

Report on the Progress of Management Plan
Implementation for the Blackstripe Topminnow,
Pugnose Minnow, Spotted Sucker and Warmouth in
Canada for the Period 2009 to 2015

Blackstripe Topminnow, Pugnose Minnow, Spotted
Sucker, and Warmouth



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Cover illustration: Clockwise from upper left: Blackstripe Topminnow, Pugnose Minnow, Warmouth, and Spotted Sucker. Blackstripe Topminnow, Pugnose Minnow and Spotted Sucker © Konrad Schmidt.

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Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk](#) (1996) agreed to establish complementary legislation and programs that provide for the protection of species at risk throughout Canada. Under section 72 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the management plan for a species at risk with a special concern status, and on the progress towards meeting its objectives within five years of the date when the document was placed on the Species at Risk Public Registry and in every subsequent five-year period, until its objectives have been achieved, or the species becomes threatened or endangered under SARA, at which point a recovery strategy would be required.

Reporting on the progress of management plan implementation requires reporting on the collective efforts of the competent minister(s), provincial and territorial governments, and all other parties involved in conducting activities that contribute towards the conservation of the species. Management plans identify broad strategies and conservation measures that will provide the best chance of conserving species at risk. Some of the identified strategies and measures are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the time frame of a report on the progress of management plan implementation (progress report).

The Minister of Fisheries and Oceans is the competent minister under SARA for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth. Since Warmouth is located in Point Pelee National Park of Canada, the Minister responsible for the Parks Canada Agency (PCA), is also a competent minister under SARA for this species. The Minister of Fisheries and Oceans and the Minister responsible for the PCA have prepared this progress report.

As stated in the preamble to SARA, success in the conservation of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the management plan and will not be achieved by Fisheries and Oceans Canada (DFO) and PCA, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the “Management Plan for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada” for the benefit of the species and Canadian society as a whole.

Acknowledgments

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Executive summary

The Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth were all listed as special concern under the *Species at Risk Act* (SARA) in 2003. Pugnose Minnow was up-listed to threatened in 2019. The “Management Plan for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada” was finalized and published on the Species at Risk Public Registry in 2009.

The main threats identified for these species include habitat loss and degradation, sediment loading, and nutrient loading. Additional threats include oil seepage, invasive species, altered coastal processes, toxic compounds, climate change, incidental harvest, and barriers to movement.

The long-term management goal for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth is to maintain or enhance existing populations in Canada and to improve the quality and quantity of their associated habitats.

During the time period reported by this progress report, progress has been made in many areas including: an increased understanding of the range and extent of Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada; the determination of the most applicable gear for sampling Blackstripe Topminnow; the evaluation of the effects of threats, specifically the invasive species Common Reed on Warmouth habitat, as well as the efficacy of related restoration projects; the implementation and promotion of best management practices leading to reduced sedimentation and nutrient loading in locations such as [Rondeau](#) and Long Point bays; and, the delivery of information sessions focused on species at risk and their habitat to conservation authorities, drainage supervisors, contractors, consultants, and municipal planners.

Overall, these ongoing and/or completed activities indicate that a substantial degree of progress has been made towards the goal of conserving these four species in Canada; however, there are still a number of species-specific research questions stemming from the management plan that remain unanswered. For example, no research has yet been conducted that explores the potential for interspecific competition between Warmouth and Green Sunfish. Furthermore, investigations into the potential impacts of various contaminants on Warmouth have not yet been undertaken. For this reason, it may be beneficial to focus future management activities on filling these knowledge gaps.

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1 Introduction

The “Report on the Progress of Management Plan Implementation for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada for the Period 2009 to 2015¹” (progress report) outlines the progress made towards meeting the conservation measures listed in the “Management Plan for the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada” (management plan) during the indicated time period and should be considered as part of a series of documents that are linked and should be taken into consideration together, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports ([COSEWIC 2005a](#); [COSEWIC 2005b](#); [COSEWIC 2012a](#); [COSEWIC 2012b](#); [COSEWIC 2014](#); [COSEWIC 2015](#)) and the management plan (Edwards and Staton 2009).

