when the species was present. Dissolved oxygen at this site ranged from 12.22 – 12.48 mg/L (Davis 2016). • Streams with healthy populations of Redside Dace had greater contributions of groundwater and more stabilized flow conditions (Reid and Parna 2017)	• Average stream depth was 1.2 m (n = 11; range: 0.3 – 2 m; OMNRF RSD database) • Average pool width = 6.3 m (n = 8; range:1 – 13 m; OMNRF RSD database) • Average dissolved oxygen = 8.79 mg/L (n=14; range: 7 – 10.71 mg/L; OMNRF RSD database) • Median values for substrate percent composition from 20 sites: Detritus (5), Clay (10), Silt (11), Sand (25), Gravel (22), Rock (20), Boulder (10), Rubble (10) (DFO unpubl. data)	• Undercut banks and in-stream structure such as boulders and large woody debris (cover for Redside Dace) • Summer wetted stream range from 1 – 10 m in width and 0.1 – 2 m in depth • Substrates include boulders, cobble/rock, sand, clay, silt, mud, gravel and detritus. Redside Dace most often associated with gravel • Relatively clear waters (preference for clear waters, but sometimes occur in moderate turbidity) • Summer water temperatures <24 °C and dissolved oxygen levels >7 mg/L • Deep pools (>1.0 m depth) with little current (important as refugia for overwintering) • Adequate supply of overwinter prey species (aquatic insect larvae) • Streams with high contributions of groundwater and more stabilized flow conditions

Life Stage	Function	Features	Habitat Attributes		
			Scientific Literature	Current Records	For Identification of Critical Habitat
All life stages	Feeding Cover Maintenance of water quality	Riparian Zone	• Overhanging riparian vegetation (grasses and shrubs) important component of habitat • Feeds primarily on terrestrial insects, especially adult flies (Schwartz and Norvell 1958; McKee and Parker 1982) • Prefers clear water but has been found in streams with moderate turbidity (Holm and Crossman 1986) • Mean channel width was 3.0 m for 20 Lake Ontario Tributary sites (Reid et al. 2008) • Percentage of substrate size classes for Lake Ontario tributary sites are as follows: Fine sediment (39.5), Gravel (15.5), Cobble (7.4) (Reid et al. 2008). Other substrate class percentages were not given. • Sites with Redside Dace had higher amounts of instream cover than historical sites that no longer have Redside Dace (Reid et al. 2008)	• Several Redside Dace observed and photographed feeding in deep pools that had overhanging streamside vegetation in Rouge River in August 2014 (OMNRF RSD Database) • Dense riparian vegetation in form of grasses, shrubs, and some trees at site in Purpleville Creek in September 2014 (OMNRF RSD Database)	• Riparian vegetation including but not limited to low, overhanging vegetation (grasses, forbes and shrubs) • Adequate supply of terrestrial insect species (terrestrial insects, especially adult flies, are an important food resource of Redside Dace) • Relatively clear waters (preference for clear waters, but sometimes occur in moderate turbidity)
All life stages	Spawning Cover Nursery Feeding Maintenance of water quality	Meander Belt	• Unknown		• Riparian habitat that is a minimum of 30 m from the meander belt (measured horizontally) is considered an important habitat element (RDRT 2010)

Recovery Modelling

The analysis consisted of five parts:

1. information on vital rates was compiled to build projection matrices using uncertainty in life history to represent variation in the life cycle for stochastic simulations.

   With these projection matrices:

2. stochastic sensitivity of population growth rate to changes in each vital rate was determined and used to estimate allowable chronic harm following Vélez-Espino and Koops (2009);
3. simulations were used to estimate the impact of transient harm (a one-time removal of fish of various age-classes) on population growth;
4. stochastic simulations were conducted to estimate the MVP and the minimum area for population viability (MAPV; i.e., the amount of suitable habitat required to support the MVP); and,
5. using MVP as a recovery target, simulations were conducted to estimate the probability of recovery over a given time frame through application of potential recovery efforts.

