Photo: W.N. Roston/AFS Fish Slide Catalog

Redside Dace

(*Clinostomus elongatus*) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the *Endangered Species Act, 2007*

February 2010

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act, 2007 (ESA, 2007) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA, 2007, a recovery strategy provides the best available scientific knowledge onwhat is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA, 2007 outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA, 2007. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

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DECLARATION

The Ontario Ministry of Natural Resources has led the development of this recovery strategy for the Redside Dace in accordance with the requirements of the *Endangered Species Act,* 2007 (ESA 2007). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

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

The goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

RESPONSIBLE JURISDICTIONS

Ontario Ministry of Natural Resources
Department of Fisheries and Oceans Canada

EXECUTIVE SUMMARY

The Redside Dace (*Clinostomus elongatus*) is a small colourful cyprinid (minnow family) that lives in small streams in the southern Great Lakes basin, the upper Mississippi drainage and the upper Susquehanna River drainage. In Canada, the Redside Dace is found only in southern Ontario where it most frequently occurs in streams flowing into western Lake Ontario. The species has declined in many areas throughout its range. The Committee on the Status of Species at Risk in Ontario (COSSARO) originally assessed the Redside Dace as threatened in 2000. Based on observed declines and threats to remaining populations the species was uplisted to endangered in 2009 under Ontario's *Endangered Species Act, 2007* (ESA 2007). Redside Dace was assessed as endangered in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April of 2007. The Redside Dace is currently being considered for listing as endangered under the federal *Species at Risk Act* (SARA).

The recovery strategy has been prepared by a recovery team consisting of representatives from the provincial and federal governments, conservation authorities, the Royal Ontario Museum, the Toronto Zoo, and Ontario Streams. The recovery strategy provides a framework for action for responsible jurisdictions and others to secure the persistence and sustainability of Redside Dace in Ontario.

Redside Dace require cool, clear flowing water with riffle-pool sequences and overhanging streamside vegetation. Redside Dace populations have been lost from several tributaries to western Lake Ontario and the length of stream occupied by several of the remaining populations has been reduced. Urban development is considered to be the most significant threat acting upon Redside Dace populations in Ontario. Most of Canada's Redside Dace populations are found in the 'Golden Horseshoe Region' of Ontario which is an area that is rapidly being developed. Urban development can cause siltation, changes in stream channel structure and water clarity, increased stream temperatures, alteration to groundwater and stream baseflow, result in the removal of riparian vegetation and result in the input of pollutants to streams. All of these factors can have negative impacts on Redside Dace populations. Other contributing threats to Redside Dace populations include intensive agricultural activities and introductions of non-indigenous species.

Several knowledge gaps are identified related to the distribution, biology and factors that limit Redside Dace populations. In order to direct recovery efforts efficiently, it is important to clearly identify the principal factors that limit the abundance and distribution of Redside Dace populations in Ontario.

The long-term goal of this recovery strategy is to restore viable populations of Redside Dace in a significant portion of their historic range in Ontario by:

i) protecting existing healthy, self-sustaining populations and their habitats;
ii) restoring degraded populations and habitats;
iii) re-establish Redside Dace to sites of former distribution where feasible.

The short-term recovery objectives to be addressed over the next 5 years are to:

1. Determine distribution and abundance of extant populations.
2. Maintain the current geographical distribution and abundance of Redside Dace through habitat protection and other measures.
3. Establish a long-term monitoring program to assess the status of Redside Dace and its habitats.
4. Generate awareness regarding the significance of Redside Dace and protection and stewardship of its habitats.
5. Rehabilitate degraded Redside Dace habitats and identify candidate areas for re-introductions.

The recovery strategy identifies approaches that will protect existing populations, rehabilitate degraded habitats, collect information on the status of Redside Dace and its habitats, and increase awareness regarding the significance of Redside Dace.

Significant progress has been made on several recovery actions during (and prior to) the development of the recovery strategy. An action group has been established on Irvine Creek to promote stewardship initiatives and stream rehabilitation projects are ongoing on the Morningside tributary, Fourteen Mile Creek, and Purpleville Creek. Monitoring projects have been conducted throughout the Ontario range of Redside Dace by the Royal Ontario Museum, the Ontario Ministry of Natural Resources (OMNR), Ontario Streams and several conservation authorities. Redside Dace genetic research has been initiated by the OMNR and Fisheries and Oceans Canada. The Toronto Zoo has led the production and distribution of several awareness and education materials including a brochure, curriculum materials and displays. Research has also been conducted on monitoring protocols, habitat requirements, movements and food availability.

Evaluation of the approaches to recovery set out in this strategy should be largely accomplished through the extensive and intensive monitoring programs. These programs should assess the number of extant occurrences, the extent of occupied range, as well as population and habitat trends at specific sites. Evaluation measures should also be incorporated into the awareness strategy to assess the effectiveness of awareness efforts. This recovery strategy should be reviewed in 5 years to evaluate the progress on stated objectives and to identify additional approaches and changes that may be required.

It is recommended that all reaches currently occupied by Redside Dace, upstream headwaters (natural heritage features and supporting functions supporting the occupied reaches) and historically occupied reaches where there is a high likelihood of rehabilitation be prescribed as habitat within a habitat regulation under the *Endangered Species Act, 2007*. Redside Dace habitat consists of two elements. The first element includes bankfull stream width within the aquatic resource area. The second element of habitat includes the meander belt width of the stream and associated riparian habitat that is a minimum of 30 metres from the meander belt (measured horizontally).

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Redside Dace
SCIENTIFIC NAME: *Clinostomus elongatus*
SARO List Classification: Endangered
SARO List History: Endangered (2009), Threatened (2004)
COSEWIC Assessment History: Endangered (2007), Special Concern (1987)
SARA Schedule 3: Special Concern (June 5, 2003)
CONSERVATION STATUS RANK: GRANK: G3G4 NRANK: N3 SRANK: S2

The glossary provides definitions for the abbreviations above.

1.2 Distribution, Abundance and Population Trends

Global Distribution

The global range of the Redside Dace is discontinuous. In the west, this species is found in the upper Mississippi basin in Minnesota, and the upper Mississippi and Lake Michigan watersheds of Wisconsin. In the east it occurs in a wide band south of Lake Erie and Lake Ontario, as well as in parts of Michigan and Ontario. Page and Burr (1991) described the Redside Dace as locally common in the eastern part of its range although it is declining in many areas. In the western portion of its range, the Redside Dace is localised and rare. The global conservation status rank of Redside Dace was upgraded from G4 to G3G4 in 2007 (NatureServe 2008), and the species was added to the American Fisheries Society list of imperiled North American Freshwater and Diadromous Fishes in 2008 (Jelks et al. 2008).

Redside Dace are most abundant in the state of Pennsylvania (upper Susquehana River drainage) where they have a sub-national conservation status rank of S4 (Table 1). The species has a restricted distribution in Indiana, Michigan and West Virginia and has been extirpated from Iowa and Maryland (where only a few populations formerly occurred). Redside Dace were recently discovered at one location in the Raccoon Creek drainage of Illinois adjacent to the Wisconsin border (Sabaj 2000). The Redside Dace is listed as endangered in Indiana and Michigan, and as special concern in Wisconsin (COSEWIC 2007).