Section 2 of the progress report reproduces and summarizes key information on the challenges the species are facing, management objectives for conserving the species, and activities to achieve the management objectives. For more details, readers should refer to the management plan. Section 3 reports on the progress of activities identified in the management plan to support achieving the management objectives. Section 4 summarizes the progress made and the outcome of the conservation efforts.

2 Background

2.1 COSEWIC assessment summary

The listing of the Blackstripe Topminnow (*Fundulus notatus*), Pugnose Minnow (*Opsopoeodus emiliae*), Spotted Sucker (*Minytrema melanops*), and Warmouth (*Lepomis gulosus*) under the *Species at Risk Act* (S.C 2002, c.29) (SARA) in 2003 led to the development and publication of the management plan in 2009. The management plan is consistent with the information provided in the COSEWIC status reports (COSEWIC 2000; COSEWIC 2001; COSEWIC 2005a; COSEWIC 2005b). This information has also been included in section 1.1 of the management plan.

Assessment summary: May 2001

Common name (population): Blackstripe Topminnow

Scientific name: *Fundulus notatus* (Rafinesque, 1820)

COSEWIC status: Special concern

Reason for designation: This species has a limited distribution in southwestern Ontario where it is impacted by habitat degradation and loss from industrial, urban and agricultural development.

Canadian occurrence: Ontario

COSEWIC status history: Designated special concern in April 1985. Status re-examined and confirmed as special concern in May 2001.

In 2012, COSEWIC re-examined and confirmed the status of the Blackstripe Topminnow as special concern (COSEWIC 2012a).

¹ The reporting period is from 2009 to 2015; however, the scheduling of some actions are reported between 2013 to 2016, which is within the reporting period.

Assessment summary: May 2012

Common name (population): Blackstripe Topminnow

Scientific name: *Fundulus notatus* (Rafinesque, 1820)

COSEWIC status: Special concern

Reason for designation: This small-bodied fish is found in a single river system across approximately ten locations in southwestern Ontario. Its habitat has been degraded owing to urbanization, industrialization, intensive agricultural activity, and the removal of streamside vegetation. Although the species is relatively tolerant of low oxygen levels and high sediment loads, if its habitat quality declines further it could become threatened.

Canadian occurrence: Ontario

COSEWIC status history: Designated special concern in April 1985. Status re-examined and confirmed in May 2001 and May 2012.

Assessment summary: May 2000

Common name (population): Pugnose Minnow

Scientific name: *Opsopoeodus emiliae* (Hay, 1881)

COSEWIC status: Special concern

Reason for designation: This small minnow species is limited to a small area of southwestern Ontario and is susceptible to aquatic plant removal and siltation.

Canadian occurrence: Ontario

COSEWIC status history: Designated as special concern in April 1985. Status re-examined and confirmed in May 2000. Last assessment based on an update status report.

In 2012, COSEWIC re-examined and changed the status of the Pugnose Minnow from special concern to threatened (COSEWIC 2012b).

Assessment summary: May 2012

Common name: Pugnose Minnow

Scientific name: *Opsopoeodus emiliae*

Status: Threatened

Reason for designation: This fish is a small-bodied species with a restricted and declining distribution that inhabits river, stream and lake habitats. The species is threatened by habitat loss, habitat degradation from nutrient and sediment loading, climate change and several exotic species. The overall level of threat has been assessed as high.

Occurrence: Ontario

Status history: Designated special concern in April 1985. Status re-examined and confirmed in May 2000. Status re-examined and designated Threatened in May 2012.

Assessment summary: May 2005

Common name (population): Spotted Sucker

Scientific name: *Minytrema melanops* (Rafinesque, 1820)

COSEWIC status: Special concern

Reason for designation: This freshwater fish species is restricted to southwestern Ontario. The greatest threat to this species is habitat degradation through increased erosion and turbidity. The species is also at risk in Pennsylvania but not at risk in Michigan (where it is S3-vulnerable), making rescue effect moderate at best.

Canadian occurrence: Ontario

COSEWIC status history: Designated special concern in April 1983. Status re-examined and confirmed in April 1994, November 2001 and May 2005. Last assessment based on an update status report.

In 2014, COSEWIC re-examined and confirmed the status of the Spotted Sucker as special concern (COSEWIC 2014).