Allowable Harm

Allowable harm and minimum required recovery effort were assessed using a precautionary approach within a demographic framework following Vélez-Espino and Koops (2009). Recovery effort is defined as the minimum vital rate improvement that will allow a population to begin recovery. Allowable harm is defined as the maximum change in a vital rate that will not prevent population recovery. Modelling indicated that Redside Dace population growth rate was most sensitive to perturbations of annual survival from hatch to age-2 as well as to population-level fecundity. Estimates of allowable harm are based on the estimated population growth rate. An assumed population growth rate of 0.89 indicates that there is no scope for allowable harm.

Summary of Science Advice on Allowable Harm

- For the purposes of the RPA modeling, harm refers to a negative alteration to a vital rate that reduces a population growth rate.
- If a population is stable and exceeds the recovery target (MVP) then harm may be considered that does not result in a decline of the population growth rate.
- When population trajectory is declining there is no scope for allowable harm to the population.
- When population trajectory is unknown the scope for allowable harm can only be assessed once population data are collected.
- Scientific research to advance the knowledge of population data should be allowed.

Population Sensitivity

Sensitivity analysis of matrix population models was used to determine the impact of changes to vital rates and lower level parameters on annual population growth rate (λ). Redside Dace populations were most sensitive to perturbations of pre-adult survival and fecundity which is consistent with previous modelling on the sensitivity of fish populations to vital rate perturbations. The sensitivity of λ to both survival and fecundity declined with age. See van der Lee et al. (2019) for complete details of the model and results.

Recovery Targets

Demographic sustainability was used to identify potential recovery targets for Redside Dace using the single population and meta-population models with multiple catastrophe scenarios. Demographic sustainability is related to the concept of a MVP and was defined as the minimum adult population size that results in a desired probability of persistence over 100 years (> 35 generations for Redside Dace). In choosing recovery targets, the risks associated with extinction probability were balanced with the costs associated with an increased recovery target (increased recovery effort, longer time to recovery, etc.). Recovery target values were estimated using simulations for multiple catastrophe scenarios with differing catastrophe rates and extinction thresholds. A conservative approach utilizes a quasi-extinction threshold of 50 adults, catastrophe probability of 0.15/generation, and extinction probability of 1%. The single population model and the meta-population model with linked catastrophes produced similar recovery target estimates with conservative MVP estimates of approximately 75,000 adults. This value decreased markedly when alternative catastrophe scenarios were incorporated.

Minimum Area for Population Viability (MAPV)

Estimates of required critical habitat (MAPV) assumed independent habitat use by YOY, juvenile, and adult stages. MAPV was estimated by multiplying the age-specific MVP at the time of maximum space requirement for that age by the area-per-individual (API) at that time. MAPV estimates assuming a catastrophe rate of 0.15/generation and a quasi-extinction threshold of 50 adults depended on the simulated catastrophe scenario and API estimate and ranged from 1.77 to 46.3 ha.

Recovery Strategies And Times

To investigate the probability of recovery of a population over time, simulations were used to estimate the time required for a likely recovery to occur under three recovery strategy scenarios: a 75% improvement to YOY survival; a 75% improvement to adult survival; and a 25% improvement to survival of all age-classes. Simulations began with a population size of 737 adults and populations were deemed to be recovered when the population size reached the MVP. The minimum time to recovery with a catastrophe rate of 0.15/generation, quasi-extinction threshold of 50 adults, and a probability of persistence of 1% was 48.1 years for a meta-population with independent catastrophes. When catastrophes affecting sub-populations were linked this value increased to 73.1 years.