Table 1. Sub-national conservation status ranks for Redside Dace (*Clinostomus elongatus*) (NatureServe 2008)

United States	Indiana (S1), Iowa (SX), Kentucky (S3S4), Maryland (SX?), Michigan (S1S2), Minnesota (SNR), New York (S3), Ohio (SNR), Pennsylvania (S4), West Virginia (S1S2), Wisconsin (S3)
Canada	Ontario (S3)

The glossary provides definitions for the abbreviations above.

Canadian Range

The current Canadian distribution of Redside Dace is limited to southern Ontario and the Two Tree River on St. Joseph Island (Figure 1). Most populations occur in tributaries to western Lake Ontario from Spencer Creek in the west, to Pringle Creek in the east. Populations are also known from the Holland River system (Lake Simcoe drainage), the Two Tree River, the Saugeen River system, Gully Creek, unnamed creek south of Gully Creek, (Lake Huron drainages) and Irvine Creek (Lake Erie drainage) (Parker et al. 1988, Mandrak and Crossman 1992, COSEWIC 2007). Canadian populations have experienced a continuing decline over the last 50 years, and only a few populations could currently be considered to be healthy. Redside Dace populations have been lost from several tributaries to western Lake Ontario and the length of stream occupied by several populations has been reduced (Parker et al. 1988, COSEWIC 2007). Despite observed declines, the boundaries of the overall range (extent of occurrence) of Redside Dace in Canada have not retracted significantly.

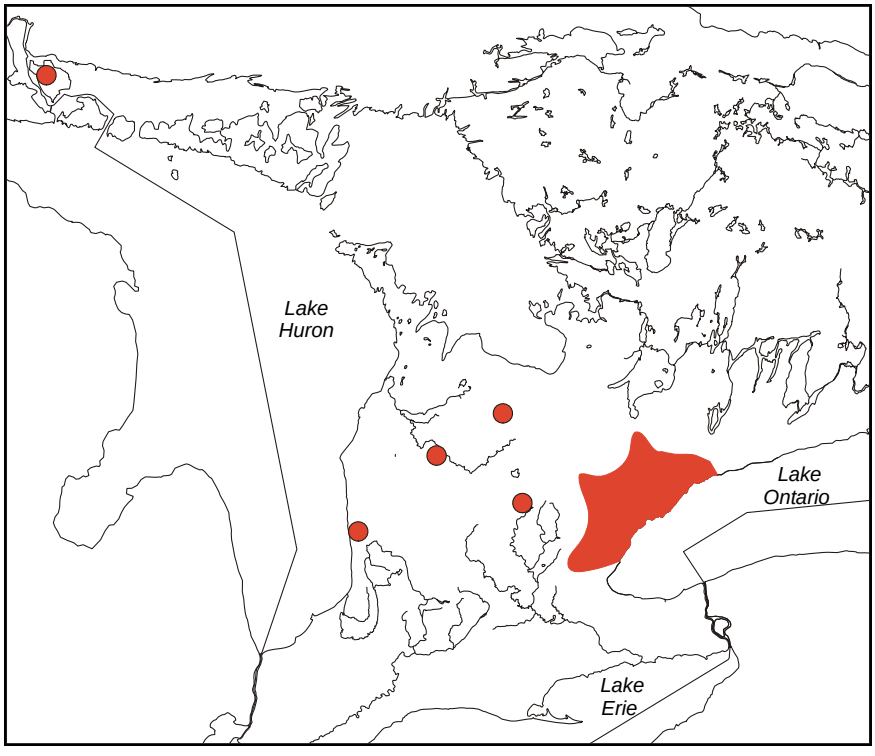

Figure 1. Distribution of Redside Dace (*Clinostomus elongatus*) in Ontario

Percent of Global Distribution in Canada

In Canada, the Redside Dace is found only in Ontario. The Ontario distribution represents just under 10 percent of the global distribution of Redside Dace. The number of element occurrences for Redside Dace is estimated as a little over 100, although these are decreasing and disjunct (NatureServe 2008). Given the ranks of S4 in Pennsylvania and S3S4 in Kentucky combined with ranks of S3 in three other jurisdictions, it seems likely that there are several hundred populations globally.

Population Sizes and Trends

Redside Dace have been captured from a total of 62 streams or sections of rivers in 24 watersheds in Ontario. Our knowledge of its decline is inadequate because many streams have been insufficiently surveyed through time. However, a summary of available data indicates that the species was still extant in 34 streams in 16 watersheds from 1980-2002. It has likely been extirpated from the following eight watersheds: an unnamed creek in Clarkson, Highland Creek, Morrison Creek, Pringle Creek, Petticoat Creek, Etobicoke Creek, Mimico Creek and a watershed on the Niagara peninsula (COSEWIC 2007). Sampling efforts targeting historical sites of Redside Dace indicate that the abundance and range of many of the extant populations have been reduced, in some cases dramatically. For example, in the upper Saugeen River, Redside Dace was recorded in a stream stretch of approximately 40 kilometres at 25 sites in 1951. Sampling in 1985 and 2000 at most of these sites found it at only three sites in a three kilometre stretch. In Spencer Creek, it was found in scattered locations in a stream stretch of approximately 18 kilometres in the early 1970s. Intensive sampling from 1997 to 2001 at historical sites produced only a single specimen. Reductions in range and abundance have also occurred in other watersheds such as Lynde Creek, the Don River, Duffins Creek, Kettleby Creek, and Bronte Creek.

1.3 Habitat Needs

In Ontario, Redside Dace inhabit slow moving sections of streams (1-10 m wide) having a mixture of overhanging stream side vegetation and pool and riffle habitat (Holm and Crossman 1986, Parker et al. 1988). Pools are used as resident habitat while riffles are used for spawning. Commonly, Redside Dace have been observed spawning in or near the nests of Creek Chub (*Semotilus atromaculatus)* and Common Shiner (*Luxilus cornutus*) (Scott and Crossman 1973). Stream sections flowing through open habitats (meadows, pasture and shrubs) with overhanging vegetation, undercut banks and submerged branches and logs are most suitable. Bottom substrates include boulders, rocks, gravel or sand, often with a shallow surface covering of detritus or silt (McKee and Parker 1982). Streams are clear or colourless in conjunction with hard substrates and clear to brown tinged in streams with organic substrates. Redside Dace prefer clear water and are sensitive to turbidity, however, they have been found in some streams of moderate turbidity (Holm and Crossman 1986). Redside Dace are a coolwater species (COSEWIC 2007). Preferred temperatures are usually less than 24°C and dissolved oxygen concentrations are at least seven milligrams per litre (McKee and Parker 1982). Little is known regarding seasonal movements and habitat use, but this is currently

being investigated for Ontario populations through a research project (University of Toronto and Toronto and Region Conservation Authority).