Assessment summary: November 2014

Common name (population): Spotted Sucker

Scientific name: *Minytrema melanops* (Rafinesque, 1820)

COSEWIC status: Special concern

Reason for designation: This species is a relatively rare fish that inhabits lakes and rivers in southwestern Ontario. Its spatial distribution has remained relatively constant in these environments but there are indications that occurrence has declined in the Lake Erie part of its range. Specific threats are poorly understood, but the species is likely sensitive to high turbidity, which is common in the degraded environments it inhabits. The species may become threatened if factors suspected of negatively influencing its persistence are neither reversed nor managed effectively.

Canadian occurrence: Ontario

COSEWIC status history: Designated special concern in April 1983. Status re-examined and confirmed in April 1994, November 2001, May 2005, and November 2014.

Assessment summary: May 2005

Common name (population): Warmouth

Scientific name: *Lepomis gulosus* (Cuvier, 1829)

COSEWIC status: Special concern

Reason for designation: This species has a very restricted Canadian distribution, existing at only 4 locations along the Lake Erie shore between Point Pelee and Long Point. It is sensitive to habitat change which results in loss of aquatic vegetation.

Canadian occurrence: Ontario

COSEWIC status history: Designated special concern in April 1994. Status re-examined and confirmed in November 2001 and in May 2005. Last assessment based on an update status report.

In 2015, COSEWIC re-examined and changed the status of the Warmouth from special concern to endangered (COSEWIC 2015).

Assessment summary: May 2015

Common name: Warmouth

Scientific name: *Lepomis gulosus*

Status: Endangered

Reason for designation: This species of sunfish has a very small distribution in Canada, occurring only within the Lake Erie drainage. It exists at few locations and is subjected to continuing decline in habitat quality due to a complexity of ecosystem modifications to its preferred vegetated habitat, primarily from the establishment of dense beds of non-native aquatic plants and eutrophication resulting from agricultural runoff.

Occurrence: Ontario

Status history: Designated special concern in April 1994. Status re-examined and confirmed in November 2001 and in May 2005. Status re-examined and designated Endangered in May 2015.

2.2 Threats

This section summarizes the information found in the management plan (Edwards and Staton 2009) on threats to the conservation of the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth.

Table 1 summarizes the species-level threats to the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth. Please refer to section 5 of the management plan (Edwards and Staton 2009) for more information on these threats. Since the publication of the management plan, a recovery potential assessment (RPA) has been completed for Pugnose Minnow, which includes changes to the threat list and associated impact levels (table 2). For Warmouth, it currently appears that invasive species are now likely the highest threat. In this case, the increased expansion of the invasive species European Common Reed (*Phragmites australis australis*) is the main mechanism driving habitat loss and degradation within the Lake Erie coastal wetlands where Warmouth is found. For instance, Gilbert and Locke (2007) documented that available wetted habitat within [Rondeau Bay](#) has been reduced as a consequence of the expansion of dense Common Reed stands. Similarly, the habitat within areas of Long Point Bay has also been greatly altered by the growth of dense stands of this invading plant species. For example, between 1999 and 2006, Common Reed stands expanded in surface area by 27.8, 12.9, 33.9, and 48% in the Crown Marsh, the Long Point Company Marsh, the tip of Long Point, and the Big Creek Marsh, respectively (Badzinski et al. 2008). More recently, modelling studies conducted in the Crown Marsh, Long Point Bay, have predicted that European Common Reed will continue to expand its range out into the wetland, significantly decreasing open-water habitat, based on projected water-level reductions attributable to climate change (W. Glass, Fisheries and Oceans Canada [DFO], pers. comm., 2016).

It has been postulated that the increased expansion of Common Reed within coastal wetlands of Lake Erie has been expedited by water level declines, increased air temperatures, and potentially both anthropogenic and natural disturbances (Wilcox et al. 2003). In addition, further declines in water levels, paired with an increase in extreme weather events, are expected as a result of climate change and will likely continue to promote the expansion of Common Reed along coastal Great Lakes shorelines (Alexander 2012). The spread of Asian carp species within Lake Erie may also pose a significant future threat to Warmouth in coastal wetland

habitats. Grass Carp (*Ctenopharyngodon idella*) has recently been detected within the Lake Erie basin, and spawning has been confirmed within a tributary of this watershed (Chapman et al. 2013; Embke et al. 2016). Furthermore, Grass Carp has been documented to directly reduce macrophyte abundance through consumption leading to indirect impacts on a number of freshwater game and cyprinid species (Wittmann et al. 2014). Therefore, the establishment of this invasive species will likely lead to degraded habitat for Warmouth within [Rondeau](#) and Long Point bays.