Threats

A wide variety of threats negatively impact Redside Dace across its range. The greatest threats to Redside Dace habitat include habitat alteration and degradation due to urban development and agricultural activities. This includes natural systems modifications such as the installation of dams or weirs. Urban development has the potential to impact Redside Dace habitat through:

1. increasing imperviousness of the watershed which affects runoff patterns, increases erosion, alters hydrology (e.g., water depth, flow patterns), and may increase water temperatures;
2. site dredging and excavation which may lead to increased sedimentation and erosion of stream banks; and,
3. direct loss of habitat including loss of riparian vegetation, wetlands, and groundwater sources (OMNRF 2016).

Activities that are carried out without proper sediment and erosion control (e.g., installation of bridges and pipelines, removal of riparian vegetation, unrestricted livestock access to waterbodies) which can cause increased turbidity and sediment deposition in pool and riffle habitats. A reduction in water clarity and increased siltation could impair the feeding and spawning success of Redside Dace.

Degradation of Redside Dace preferred habitat from urban development or agricultural practices may also result in increases in nutrient loading as a result of over-application of fertilizers and improper nutrient management from septic and municipal sewage and animal manure piles. Elevated nutrient levels (phosphorus and nitrogen) can lead to the development of algal blooms resulting in changes in water temperatures and decreased levels of DO required to support Redside Dace populations. In addition, the release of untreated urban stormwater and industrial pollution into habitat may introduce toxic chemical and pollutants into the watercourse which may lead to an increase in water temperature or change in hydrological regime (OMNRF 2016).

Threat Level Assessment

To assess the Threat Level of Redside Dace populations in Ontario, each threat was ranked in terms of the Threat Likelihood of Occurrence, Threat Level of Impact, and Causal Certainty on a population-by-population basis. Terms used to describe population level threat categories are described in Table 3.Threats were rolled-up to create a species-level threat assessment in Table 4.

Table 3. Definition and terms used to describe Population Level Threat Occurrence (PTO), Threat Frequency (PTF) and Threat Extent (PTE) information taken from DFO (2014).

Population-Level Threat Occurrence (PTO)

Term	Definition
Historical (H)	A threat that is known to have occurred in the past and negatively impacted the population.
Current (C)	A threat that is ongoing and is currently negatively impacting the population.
Anticipatory (A)	A threat that is anticipated to occur in the future and will negatively impact the population.

Population-Level Threat Frequency (PTF)

Term	Definition
Single (S)	The threat occurs once.
Recurrent (R)	The threat occurs periodically or repeatedly.
Continuous (C)	The threat occurs without interruption.

Population-Level Threat Extent (PTE)

Term	Definition
Extensive (E)	71-100% of the population is affected by the threat.
Broad (B)	31-71% of the population is affected by the threat.
Narrow (NA)	11-30% of the population is affected by the threat.
Restricted (R)	1-10% of the population is affected by the threat.

Table 4. Species-level Threat Assessment for Redside Dace in Canada resulting from a roll-up of Population-Level Threat Assessment (In Lebrun et al. 2019). The Species-level Threat Extent is calculated as the mode of Population-Level Threat Extent.

Threat	Species-level Threat Risk	Species-level Threat Occurrence	Species-level Threat Frequency	Species-level Threat Extent
Residential/commercial development	High	H, C, A	S, R, C	E
Agriculture	High	H, C, A	R, C	B
Pollution	High	H, C, A	R, C	E
Natural system modifications	High	H, C, A	S, R, C	B
Invasive species	Medium	H, C, A	R, C	B
Human intrusion	Low	H, C, A	R	R
Biological resource use	Low	H, C, A	R	R
Climate change	Unknown	A	C	E

Mitigations and Alternatives

Threats to species survival and recovery can be reduced by implementing mitigation measures to reduce or eliminate potential harmful effects that could result from works or undertakings associated with projects or activities in Redside Dace habitat. Within Redside Dace habitat, a variety of works, undertakings, and activities have occurred in the last five years including water crossings (e.g., bridge maintenance), shoreline and streambank works (e.g., stabilization), instream works (e.g., channel maintenance), and the placement or removal of structures in water. A review has been completed summarizing the types of work, activity, or projects that have been undertaken in habitat known to be occupied by Redside Dace (Table 5). For full details of this review, see Lebrun et al. 2019)

The most frequent project type was for water crossings including bridge and culvert replacements and streambank stabilization. Based on the assumption that historical and anticipated development pressures are likely to be similar, it is expected that similar types of projects will likely occur in or near Redside Dace habitat in the future. The primary project proponents were provincial and municipal road departments.