Destruction and degradation of habitat, including headwater natural heritage features and functions that directly or indirectly support in stream habitat, are considered to be the major factors in the reduction of Redside Dace distribution. Siltation, removal of riparian vegetation, loss of supporting wetlands, extraction of surface flows, groundwater base flow alterations, channelization and agricultural, domestic and industrial pollution of streams reduce suitable habitat and food sources. The species is now restricted to the headwaters of many streams where it was once widespread.

Headwaters of streams are the source of physical needs of the species. Headwaters regulate the hydrology of the stream reach occupied by Redside Dace. It has been estimated that 90 percent of the flow of a river originates from the watershed's headwaters. Accordingly, the protection of headwater wetlands, groundwater seepage areas and in stream sediment supply areas is important to sustaining populations that remain close by. These populations directly depend on the functions of these headwater features in supplying baseflow, organic litter for invertebrates, coarse sediment for spawning habitat, food or attenuating storm flows.

Habitat Protection/Ownership

The habitat of the Redside Dace receives general protection under the habitat provisions of the federal *Fisheries Act* and provincial *Endangered Species Act, 2007* (ESA 2007). Floodplain regulations enforced by local Conservation Authorities and the Provincial Policy Statement under the provincial *Planning Act* provide some control over stream-side development. The beds of navigable streams inhabited by Redside Dace are owned by the Crown, but in many areas, the adjacent lands are in private ownership. Lands immediately adjacent to streams in urban subdivisions are normally given back to the local municipality as green space.

1.4 Limiting Factors

Foraging Strategy/Predator Avoidance Behaviour

The Redside Dace is a small insectivorous fish (average length 7.5 cm, maximum 12 cm) that relies on visual search of prey at the water's surface. It spends most of its time in mixed-species schools in pools, at or near a mid-depth position in the water column. It is a specialized feeder, its primary food consisting of terrestrial insects, especially adult flies (Schwartz and Norvell 1958, McKee and Parker 1982, Daniels and Wisniewski 1994). The Redside Dace leaps out of the water to obtain such prey. On occasion, it may also feed on aquatic insects and invertebrates. In a study of two streams in New York, most of its insect prey were danceflies (*Hilara*) that occur in large swarms over the surface of the water (Daniels and Wisniewski 1994). The Redside Dace seeks cover under overhanging grasses, forbs and small shrubs. This streamside vegetation is important both as a source of cover and as a source of food.

Reproductive Attributes

Typically, the Redside Dace is sexually mature at two years, but spawning may not occur until its third year. Maximum age is three years, with occasional individuals surviving to age four. Fecundity ranges from 409-1526 eggs, based on 15 individuals from northern New York (Scott and Crossman 1973). Redside Dace spawning is somewhat specialized and may limit their ability to rebound from low population levels. Spawning occurs when water temperature reaches 16 to 18°C, typically in May on gravely riffles (Koster 1939, COSEWIC 2007). It uses nests of Creek Chub and/or Common Shiner, synchronizing its spawning with that of these two species. This strategy contributes to increased egg survivorship of Redside Dace through the protection afforded by the guarding behaviour of the parental Creek Chub or Common Shiner. The guarding fish keep the nest free of silt and protect the eggs from predation. Although Creek Chub and Common Shiners are ubiquitous in southern Ontario streams, they initiate spawning at slighter cooler temperatures (12-17°C) than the preferred spawning temperature for Redside Dace (18°C) (Becker 1983). The temperature differential and the shorter spawning period of Redside Dace may limit opportunities for communal nesting in some years. The eggs of Redside Dace are non-adhesive (Scott and Crossman 1973), possibly making them more susceptible to being washed away from nests by high water velocities (e.g., spring floods).

Other Attributes

The bright yellow and red colour pattern of the Redside Dace may make it more visible to predators as well as more desirable for aquarists and pond keepers and thus more susceptible to both predation and exploitation (no evidence of exploitation exists). Its preference for small, cool, headwater streams limits widespread dispersal. Although Redside Dace can leap several centimetres out of the water to catch flying insects (COSEWIC 2007), they are probably intolerant of dams and low head weirs in streams. Habitat fragmentation is an issue in streams.

1.5 Threats to Survival and Recovery

Redside Dace populations in Ontario are subject to numerous threats that vary across its range. Parker et al. (1988) suggested that siltation and removal of bank cover in urban areas were important limiting factors. At least nine threats or potential threats to Redside Dace populations in Canada have been identified (Table 2) and these are characterized and described below. Some specific mechanisms by which these stressors affect Redside Dace populations have not been evaluated through scientific study and are therefore poorly understood. There is sufficient evidence to identify probable cause and effect in some instances. Direct or indirect effects are likely involved depending on the severity of the threat in question.

Table 2. Threats to Redside Dace populations in Canada

Threats	Relative Impact	Spatial Temporal	Certainty
Urban Development	Predominant	Widespread/Chronic	Certain
Agricultural Activities	Contributing	Local/Chronic	Certain
Introductions	Contributing	Local/Chronic	Probable
Scientific Monitoring	Contributing	Ephemeral	Speculative
Anthropogenic Induced Succession	Contributing	Local/Chronic	Speculative
Extraction Activities (water, aggregates)	Contributing	Local/Chronic	Speculative
Climate Change	Contributing	Widespread/Chronic	Speculative
Bait Harvest	????	Widespread/Chronic	Speculative
Genetic Diversity	????	????	????

Loss of suitable habitat (or habitat modification) is likely the major factor contributing to Redside Dace declines in Ontario (COSEWIC 2007). Populations have been lost from five streams that have had major habitat changes associated with intensive urban development and the construction of reservoirs. Population declines associated with habitat loss have probably occurred in about one half of Ontario's Redside Dace streams, and only a few are considered to be relatively undisturbed. Pressures on Redside Dace habitats in Ontario are expected to continue to increase as population growth and associated urban development continue in the Golden Horseshoe Region.

Urban Development

Given that more than 80 percent of Canada's Redside Dace populations are found in the Golden Horseshoe Region of Ontario, urban development represents the most immediate threat to the species in Canada. Several populations have been lost or remain only in headwater areas as urban development proceeds. Many of the remaining populations are found in areas currently scheduled for development, or that will likely be developed in the near future. The human population of the Greater Toronto Area is expected to increase by 1.3 million over the next 15 years (Federation of Ontario Naturalists 2001). In the Golden Horseshoe Region, the population is expected to increase by almost 4 million people by 2031 (MPIR 2004). The healthiest remaining populations of Redside Dace are surrounded by urban development, but are found in watersheds that are relatively undisturbed.