In addition to the threats listed in table 1, recent research has also identified drain maintenance activities as a driver of habitat loss and degradation for Blackstripe Topminnow, Pugnose Minnow, and Spotted Sucker (S. Reid, Ontario Ministry of Natural Resources and Forestry [OMNRF], pers. comm., 2015). Although threats have been listed for Pugnose Minnow in Edwards and Staton (2009) and Bouvier and Mandrak (2013), the latter document indicates that there is a lack of information within the literature regarding the specific effect these threats have on Pugnose Minnow. For this reason, threat evaluation research is of great importance for the recovery of this species.

Table 1. Summary of the population-level threats identified for Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth, based on the management plan (Edwards and Staton 2009).

Species	Specific threat	Extent (widespread/localized)	Frequency (seasonal/continuous)	Causal certainty (high, medium, low)	Severity (high, medium, low)	Overall level of concern (high, medium, low)
Blackstripe Topminnow	Habitat loss and degradation	Widespread	Continuous	High	Unknown	Medium
Blackstripe Topminnow	Oil seepage	Localized	Seasonal	Low	Unknown	Low
Blackstripe Topminnow	Channelization	Unknown	Unknown	Unknown	Unknown	Unknown
Pugnose Minnow	Habitat loss and degradation	Widespread	Continuous	High	High	High
Pugnose Minnow	Sediment loadings	Widespread	Continuous	High	High	High
Pugnose Minnow	Nutrient loadings	Widespread	Seasonal	High	High	High
Pugnose Minnow	Exotic species	Widespread	Continuous	Low	High	Medium
Pugnose Minnow	Altered coastal processes	Widespread	Continuous	Unknown	Unknown	Unknown
Pugnose Minnow	Climate change	Widespread	Continuous	Low	Medium	Medium
Pugnose Minnow	Incidental harvest	Unknown	Unknown	Unknown	Unknown	Unknown
Pugnose Minnow	Barriers to movement	Unknown	Unknown	Unknown	Unknown	Unknown
Spotted Sucker	Habitat loss and degradation	Widespread	Continuous	High	High	Medium
Spotted Sucker	Sediment loadings	Widespread	Continuous	Medium	High	Medium
Spotted Sucker	Nutrient loadings	Widespread	Continuous	High	High	Medium
Spotted Sucker	Exotic species	Widespread	Continuous	Low	High	Medium
Spotted Sucker	Barriers to movement	Localized	Continuous	Unknown	Unknown	Unknown
Spotted Sucker	Altered coastal processes	Widespread	Continuous	Unknown	Unknown	Unknown
Spotted Sucker	Toxic compounds	Widespread	Continuous	Unknown	Unknown	Unknown
Spotted Sucker	Climate change	Widespread	Continuous	Low	Medium	Low
Spotted Sucker	Incidental harvest	Localized	Seasonal	Low	Low	Low
Warmouth	Habitat loss and degradation	Widespread	Continuous	High	Medium	Medium
Warmouth	Sediment loadings	Widespread	Continuous	High	Medium	Medium
Warmouth	Nutrient loadings	Widespread	Continuous	High	Medium	Medium
Warmouth	Exotic species	Widespread	Continuous	Low	High	Medium
Warmouth	Altered coastal processes	Widespread	Continuous	Unknown	Unknown	Unknown
Warmouth	Climate change	Widespread	Continuous	Low	Medium	Medium
Warmouth	Toxic compounds	Unknown	Seasonal	Low	Unknown	Low
Warmouth	Barriers to movement	Localized	Continuous	Low	Unknown	Low
Warmouth	Changes to trophic dynamics	Localized	Unknown	Low	Unknown	Low

Table 2. Threat level for all Pugnose Minnow populations in Canada (taken from Bouvier and Mandrak 2013), resulting from an analysis of both the threat likelihood and threat impact. The number in brackets represents the level of certainty assigned to the threat impact and was classified as: 1=causative studies; 2=correlative studies; and, 3=expert opinion.