Table 5. Summary of works, projects and activities that have occurred during the period of 2013 to 2017 in areas known to be occupied by Redside Dace. Threats known to be associated with these types of works, projects, and activities have been indicated by a checkmark. The number of works, projects, and activities associated with each Redside Dace population, as determined from the project assessment analysis, has been provided. Applicable Pathways of Effects have been indicated for each threat associated with a work, project, or activity (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).

Work/Project/Activity	**Threats** (associated with work/project/activity)						**Watercourse / Waterbody** (number of works/projects/activities between 2013 and 2017)				
	Habitat removal and alteration	**Nutrient loading**	**Turbidity and sediment loading**	**Contaminants and toxic substances**	**Invasive species and disease**	**Incidental harvest**	**Fourteen and Sixteen Mile Creeks**	**Credit River**	**East and West Humber River**	**Rouge River**	**Lynde Creek**
Applicable pathways of effects for threat mitigation and project alternatives	1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 15, 18	1, 4, 7, 8, 11, 12, 13, 14, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 18	1, 4, 5, 6, 7, 11, 12, 13, 14, 15, 16, 18							
Water crossings (bridges, culverts, open cut crossings)	✓		✓	✓			5	2	4	5	2
Shoreline, streambank work (stabilization, infilling, retaining walls, riparian vegetation management)	✓		✓	✓			3	1	4	1	1
Instream works (channel maintenance, restoration, modifications, realignments, dredging, aquatic vegetation removal)	✓	✓	✓	✓			1		2		

Work/Project/Activity	**Threats** (associated with work/project/activity)						**Watercourse / Waterbody** (number of works/projects/activities between 2013 and 2017)				
	Habitat removal and alteration	**Nutrient loading**	**Turbidity and sediment loading**	**Contaminants and toxic substances**	**Invasive species and disease**	**Incidental harvest**	**Fourteen and Sixteen Mile Creeks**	**Credit River**	**East and West Humber River**	**Rouge River**	**Lynde Creek**
Applicable pathways of effects for threat mitigation and project alternatives	1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 15, 18	1, 4, 7, 8, 11, 12, 13, 14, 15, 16	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 18	1, 4, 5, 6, 7, 11, 12, 13, 14, 15, 16, 18							
Water management (stormwater management, water withdrawal)		✓	✓	✓							
Structures in water (boat launches, docks, effluent outfalls, water intakes, dams)	✓	✓	✓	✓							
Baitfishing						✓					
Invasive species introductions (accidental and intentional)					✓						

Numerous threats affecting Redside Dace populations are related to habitat loss or degradation. Habitat-related threats to Redside Dace have been linked to the Pathways of Effects developed by DFO Fish Habitat Management (FHM) (Table 5). DFO FHM has developed guidance on mitigation measures for 19 Pathways of Effects for the protection of aquatic species at risk in the Central and Arctic Region (Coker et al. 2010). This guidance should be referred to when considering mitigation and alternative strategies for habitat-related threats. Additional mitigation and alternative measures specific to Redside Dace related to invasive species and incidental harvest are listed below:

1. **Invasive and other problematic species, genes, and diseases**

   Mitigation

   - Removal/control of introduced species from areas inhabited by Redside Dace.
   - Monitor for introduced species that may negatively affect Redside Dace populations or preferred habitat.
   - Develop a plan to address potential risks, impacts, and proposed actions if monitoring detects the arrival or establishment of introduced species.
   - Initiate a public awareness campaign and encourage the use of existing invasive species reporting systems.
   - Under circumstances where barriers to fish movement (i.e., dams) are to be removed or fish passage is to be increased (i.e., creation of a fishway) the potential negative effects of introduced species moving into Redside Dace habitat should be considered.