As reductions in Redside Dace populations have coincided with areas of urban development in southern Ontario, it is generally understood that the environmental impacts often associated with urban development are responsible for changes in Redside Dace habitats, and thus the populations. Impacts from urban development which are likely responsible include change in imperviousness of the watershed,

channelization of streams, loss of natural heritage features like wetlands and groundwater discharge area, unsatisfactory stormwater management that results in reduced water clarity thereby affecting Redside Dace feeding success, increases in water temperature, and changes in a watershed's hydrography (flow regime) that results in changes to in-channel structure (e.g., dimensions of riffles, pools, bankfull width). Several studies have shown that the quality of streams and their biota can be negatively affected when impervious cover (e.g., roads, houses, parking lots) exceeds 10 percent of a stream's catchment area (Booth and Jackson 1997, Environment Canada 2004, Stanfield et al. 2004). Environment Canada (2004) recommends maintaining urbanizing watersheds at less than 10 percent imperviousness to maintain stream-water quality and quantity, and to preserve aquatic species density and biodiversity. A study of streams in the Lake Ontario basin (Stanfield et al. 2004) demonstrated that salmonid species only occurred in streams with a catchment that was less than 10 percent impervious cover. While such detailed landscape-based analysis has not yet been conducted for Redside Dace habitats in Ontario, a preliminary analysis by Parish (2004) also found that Redside Dace preferred stream channels that are not heavily influenced by urban drainage. Further study is required to identify appropriate thresholds for impervious cover in watersheds to maintain Redside Dace populations.

Direct changes to channel structure through channelization that often occurs in urban areas would have similar effects. Removal of riparian vegetation would directly affect the production of terrestrial insects required by Redside Dace during a large portion of the year. Riparian vegetation is also an important source of cover in the small streams inhabited by Redside Dace. In-stream barriers and weirs may affect Redside Dace access to spawning areas and could be detrimental if metapopulation dynamics are important to Redside Dace. A rise in stream temperature is often associated with clearing of forests and urban development within a watershed and may pose a particular problem for Redside Dace in some streams owing to their preference for cool water habitats. Other developments may contribute to diversions, reductions or dramatic increases in ground water inputs, which are important in regulating summer temperatures and base flows in streams. Although the tolerance of Redside Dace to pollutants is unknown, urban developments pose the risk of exposing local populations to household chemicals and storm water run-off.

Agricultural Activities

Despite the fact that urban development is the primary factor affecting Redside Dace populations in Canada, declines in Redside Dace distribution and abundance have also been observed in agricultural settings (e.g., Saugeen River and Irvine Creek). While low intensity operations (e.g., hayfields) may not pose a problem, intensive agriculture (e.g., row cropping and intensive grazing) and drain maintenance present several threats to Redside Dace populations.

Some of the factors that may affect Redside Dace are similar to those found in urban settings, however, specific mechanisms are poorly understood. Removal of riparian vegetation to increase crop production or allowing livestock access to streams can contribute to siltation and changes in channel structure. Some streams formerly

occupied by Redside Dace and tributaries to streams currently occupied have been channelized and/or converted to municipal drains. The extensive use of tile drains also increases flows after storm events and can serve as a conduit for sediment and pollutants. Agricultural landscapes also provide the opportunity for episodic or chronic pollution events associated with the use of pesticides and fertilizers. A recent manure spill in Irvine Creek killed all fish along several kilometres of stream (D. Coulson pers. comm.). Specific mechanisms affecting Redside Dace in agricultural settings have not been evaluated through scientific study.

Introductions

The impacts of introduced species on Redside Dace have not been specifically studied, but declines in Redside Dace populations have been observed in Spencer Creek concomitant with the introduction of potential cyprinid competitors and predatory Northern Pike (*Esox lucius*) (Holm 1999). Declines in Redside Dace populations in the Bronte Creek watershed occurred after introductions of centrarchids and Northern Pike to a reservoir in the upper portion of the watershed (D. Featherstone pers. comm.). Although Greeley (1938) reported that Redside Dace compete with trout for food, the interactions between Redside Dace and salmonids have not been specifically studied. Resident Brown Trout (*Salmo trutta*) and migratory Rainbow Trout (*Oncorhynchus mykiss*) have been introduced into several Toronto area streams with Redside Dace populations and Redside Dace occasionally naturally co-occur with Brook Trout (*Salvelinus fontinalis*). There is evidence that Redside Dace have co-existed with introduced salmonids in several Toronto area streams, but specific studies on the interactions between these species are required. Lyons et al. (2000) noted that Redside Dace disappeared from two Wisconsin streams after the introduction of Brown Trout, but no cause and effect relationship was established. An experimental examination of the interactions between Rainbow Trout and the closely related Rosyside Dace (*Clinostomus funduloides*) suggested that interactions between the two species were minimal (Rincon and Grossman 1998). Redside Dace may be more susceptible to the impacts of introduced species when stream systems are affected by multiple stresses.

Scientific Monitoring

While it is unlikely that scientific collections have had a major impact on Redside Dace populations in Ontario (few have been collected), collecting should be viewed as a potential threat. This is particularly true for populations that currently occupy a reduced length of stream and may be restricted to a small number of pools. Direct impacts can occur when specimens are collected. Although Redside Dace are normally released when they are captured during monitoring projects, there are examples of studies where relatively large numbers of specimens have been collected. The indirect impacts of non-lethal sampling (electrofishing, seining) have not been studied.

Anthropogenic Induced Succession

In Ontario, Redside Dace appear to achieve highest abundance in open streams with riparian zones consisting of grasses, forbs and low shrubs. These habitats may be maintained by the presence of wetlands, historic land clearing, spring flooding and

beaver activity. Treed areas with complete canopy closure do not appear to provide optimal habitat. Induced succession to tree species and canopy closure, as a result of tree planting projects in meadow type riparian areas, may similarly reduce the duration of quality Redside Dace habitat.

Extraction Activities

Activities associated with the extraction of aggregates may result in reduced base flows and increased stream temperatures (OMNR 2001). Similarly, withdrawals of surface water and ground water in watersheds with Redside Dace populations may reduce flows to unacceptable levels and result in increased stream temperatures. The impacts of such extraction and withdrawal activities on Redside Dace populations have not been investigated but are expected to be negative.

Climate Change

Global climate change effects on Redside Dace populations are difficult to forecast. It is expected to (1) have no effect, (2) reduce stream flows and increase stream temperatures or (3) increase the frequency of flooding events in southern Ontario within the range of Redside Dace (IPCC 2001). The last two changes are expected to be detrimental to populations of Redside Dace. Although climate change may make conditions more suitable for Redside Dace in more northern portions of the province, the potential for colonizing new areas is low.

Bait Harvest

The impact of bait harvest on populations of Redside Dace has not been studied. Populations restricted to a small length of stream may be particularly vulnerable to exploitation through bait harvesting. Redside Dace are very vulnerable to capture by seine nets, the most common gear used by baitfish harvesters in southern Ontario streams. However, due to restricted access, most streams are only harvested at road crossings. Redside Dace are not a legal baitfish in Ontario (they are protected under the Ontario Fisheries Regulations and the ESA 2007), but there is potential for incidental harvest.