Threats	Lake St. Clair and tributaries	Detroit River
Turbidity and sediment loading	High (3)	Medium (3)
Nutrient loading	High (3)	Medium (3)
Habitat alteration	High (3)	High (3)
Contaminants and toxic substances	High (3)	High (3)
Invasive species	Low (3)	Low (3)
Incidental harvest	Low (1)	Low (1)

2.3 Management

This section summarizes the information found in the management plan (Edwards and Staton 2009), on the management goal and objectives necessary for the conservation of the Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth.

2.3.1 Goal

The long-term goal of the management plan (over the next 20 years) is to maintain, or enhance, existing populations of Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada, and to improve the quality and quantity of their associated habitats.

2.3.2 Objectives

The following short-term objectives (over the next 5 to 10 years) have been identified to assist in achieving the management goal:

- i. to understand the health and extent of existing populations
- ii. to improve our knowledge of the species' biology, ecology and habitat requirements
- iii. to understand trends in populations and habitat
- iv. to maintain and improve existing populations
- v. to ensure the efficient use of resources in the management of these species
- vi. to improve awareness of these species and engage the public in conservation of these species

3 Progress towards conservation

The management plan (Edwards and Staton 2009) outlines six actions to be taken to achieve the management objectives: 1) background surveys; 2) monitoring; 3) research; 4) management and coordination; 5) outreach and communication; and 6) stewardship and habitat improvement. Progress in carrying out these actions is reported in table 3, section 3.1.

3.1 Actions supporting management objectives

Table 3 provides information on the implementation of activities undertaken to achieve the management objectives identified in the management plan. Each activity has been assigned one of four statuses:

- 1) completed: the planned activity has been carried out and concluded
- 2) in progress: the planned activity is underway and has not concluded
- 3) not started: the activity has been planned but has yet to start
- 4) cancelled: the planned activity will not be started or completed

Table 3. Status of activities undertaken to achieve the management objectives identified in the management plan for Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth. Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all activities have specific participants identified. Some of the details and participants of the activities to support the actions only apply to specific species. The relevant species are identified by superscripted numbers in the table (see footnotes at the end of the table).

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Background surveys	Blackstripe Topminnow	Surveys in Black Creek, Bear Creek, East Otter Creek, Whitebread Drain, Little Bear Creek	2009 to 2015	Completed	<p>Targeted sampling for Blackstripe Topminnow has occurred at two sites in Black Creek yielding 29 Blackstripe Topminnow. Non-targeted sampling was conducted within these watersheds leading to detections in East Otter Creek (six), Whitebread Drain (two) and Little Bear Creek (100).</p> <p>310 Blackstripe Topminnow were captured from six other locations within the known range of the species during non-targeted surveys.</p> <p>Non-targeted surveys were conducted within the Sydenham River watershed leading to the detection of 97 and 141 Blackstripe Topminnow within the north and main branches, respectively.</p> <p>In addition, a total of 222 Blackstripe Topminnow were detected during an Ontario Ministry of Natural Resources and Forestry (OMNRF) gear evaluation study among 12 sites within the Sydenham River watershed in 2010 and 2011.</p>	i, ii	<p>Fisheries and Oceans Canada (DFO), OMNRF, St. Clair Region Conservation Authority (SCRCA), Upper Thames River Conservation Authority (UTRCA), University of Toronto (UT), McGill University</p>

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Background surveys	Pugnose Minnow	Surveys in North Sydenham River, Bear Creek, Black Creek, Whitebread Drain, East Sydenham River, Long Point Bay	2009 to 2015	Completed	<p>Targeted sampling for Pugnose Minnow occurred at three of the six locations identified in the management plan including the North Sydenham River (0 detected), Whitebread Drain (0 detected) and the East Sydenham River (56 detected). Targeted sampling remains to be completed in Bear and Black creeks as well as Long Point Bay; although, the historical presence of Pugnose Minnow at this last location may be based on faulty evidence.</p> <p>Further targeted sampling for this species was conducted at Otter, West Otter, East Otter, Maxwell, Indian, Big and Little Bear creeks with 11 individuals captured at the last location.</p>	i, ii	DFO, OMNRF, Long Point Region Conservation Authority (LPRCA), SCRCA, UTRCA