   Alternatives

   - Do not stock non-native species in areas inhabited by Redside Dace
   - Do not enhance habitat for non-native species in areas inhabited by Redside Dace

2. **Human intrusion and disturbance**

   Mitigation

   - Use of non-lethal sampling methods. Consider sampling during morning hours to avoid periods of thermal stress. Ensure that personnel are able to identify Redside Dace in the field in order to minimize stress.
   - Improve co-ordination of sampling to reduce duplication of sampling at sites.

   Alternatives

   - Consider allowable-harm recommendations when collection for scientific purposes is necessary.

3. **Biological resource use**

   Mitigation

   - Provide information and education to anglers and bait harvesters on Redside Dace to raise awareness. This should include education on the use of baitfish alternatives when fishing as well as voluntary avoidance of occupied Redside Dace areas.
   - Immediate release of Redside Dace if incidentally caught as defined under the Ontario Fishery Regulations

Alternatives

- Prohibit the harvest of baitfish in areas where Redside Dace is known to exist.
- Seasonal or zonal restrictions applied to harvesting/fishing during Redside Dace spawning season.
- Restrict gear type used to catch baitfish to minimize the probability of Redside Dace capture.

The OMNRF has also developed best management practices (BMP) related to developing lands in and adjacent to protected Redside Dace habitat in Ontario (OMNRF 2016). A brief summary of the BMPs has been provided below:

1. **Comprehensive Planning for Subwatersheds**: Complete subwatershed plans prior to the Secondary Planning stage to ensure Redside Dace requirements are fully incorporated into the planning and development process;
2. **Stream Crossings**: Minimize the number of stream crossings (e.g., one per km of stream) while avoiding reaches known to be occupied by Redside Dace, adhering to timing windows, and incorporating erosion and sediment control measures;
3. **Construction Activities**: Prevent total suspended sediment (TSS) concentrations from exceeding 25 mg/L above background conditions and follow an approved Erosion and Sediment Control Plan;
4. **Stormwater Management***:* Ensure target outflows are consistent with Redside Dace habitat requirements including water temperatures below 24 °C, DO levels above 7 mg/L, and TSS levels less than 25 mg/L;
5. **Installation of New Infrastructure**: Where possible, utilities should be located either over or under streams to avoid impact to Redside Dace habitat and should be built in conjunction with new or replacement road crossings, and;
6. **Stream Realignments and Relocations**: Maintain natural flow and function of streams that Redside Dace requires including stream corridors (meander belt plus 30 m of riparian habitat) and hydrology.

Sources of Uncertainty

There are several knowledge gaps related to the distribution, abundance, biology and key factors associated with threats affecting populations of Redside Dace in Canada. A long-term monitoring program would be beneficial to assess and confirm the distribution and abundance of extant populations and the status of their habitats and threats. Long term monitoring would allow for further investigations on habitat use by each life stage of Redside Dace. Furthermore, areas that contain essential habitat features (e.g., meander belt and riparian zone) required to support Redside Dace populations need to be identified and prioritized for protection. The feasibility of rehabilitating degraded habitats and re-patriating populations into watersheds that once supported Redside Dace populations should also be investigated.

Additional research is required to identify the causative factors associated with urban development and agricultural activities that cause declines in Redside Dace populations as well as further investigations on the impacts of introduced species, anthropogenic-induced succession, scientific monitoring, and climate change on the species. This includes research on the interactions between Redside Dace and introduced species (i.e., salmonids particularly Brown Trout, centrarchids, and other cyprinids), the effects of gear type on mortality during scientific sampling, and the implications of canopy closure due to succession. There is much unknown about the effect of bait fish harvesting on Redside Dace. For example, for many occupied streams it is unknown if baitfish harvesting occurs. Therefore, Redside Dace mortality due to baitfish harvesting is unknown for many streams.