Genetic Diversity

Genetic diversity may be an important conservation issue for Redside Dace in Ontario (and elsewhere) as most populations are small and isolated. Many potential pathways of genetic interchange have been lost through the loss of intervening populations and habitat or the construction of barriers. Research into the genetic diversity of this species in Ontario is required to determine how important these losses may be to the conservation of Redside Dace in Ontario. Preliminary findings from research at Trent University suggests that Ontario populations in close proximity are genetically divergent, and that the populations examined had relatively high genetic diversity when compared to Ohio populations (COSEWIC 2007).

1.6 Knowledge Gaps

There are several gaps in knowledge related to the distribution, abundance, biology and factors that limit Redside Dace populations in Ontario. Despite the extensive information requirements, there is little doubt that populations in Ontario have declined drastically over the last 50 years, primarily related to human-caused factors, most notably urban development. However, significant declines have also occurred in non-urban streams. Specific knowledge gaps and the priorities to fill them are defined below.

Survey Requirements

As with most freshwater fishes at risk in Canada, specific knowledge regarding the distribution and abundance of Redside Dace is limited. However, knowledge of Redside Dace is better than for many other species. Early records for Redside Dace were based on incidental captures associated with other survey work. In 1985 the Royal Ontario Museum conducted specific field surveys to assess Redside Dace populations (Holm and Crossman 1986), and in the last 10 years there have been considerable efforts to examine Redside Dace populations in Ontario (Holm and Boehm 1998, Holm 1999, Holm 2003, Reid et al. 2008, E. Holm unpublished data). Many of the streams are also sampled intensively on a regular basis by Conservation Authorities. Despite recent sampling efforts, there is an immediate need to assess the following streams to identify if populations are extant, their area of occupancy and relative abundance: Meux Creek, Sixteen Mile Creek, Bronte Creek, South Saugeen River, Turtle Creek, Lake Huron Tributaries south of Gully Creek, Credit River (Rogers Creek, Escarpment Tributaries, Fletcher's Creek upper watershed), upper Humber River, Duffin's Creek, and Holland River tributaries. In addition to these survey requirements, there is a need to establish a long-term monitoring program that can provide reliable trend-through-time information on the status of Redside Dace populations and their habitats in Canada.

Biological/Ecological Research Requirements

Little is known regarding the life history and ecology of Redside Dace in Ontario. A few studies have examined the feeding ecology, physiology and behavior of this species in the United States, but, like many cyprinids, it is not a well-studied species. Table 3 identifies priority research needs related to the biology and ecology of Redside Dace in Ontario.

Table 3. Research needs related to the biology/ecology of Redside Dace in Ontario

Research Need	Details
Habitat Use	Identification of most important habitats for adults and juveniles, seasonal changes, aquatic and terrestrial components.
Spawning Habitat	Identification of spawning areas and spawning behaviour. Are nests of other species (i.e., Creek Chub, Common Shiner) always required for successful spawning?
Physiological Tolerances	What are the physiological tolerances of Redside Dace to the key physical and chemical water quality parameters?
Feeding Behaviour	What are the primary foods of Redside Dace in Ontario? How do they vary seasonally? Are there specific terrestrial features that are important to prey organisms?
Migration/Movements	Are there Redside Dace spawning migrations? What is the degree of movement between areas of suitable habitat?
Genetic Diversity	What is the variation across the global range? Is there divergence among/within Ontario populations? Are metapopulation dynamics important?
Community Interactions	Do different fish communities affect the abundance and distribution of Redside Dace? Which species are important competitors/predators?
Disease/Parasites	Are there diseases or parasites that limit Ontario populations?

Threat Clarification Research Requirements

In order to direct recovery efforts efficiently, it is important to clearly identify the principal factors associated with threats that limit the abundance and distribution of Redside Dace populations in Ontario. Research questions related to threats and potential threats to Redside Dace populations are identified in Table 4.

Table 4. Research needs related to factors threatening Redside Dace in Ontario

Threat	Research Needs
Urban Development	What are the key factors associated with urban development that cause declines in Redside Dace populations?
Agriculture Development	What are the key factors associated with agricultural activities that cause declines in Redside Dace populations?
Extraction Activities	How do aggregate operations and water withdrawals affect the supply of Redside Dace habitat?
Introduced Species	What are the interactions/impacts of the introduced species most often introduced into Redside Dace streams (salmonids, centrarchids, Northern Pike, other cyprinids)?
Succession	Are forested riparian areas with canopy closure unsuitable for Redside Dace? What are the implications for rehabilitation projects?
Genetic Diversity	What is the variation across the global range? Is there divergence among/within Ontario populations? Are metapopulation dynamics important?
Bait Harvest	What is the impact of bait harvest on Redside Dace populations?
Sampling Mortality	What are the effects of timing, gear type and water temperature on mortality associated with scientific sampling?
Climate Change	How will climate change impact future supply of Redside Dace habitat?

1.7 Recovery Actions Completed or Underway

Irvine Creek

The Irvine Creek population is addressed in the Grand River Fish Species at Risk Recovery Strategy (Portt et al. 2007). This strategy includes Redside Dace and five other species at risk, and its goal is to, “conserve and enhance the native fish community using sound science, community involvement and habitat improvement measures”. An Irvine Creek Action Group was formed to implement specific actions identified in the recovery strategy, including monitoring, working with local bait fishermen, increasing awareness and promoting stewardship initiatives.

Morningside Tributary Rehabilitation

Initiated in 1997 by Ontario Streams and the Toronto Zoo, this community-based project is rehabilitating a three kilometre reach of the Morningside Creek tributary of the Rouge River in Toronto, where a remnant population of Redside Dace occurs. The project includes removal of concrete-lined reaches of the stream and development of a natural channel, creation of in-stream cover, barrier mitigation and riparian buffer rehabilitation.

Purpleville Creek
In 1996, the Ontario Ministry of Natural Resources (OMNR), with the assistance of the Region of York, City of Vaughan, Ontario Streams and local schools, undertook an extensive fencing project to restrict cattle access from approximately 1.6 kilometres of Redside Dace habitat. Work has continued, both upstream and downstream of the initial site, focusing on reducing in-stream erosion and improving the health of the stream corridor.

Lake Huron Tributaries - Gully Creek, unnamed creek
In 2009, the Ausable Bayfield Conservation Authority (ABCA) drafted the Bayfield North Watersheds Management Plan (includes Gully Creek), and undertook stream habitat and fish community assessments within Gully Creek. The ABCA has been working with the local community to increase awareness and promote stewardship initiatives in the Gully Creek area. Another unnamed gully (tributary to Lake Huron) south of Gully Creek, was found to have Redside Dace in 2008.

Two Tree River
In the summer of 2009, OMNR Sault Ste. Marie District, undertook fish community surveys and detected Redside Dace in the Two Trees River.

Fourteen Mile Creek
Monitoring and habitat rehabilitation work has been ongoing through the work of Conservation Halton, Ontario Streams and OMNR. A large reach has been naturalized in conjunction with the Town of Oakville.

Lynde Creek
The Central Lake Ontario Conservation Authority has identified potential Redside Dace habitats in the watershed and confirmed locations of extant populations. Redside Dace have been identified as a target species for management in the recently developed Central Lake Ontario Fisheries Management Plan.