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Background surveys	Spotted Sucker	Surveys in Belle River, River Canard, Thames River, Whitebread Drain, Sydenham River	2009 to 2015	Completed	<p>Although no targeted sampling for Spotted Sucker has been conducted at these locations by DFO, a number of non-targeted sampling events occurred, which used gear types suitable for detecting Spotted Sucker. A total of 129 specimens were captured as a result of these surveys, including at two new locations within Cedar and Baptiste creeks.</p> <p>Targeted sampling was conducted by OMNRF in the Canard (six sites) and Belle (seven sites) rivers, as well as Duck Creek (one site). From these sampling events, five specimens were detected at two locations on the Canard River.</p>	i, ii	DFO, OMNRF

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Background surveys	Warmouth	Surveys in Duck Creek (Essex County), Long Point Bay, Turkey Point, Rondeau Bay	2009 to 2015	Completed	<p>No surveys specifically targeting Warmouth have been conducted in Duck Creek, Long Point Bay, Turkey Point or Rondeau Bay.</p> <p>Surveys targeting multiple species at risk (SAR) have occurred in Long Point Bay (58 Warmouth detected); Mill Creek (one Warmouth detected); and, Rondeau Bay (14 Warmouth detected).</p> <p>Non-targeted surveys within tributaries of Rondeau Bay (113 sampling events, at least 50 of which used suitable gear types) resulted in the capture of nine Warmouth.</p> <p>Sampling conducted by external agencies has led to the detection of Warmouth in areas of Long Point and Rondeau bays.</p>	i, ii	DFO, OMNRF, Ontario Commercial Fisheries Association (OCAF), LPRCA, University of Windsor (UW)

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Monitoring	Blackstripe Topminnow	A standardized index population and habitat monitoring program is required and will be coordinated with existing monitoring programs (for example, surveys for endangered/ threatened species as part of ecosystem-based recovery programs).	2009 to 2014	Completed	A study investigating the suitability of sampling techniques for Blackstripe Topminnow (Reid and Hogg 2014) prescribes a three-pass approach using seine nets, combined with backpack electrofishing where net use is inapplicable. Similarly, research conducted by Poesch (2014) demonstrated that the detectability of Blackstripe Topminnow increased when seine hauls were employed after electrofishing.	ii, iii	OMNRF, DFO
Monitoring	Blackstripe Topminnow	The range and abundance of the Blackstripe Topminnow in the Sydenham River, Whitebread Drain, and Little Bear Creek, as well as the quality and quantity of instream habitat and riparian areas throughout its range, will be monitored as part of existing monitoring programs.	2009 to 2014	Completed	Targeted sampling has occurred in Bear Creek, Black Creek, East Otter Creek, Little Bear Creek, Sydenham River, and Whitebread Drain while non-targeted sampling has led to detections in the Sydenham River (both branches). The information collected from these surveys will be used to inform questions pertaining to the species' range and abundance, as well as the quality and quantity of available habitat.	ii, iii	DFO, OMNRF, UT

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Monitoring	Pugnose Minnow	The Pugnose Minnow will be monitored as part of standard surveys, by seining vegetated habitats (Dextrase et al. 2003; TRRT 2005). Long-term monitoring is required to assess the cumulative impacts of upstream habitat improvements in the Sydenham and Thames rivers on Pugnose Minnow populations and their habitats (Dextrase et al. 2003; TRRT 2005).	2009 to 2014	Completed	Targeted sampling has been conducted at a number of sites within the Sydenham River (both branches), Otter Creek (all three branches), Little Bear, Maxwell, Big and Indian creeks, as well as Whitbread Drain/Grape Run, which will be used to inform questions pertaining to the conservation of the species in relation to habitat restoration projects as well as the quality and quantity of available habitat. No targeted sampling has occurred for this species within the Thames River at this point in time.	ii, iii	DFO, OMNRF, UT