Knowledge gaps on the species' ecology and life history in Ontario should also be addressed as the majority of what is known comes from studies on American populations (RDRT 2010). This includes physiological tolerances to key physical and chemical water quality parameters such as critical thermal maximum (CT_{max}) and pollutants. Further refinement of our knowledge of reproduction such as spawning cues and spawning site locations is also required. Information on movements between areas of suitable habitat, overwintering habitat use, and the effect of flow rate on movement should be addressed to better understand movement patterns of the species. Factors that could be limiting abundance such as prey availability, predation, fish community interactions, and genetic diversity among populations and disease are important sources of uncertainty that also require research in the future.

LIST OF MEETING PARTICIPANTS

Name	Organization/Affiliation
Lynn Bouvier (Chair)	DFO - Science
Kari Jean	Ausable Bayfield Conservation Authority
Ian Kelsey	Central Lake Ontario Conservation Authority
Jon Clayton	Credit Valley Conservation Authority
Amanda Conway	DFO – Fisheries Protection Program
Bill Glass	DFO – Fisheries Protection Program
Karla Zubrycki	DFO – Policy
Adam van der lee	DFO – Science
Andrew Drake	DFO – Science
Dave Andrews	DFO – Science
Dominque Lebrun	DFO – Science
Marten Koops	DFO – Science
Elliot Quider (Rapporteur)	DFO – Science
Kristin Thiessen (Rapporteur)	DFO – Science
Amy Boyko	DFO – Species at Risk
Dave Balint	DFO – Species at Risk
Shawn Staton	DFO – Species at Risk
Andrew Dunn	Halton Region Conservation Authority
Chris Wilson	Ontario Ministry of Natural Resources and Forestry
Emily Funnel	Ontario Ministry of Natural Resources and Forestry
Jeff Anderson	Ontario Ministry of Natural Resources and Forestry
Maria Vavro	Ontario Ministry of Natural Resources and Forestry
Mark Heaton	Ontario Ministry of Natural Resources and Forestry
Nick Jones	Ontario Ministry of Natural Resources and Forestry

Name	Organization/Affiliation
Scott Gibson	Ontario Ministry of Natural Resources and Forestry
Scott Reid	Ontario Ministry of Natural Resources and Forestry
Doug Forder	Ontario Streams
Dave Lawrie	Toronto and Region Conservation Authority
Jan Moryk	Toronto and Region Conservation Authority
Rick Portiss	Toronto and Region Conservation Authority
Mark Poesch	University of Alberta
Nicholas Mandrak	University of Toronto, Scarborough
Trevor Pritcher	University of Windsor

SOURCES OF INFORMATION

This Science Advisory Report is from the February 21-22, 2018 Recovery Potential Assessment for Redside Dace (*Clinostomus elongatus*) in Canada. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison, WI. xii + 1052 p.

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. 2017. COSEWIC assessment and status report on the Redside Dace *Clinostomus elongatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. xii + 63 pp.

Davis, L. 2016. Overwinter habitat of minnows in small, southern Ontario streams. Thesis (M.Sc.) University of Guelph, Guelph, Ont. 83 pp.

DFO. 2019. Proceedings of the Recovery Potential Assessment of Redside Dace (*Clinostomus elongatus*) in Canada; 21-22 February 2018. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2019/006.

Holm, E., and Crossman, E.J. 1986. A Report on a 1985 attempt to resurvey some areas within the Ontario distribution of *Clinostomus elongatus,* the Redside Dace and to summarize previous records. Royal Ontario Museum, Toronto, ON. 11 p.