Rouge River
The Toronto Region Conservation Authority has established a long-term research program in collaboration with the University of Toronto to better understand Redside Dace ecology within the Rouge River Watershed. The research will evaluate changes to in-stream habitat as a result of landuse change, define Redside Dace population sizes, examine species interactions and spawning habitat, movement patterns and habitat characteristics. This project will fulfill some of the outlined recommendations for the species contained within the forthcoming Watershed Based Rouge River Fisheries Management Plan.

Extensive Monitoring
The Royal Ontario Museum has coordinated substantial targeted monitoring throughout the Ontario range of Redside Dace. Sampling has focused on determining presence/absence of Redside Dace and comparing abundance with historical records.

Intensive Monitoring

Several streams with Redside Dace populations have been sampled using the Ontario Stream Assessment Protocol through the work of Conservation Authorities, Ontario Streams and a University of Toronto research project. A research project by Trent University and OMNR has demonstrated the utility of single pass methods for intensive monitoring of Redside Dace populations (Reid et al. 2008).

Habitat Requirements

A research project at the University of Toronto examined Redside Dace habitat requirements at multiple scales. Seasonal movements of Redside Dace were also being examined in streams with different habitat conditions.

Redside Dace Feeding

Two research projects (Fisheries and Oceans Canada and Savanta) examined the availability of insect prey in and adjacent to streams in the Greater Toronto Area with different habitat conditions.

Genetic Research

Allozyme samples have been obtained from three Ontario populations and one Ohio population (samples are still required from Kentucky and Wisconsin). DNA samples have been collected from several Ontario populations. Analysis is being conducted by OMNR's Aquatic Biodiversity and Conservation Lab at Trent University. The lab is also developing microsatellite DNA markers for Redside Dace.

Awareness/Outreach

The recovery strategy has been promoted at the public Redside Dace display at the Toronto Zoo. The Zoo has also developed a brochure, a curriculum package and a display focusing on Redside Dace with support from Canada's Habitat Stewardship Program for Species at Risk.

Incentives and Protection Approaches

A report entitled "Redside Dace Conservation in the Greater Golden Horseshoe: An Exploration of Innovative Approaches 2008" was prepared by Savanta that identified possible alternatives for protecting Redside Dace populations including innovative incentive programs, the use of protected areas, and using low impact urban development design.

2.0 RECOVERY

2.1 Recovery Goal

The long-term goal of this recovery strategy is to restore viable populations of Redside Dace in a significant portion of their historic range in Ontario by:

i) protecting existing healthy, self-sustaining populations and their habitats;
ii) restoring degraded populations and habitats; and
iii) re-establish Redside Dace to sites of former distribution where feasible.

2.2 Protection and Recovery Objectives

Table 5. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Determine distribution and abundance of extant populations
2	Maintain the current geographical distribution and abundance of Redside Dace through habitat protection and other measures
3	Establish a long-term monitoring program to assess the status of Redside Dace and its habitats
4	Generate awareness regarding the significance of Redside Dace and protection and stewardship of its habitats
5	Rehabilitate degraded Redside Dace habitats and identify candidate areas for re-introductions

2.3 Approaches to Recovery

The approaches to recovery have been organized into the four categories: (1) Protection of Existing Populations and Habitats, (2) Rehabilitation of Degraded Populations and Habitats, (3) Research and Monitoring, and (4) Community Awareness and Outreach. These categories are not exclusive in nature and successful implementation of some strategies will require coordinated efforts. A narrative is included at the end of each section where further explanation is warranted.

Table 6. Management approaches to protect existing populations and habitats

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
High	1 & 2	Habitat Protection – habitat mapping	Maintain Redside Dace distribution database to identify Redside Dace habitat and transfer this information to appropriate planning authorities and Natural Heritage Information Centre.	Will provide current information on the distribution of Redside Dace for the protection of habitat during the planning and review of proposals for development and work in and adjacent to Redside Dace streams.
High	2	Habitat Protection – Habitat Mapping Guidelines	Develop Provincial Habitat Mapping Guidelines to identify and protect Redside Dace habitat.	Redside Dace habitat will be protected through application of the Provincial Policy Statement and the ESA 2007.
High	2 & 4	Habitat Protection – guidelines/awareness	Hold a one-day workshop with OMNR, conservation authorities, municipal staff and planning and review agencies to develop urban development guidelines for the protection of Redside Dace habitat.	Will lead to the development of habitat protection guidelines and should increase awareness of agencies regarding decisions that may impact Redside Dace habitat.
High	2	Habitat Protection – timing windows	Provide input to OMNR on the development of in water timing windows for watersheds with Redside Dace.	Will provide protection to Redside Dace populations from in stream works during the sensitive spawning and incubation period.
Medium	2 & 4	Habitat Protection – planning	Encourage planning authorities to incorporate the goal of protecting Redside Dace habitat into Official Plans, Watershed Management Plans, and Fisheries Management Plans.	Will provide additional protection for Redside Dace when development proposals are planned and reviewed.
Medium	2 & 4	Habitat Protection – Growth Management	Encourage the incorporation of the goal of protecting Redside Dace into regional Growth Management Plans.	Will provide additional protection for Redside Dace habitat.

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
Medium	1 & 2	Habitat Protection – habitat mapping	Conduct field work to further refine and map Redside Dace distribution.	Will improve ability to protect important habitat features.
Medium	2	Habitat Protection - securement	Acquire lands that support healthy populations of Redside Dace as species conservation reserves	Will protect Redside Dace population source areas
Medium	2	Habitat Protection – drainage	Work with drainage superintendents, drainage engineers and contractors, to minimize or eliminate the effects of drainage works on Redside Dace habitat.	Will protect Redside Dace habitat that may be impacted by drain maintenance activities.
Medium	2	Harvest Management – baitfish	Work with baitfish harvesters and the Bait Association of Ontario to protect and monitor Redside Dace populations and distribution.	Will protect Redside Dace from incidental harvest and provide information dissemination.
Medium	2	Introductions – intentional fish introductions	Ensure that potential impacts on Redside Dace populations are considered when introductions are proposed in Redside Dace waters.	Will protect Redside Dace populations from undesirable affects associated with planned introductions.
Medium	2	Introductions – barriers	Ensure that the potential invasion of Redside Dace waters by undesirable species is considered when removal of barriers is contemplated.	Will reduce the potential impact of undesirable species invasions on Redside Dace.

It is recognized that activities on the landscape beyond the associated riparian habitat can have profound cumulative impact(s) on Redside Dace habitat, particularly in urban areas. It is also important to note that Best Management Practices (BMP's) limited to stream channel considerations have typically been ineffective in addressing changes in water balance. Therefore, recovery actions are necessary at the broader watershed level to protect and rehabilitate habitat. Factors such as the percent impervious cover at a subwatershed scale and stormwater management practices can have hydrologic and thermal impacts on highly sensitive stream channels. Urban Development Guidelines and appropriate water quality standards will need to be developed to help address these concerns, but the area recommended for regulation (section 2.5) does

not extend beyond the associated riparian zone. It must be recognized, however, that activities that occur outside of the associated riparian zone can damage or destroy habitat, particularly when they negatively impact the existing magnitude, timing and frequency of flows. Such impacts need to be effectively mitigated.

As part of the consideration of landscape level impacts on habitat, the recovery team recognizes the Growth Plan for the Greater Golden Horseshoe 2006 prepared under the *Provincial Places to Grow Act, 2005*. The plan sets out population, density and employment targets. It is intended to support growth through good planning which may require high density development or re-development in some urbanized areas and limiting urban sprawl in other areas. The Redside Dace Recovery Team acknowledges that intensively developed areas will present additional challenges to the effective protection of Redside Dace and its habitat. For this reason, it is especially important that sub-watersheds supporting Redside Dace in areas not yet developed and outside of designated high density growth areas be effectively managed and protected.

Habitat Protection – Habitat Mapping Guidelines

Provincial Habitat Mapping Guidelines need to be developed for the identification of Redside Dace habitat. These can then be used to protect Redside Dace habitat during municipal planning through application of the Provincial Policy Statement under the *Planning Act* and when developing a habitat regulation for Redside Dace under the ESA 2007. The recommendations described in section 2.5 of this recovery strategy should be considered when these guidelines are developed.

Habitat Protection – Guidelines/Awareness

The purpose of this workshop should be to develop guidelines for urban development that will maintain or enhance stream channel form and function to protect or restore Redside Dace habitat. Key topics that should be addressed include (but should not be limited to) storm water management, sediment control within developing areas, maintaining a pre-development hydrograph (consider threshold values for impervious cover in catchment areas where Redside Dace reside), and low impact development options. The most effective means for dissemination of guidelines to planning authorities should also be investigated.

Fish Introductions

Although interactions between Redside Dace and introduced fishes have not been specifically studied, Redside Dace declines have been observed after the introduction of predatory fishes and minnow species in Ontario streams. A precautionary approach should be taken with respect to intentional introductions and the removal of barriers that might lead to introductions in Redside Dace streams. Removal of barriers should be encouraged in areas where Redside Dace populations have been fragmented and the removal of the barrier will not result in the upstream introduction of new species. Salmonids (especially Brown Trout), Northern Pike, centrarchids (bass and sunfishes) and other cyprinids (minnows) are species of particular concern in this regard.

Table 7. Management approaches to rehabilitate degraded populations and habitats

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
High	3 & 5	Habitat Improvement – rehabilitation	Evaluate health of all Redside Dace populations and habitats to identify degraded Redside Dace populations/ habitats and investigate the feasibility of restoring riparian areas, headwater features and hydrologic functions.	Will allow for the identification of recovery habitats and establish priorities for rehabilitation projects.
High	5	Habitat Improvement – rehabilitation	Continue/complete riparian and in-stream works on existing rehabilitation projects and initiate rehabilitation projects on top priority streams.	Will improve Redside Dace habitat in streams where its abundance/ range has been reduced, allowing for re-colonization/re-introduction.
High	2 & 5	Habitat Improvement – best management practices	Encourage the use of best management practices in rural streams to restore a healthy riparian zone, reduce livestock access, establish manure storage and runoff collection systems, encourage conservation tillage and reduce the impact of tile drains. Financial incentives should be offered as part of a stewardship program. Riparian rehabilitation should focus on the re-establishment of grasses and shrubs.	Will improve Redside Dace habitat by reducing agricultural runoff and bank erosion, thereby limiting the input of sediments and nutrients from agricultural lands.
Medium	5	Re-introductions – artificial rearing	Investigate the feasibility of artificial propagation versus wild fish transfers for Redside Dace re-introductions.	This will provide a source for Redside Dace re-introductions and potentially a refuge for threatened native populations.
Medium	5	Re-introductions	Identify candidate streams for re-establishing Redside Dace. Re-introductions should be restricted to areas of former occurrence where	Will increase the number and range of Redside Dace occurrences.

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
			suitable habitat occurs or has been restored and where no obvious impediments to re-establishment exist. Strain considerations will be contingent on genetics work.	
Low	2, 4 & 5	Habitat Improvement – farm planning	Encourage development of Environmental Farm Plans and Nutrient Management Plans where these are not required by law.	Provides for additional habitat protection and improvement in relation to farming practices.

Habitat Improvement – rehabilitation

The current status of all Ontario populations and their habitats needs to be assessed to identify priority sites for restoration (e.g., riparian rehabilitation, restoration of hydrology). Redside Dace populations have declined in the Saugeen River drainage, Irvine Creek, West Holland River, Spencer Creek, Bronte Creek, Fourteen Mile Creek, some Credit River tributaries, Don River, some Rouge River tributaries, and Lynde Creek (COSEWIC 2007). Redside Dace are also probably extirpated from an unnamed creek in Clarkson, Highland Creek, Morrison Creek, Pringle Creek, Petticoat Creek, Etobicoke Creek, Mimico Creek and a watershed on the Niagara peninsula. The removal of barriers should also be considered to re-connect populations that have been fragmented where possible. Although apparently healthy populations are found in a few streams where protective measures may be adequate (Sixteen Mile Creek, East Humber River, some Rouge River tributaries), the status of several populations is unknown. The feasibility of rehabilitating or restoring degraded and extirpated populations has not been assessed. It is likely that restoration is not feasible in some watersheds due to the extent and nature of changes in the watershed.

Table 8. Research and monitoring approaches

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
High	1 & 3	Monitoring – element occurrences	Establish a standard broad-scale monitoring program to assess presence/absence through time in streams throughout the Ontario range of Redside Dace.	Will provide an ongoing assessment of occupied range in Ontario.
High	1 & 3	Monitoring – population and habitat assessment	Establish an index site-specific monitoring program to assess temporal changes in population abundance and habitat conditions resulting from	Will allow an assessment of the effects of restorative actions and the condition of Redside Dace populations and habitats at specific sites.

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
			restorative actions and to compare disturbed versus undisturbed sites.	
High	3	Monitoring – fluvial geomorphology	Conduct fluvial geomorphological assessments of select Redside Dace habitats (good sites versus poor sites).	Will describe Redside Dace habitat with regard to channel form and flow necessary from an engineering perspective to develop urban development guidelines, and contribute to the design of habitat for restoration projects.
High	2 & 3	Research – habitat and life history requirements	Identify important habitats required for spawning, incubation and larval development. Investigate seasonal use of habitat, particularly over-wintering areas. Investigate movements and physiological tolerances	Will improve ability to identify and protect Redside Dace habitat.
High	2	Research – urban and agricultural impacts	Identify key factors associated with urban development and agricultural practices that may contribute to declines in Redside Dace populations. Investigate the effects of these factors on Redside Dace population dynamics. Impacts of aggregate operations and water taking should also be investigated.	Will improve ability to both protect and enhance Redside Dace habitat through urban planning and the use of best management practices.
Medium	3	Monitoring – riparian health assessment	Conduct an inventory of riparian buffer areas and their health on all Redside Dace streams.	Will identify areas in most need of attention and will allow for the assessment of best riparian conditions (i.e., forested versus grass and shrub).
Medium	2 & 5	Research – genetics	Examine global and local variation in genetic diversity of Redside Dace populations through DNA and allozyme	Will provide information regarding effects of fragmentation and inbreeding depression, and the importance of source strains for re-

Priority	Objective Number	Broad Approach	Specific Steps	Anticipated Effect
			analysis.	introductions.
Medium	2	Research – fish introductions	Investigate the impacts of species that have been introduced into Redside Dace streams (salmonids, centrarchids, Northern Pike, other cyprinids).	Will allow for the protection of populations from harmful impacts of introductions.