Koster, W.J. 1939. Some phases of the life history and relationships of the cyprinid, *Clinostomus elongatus* (Kirtland). Copeia 1939(4): 201-208.

Lebrun, D.E., Bouvier, L.D., Choy, M., Andrews, D.W., and Drake, D. Andrew R. 2019. Information in support of a Recovery Potential Assessment of Redside Dace (*Clinostomus elongatus*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/033. In press.

McKee, P.M., and Parker, B.J. 1982. The distribution, biology, and status of the fishes *Campostoma anomalum, Clinostomus elongatus, Notropis photogenis* (Cyprinidae), and *Fundulus notatus* (Cyprinodontidae) in Canada. Can. J. Zool. 60: 1347-1358.

OMNRF (Ontario Ministry of Natural Resources and Forestry). 2016. Guidance for development activities in Redside Dace protected habitat. Version 1.2. Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. iv + 32 pp.

OMNRF RSD (Ontario Ministry of Natural Resources and Forestry Redside Dace Records) Database. Accessed March 13, 2018. Aurora district office. Aurora, ON.

Parish, J. 2004. Redside Dace Recovery strategy fluvial geomorphology study. Parish Geomorphic. Mississauga, Ontario. Report prepared for the Redside Dace Recovery Team. 22 pp.

Poos, M., Lawrie, D., Tu, C., Jackson, D.A., and Mandrak, N.E. 2012. Estimating local and regional population sizes for an endangered minnow, Redside Dace (*Clinostomus elongatus*), in Canada. Aquat. Conserv. 22: 47-57.

RDRT (Redside Dace Recovery Team). 2010. Recovery Strategy for Redside Dace (*Clinostomus elongatus*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, ON. vi + 29 p.

Reid, S.M., Jones, N.E., and Yunker, G. 2008. Evaluation of single-pass electrofishing and rapid habitat assessment for monitoring Redside Dace. N. Amer. J. Fish. Manage. 28: 50–56.

Reid, S.M. and Parna, S. 2017. Urbanization, long-term stream flow variability, and Redside Dace status in Greater Toronto Area streams. Can. Manuscr. Rep. Fish. Aquat. Sci. 3118: iv + 20 p.

Serrao, N.R. 2016. Conservation genetics of Redside Dace (*Clinostomus elongatus*): insights from environmental DNA and phylogeography. Thesis (M.Sc.) Trent University, Peterborough, Ont. xvi + 175 pp.

Schwartz, F.J., and Norvell, J. 1958. Food, growth and sexual dimorphism of the Redside Dace *Clinostomus elongatus* (Kirtland) in Linesville Creek, Crawford County, Pennsylvania. OH. J. Sci. 58(5): 311-316.

Scott, W.B., and Crossman, E.J. 1973. Freshwater Fishes of Canada. Fish. Res. Board. Can.Bull. No. 184. 966 p.

Van der Lee, A.S., Poesch, M.S., Drake, D.A.R, and Koops M.A. 2019. Recovery Potential Modelling of Redside Dace (*Clinostomus elongatus)* in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/034. In press.

Vélez-Espino, L.A., and Koops, M.A. 2009. Quantifying allowable harm in species at risk: application to the Laurentian black redhorse (*Moxostoma duquesnei*). Aquat. Conserv. Mar. Freshw. Ecosyst. 19: 676–688. doi:10.1002/aqc.1023.

THIS REPORT IS AVAILABLE FROM THE:

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

Telephone: (204) 983-5232
E-Mail: csas-sccs@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-5087

Correct Citation for this Publication:

DFO. 2019. Recovery Potential Assessment of Redside Dace (*Clinostomus elongatus*) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2019/012.

Aussi disponible en français :

MPO. 2019. Évaluation du potentiel de rétablissement du méné long (Clinostomus elongatus) au Canada. Secr. can. de consult. sci. du MPO, Avis sci. 2019/012.