Monitoring

Most of the monitoring of Redside Dace populations in Ontario has been ad hoc or has been incidental to other sampling programs. Given the number of Redside Dace streams, it is important to conduct regular extensive monitoring to assess presence/absence on an ongoing basis. It is also important to conduct more intensive monitoring to assess habitat and population abundance at select index sites. This will allow for a more detailed assessment of temporal trends at representative sites in the province. A standard protocol that has been developed and adopted for extensive and intensive monitoring programs needs to be evaluated and refined.

Research

Only the highest priority research needs are identified in the approaches table above. Additional research requirements are identified in section 1.6 of this Strategy. Wherever possible, the recovery team will encourage the involvement of graduate students and fourth-year undergraduates to address Redside Dace research questions. The recovery team will also collaborate with other groups that are addressing similar issues at a watershed scale (e.g., conservation authorities, university researchers).

Table 9. Community awareness and outreach

Priority	Objective No.	Broad Approach	Specific Steps	Anticipated Effect
High	2 & 4	Awareness – strategy	Develop a Redside Dace awareness plan to guide awareness efforts.	The plan will identify audiences, develop conservation messages and encourage media support to deliver the awareness program.
High	2 & 4	Awareness – outreach	Foster public support and awareness by developing appropriate materials and programs identified in the plan.	This will improve understanding of conservation messages within the general public, landowners, developers, municipalities and other stakeholders to stimulate community support for recovery efforts.
Medium	2 & 4	Habitat Protection – incentives	Make landowners aware of existing	Will increase the number of landowners

Priority	Objective No.	Broad Approach	Specific Steps	Anticipated Effect
			incentive programs for conservation lands (Ecological Gifts Program, easements, Conservation Land Tax Incentive Program).	participating in incentive programs that protect habitat.

Awareness

The development of an awareness plan is necessary to provide for a coordinated approach to the production and distribution of awareness materials. The goal of the plan will be to generate awareness regarding the significance of Redside Dace and the protection of their habitats to promote private land stewardship and help engender public support for implementation of recovery actions. The plan will address several different target audiences including government agencies, municipalities, developers, environmental groups, stewardship councils, the farming community, school groups and other stakeholders. The plan will identify potential funding sources and partners that will assist in delivering the awareness program.

2.4 Performance Measures

Evaluation of the approaches to recovery set out in this recovery strategy should be largely accomplished through the extensive and intensive monitoring programs. These programs should assess the number of extant occurrences, the extent of occupied range, as well as population and habitat trends at specific sites. Evaluation measures should also be incorporated into the awareness plan to assess the effectiveness of awareness efforts. This recovery strategy should be reviewed in 5 years to evaluate the progress on stated objectives and to identify additional approaches and changes that may be required. Improved information on range and abundance may permit the development of quantitative population targets.

2.5 Area for Consideration in Developing a Habitat Regulation

Under the ESA 2007, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the recovery team will be one of many sources considered by the Minister when developing the habitat regulation for this species.

Redside Dace habitat may be negatively impacted by human activities and developments. Habitat protection is required to protect the area on which the Redside Dace depends, directly or indirectly, to carry on its life processes, including reproduction, rearing, migration and feeding.

It is recommended that all reaches (aquatic resource areas[1] as defined by OMNR) currently occupied by Redside Dace be regulated as habitat under the ESA 2007. Reaches in formerly occupied watersheds that have been targeted for restoration and where there is a high likelihood of successful habitat rehabilitation and repatriation of Redside Dace, should also be considered for inclusion in the regulation.

The integrity of headwater areas[2]upstream of reaches currently occupied[3] by Redside Dace is also extremely important. Headwater streams, groundwater discharge areas and wetlands play an important physical role in augmenting and maintaining baseflows, coarse sediment supply and surface water quality, and the protection of headwater systems should be given a high priority in freshwater conservation efforts (Saunders et al. 2002). It is recommended that headwater streams, groundwater discharge areas and wetlands that physically support the reaches occupied by Redside Dace also be regulated as habitat of the species.

Redside Dace habitat consists of two elements. The first element includes bankfull stream width[4] within the aquatic resource area. The second element of habitat includes the meander belt width of the stream and associated riparian habitat that is a minimum of 30 metres from the meander belt[5] (measured horizontally). This is consistent with science-based guidelines recently developed for guiding habitat rehabilitation in Great Lakes Areas of Concern which recommend a minimum of 30 metres of naturally vegetated adjacent lands on both sides of the stream (Environment Canada 2004). The inclusion of the meander belt width and associated riparian habitat recognizes the naturally dynamic nature of riverine systems and the importance of riparian areas to highly sensitive stream ecosystems. Watercourses move and change over time within the meander belt (OMNR 2001). Pools which provide habitat for Redside Dace are normally found on the outside bends of a meandering stream. Therefore, defining riparian habitat from the edge of the meander belt will provide habitat for Redside Dace over the long-term as opposed to simply based on the current observed conditions. Protection of riparian areas helps to maintain channel morphology characteristics over time, filters surface runoff containing sediment and nutrients, and provides shade, cover and terrestrial insect food. All of these elements are necessary for the long-term survival of Redside Dace. Existing structures constructed by humans (e.g., buildings, roads) that are within the associated riparian habitat should not be considered habitat. These recommendations should also be considered when Habitat Mapping Guidelines for the identification of habitat of Redside Dace are being developed in relation to the Provincial Policy Statement (section 2.3).

[1] Aquatic Resource Areas are aggregations of stream segments with similar physical and biological characteristics.

[2] Headwater areas or features are small channels or depressions that directly influence the hydrology, sediment supply or food supply of flowing streams and rivers

[3] Occupied based on a record within the past 20 years within the Aquatic Resource Area

[4] Bankfull stream width is the width of the stream or river at bankfull discharge which is the flow at which water begins to leave the channel and move into the floodplain.

[5] The meander belt is the land area on either side of a watercourse representing the furthest potential limit of channel migration. Areas within the meander belt may some day be occupied by the watercourse; areas outside of the meander belt will not.

GLOSSARY

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure

Endangered Species Act, 2007 (ESA 2007): The provincial legislation that provides protection to species at risk in Ontario.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk to which the SARA provisions apply. Schedules 2 and 3 contain lists of species that at the time the act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

Viable: Self-sustaining over the long term.

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