Action	Species	Activity	Timeline	Status	Details	Management objective(s)	Participant(s)
Monitoring	Warmouth	Warmouth: a standardized index population and habitat monitoring program is required and will be coordinated with existing monitoring programs (for example, OMNRF Lake Erie annual trawls, surveys for Endangered/Threatened species as part of ecosystem-based recovery programs).	2009 to 2014	In progress	Research is currently underway to develop a detection and monitoring protocol for Warmouth and other wetland fishes at risk.	ii, iii	DFO, OMNRF, UT
Monitoring	Warmouth	The range and abundance of this species will be monitored as part of existing monitoring programs.	2009 to 2014	In progress	Although targeted sampling for Warmouth has not been conducted to date, a number of non-targeted surveys, including those for SAR fishes in general, have been conducted in many areas of the species' range including: Rondeau and Long Point bays, Turkey Point, and Big and Mill creeks. The information collected from these surveys will be used to inform questions pertaining to the species' range and abundance.	ii, iii	OMNRF, DFO

Research	Blackstripe Topminnow	Research is required to determine age-specific seasonal habitat requirements and population sizes.	2013 to 2016 ¹	In progress	<p>Associations between Blackstripe Topminnow abundance and habitat features were investigated during 2010 DFO sampling surveys (Black Creek).</p> <p>A study is currently underway that investigates Blackstripe Topminnow abundance and distribution in relation to macrophyte density and species composition (N. Mandrak, UT, pers. comm., 2015).</p> <p>Aquatic vegetation and fish habitat surveys were conducted in 2014 in Little Bear Creek (Dover and Chatham Townships, Kent County) (Wiklund 2015).</p>	ii, iii, iv	DFO, OMNRF, UT
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¹ The reporting period is from 2009 to 2015; however, the scheduling of some actions are reported between 2013 to 2016, which is within the reporting period

Research	Blackstripe Topminnow	Potential threat factors impacting extant populations need to be investigated and evaluated.	2010 to 2016 ¹	In progress	<p>DFO-funded surveys assessing the distribution of Round Goby, an exotic species which may threaten Blackstripe Topminnow, were conducted within the Sydenham River in 2010.</p> <p>Research is ongoing to assess the impacts of an agricultural drain clean out on aquatic SAR in Little Bear Creek. This work explores the impacts of drain maintenance as well as potential mitigation measures such as fish exclusions (DFO 2015).</p> <p>The impacts of drain maintenance on SAR fishes was assessed through a modelling study conducted on Little Bear Creek. This study provided quantitative estimates of the amount of suitable habitat that is permanently and temporarily lost as a result of drain maintenance activities (Montgomery et al. 2016)¹.</p>	i, iv	DFO, OMNRF, UT
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Research	Pugnose Minnow	Research is required to determine age-specific seasonal habitat requirements and population sizes.	2013 to 2016 ¹	In progress	<p>Associations between Pugnose Minnow abundance and habitat features were investigated during 2010 DFO sampling surveys (Little Bear, Maxwell, Otter and Indian creeks, Whitebread Drain, and the Sydenham River watershed).</p> <p>The recovery potential assessment (RPA) for the Pugnose Minnow (Bouvier and Mandrak 2013) identifies habitat features that are important for the spawning and adult life stages; however, limited information is currently available regarding the habitat requirements of larvae and juveniles.</p>	ii	DFO
Research	Pugnose Minnow	Where possible/feasible, the development of a population-habitat supply model may be considered	2013 to 2016 ¹	Completed	The RPA for Pugnose Minnow (Bouvier and Mandrak 2013) identifies a population target of 6.4 million adult individuals to achieve a ~99% probability of persistence. A minimum of 73.2 ha is required to facilitate this goal; however, this model was developed with a limited understanding of Pugnose Minnow life history, using a surrogate species, which may limit the validity of its projections.	ii, iii, iv	DFO

Research	Pugnose Minnow	Potential threat factors impacting extant populations need to be investigated and evaluated.	2013 to 2016 ¹	In progress	<p>DFO-funded surveys assessing the distribution of Round Goby, an exotic species which may threaten Pugnose Minnow, were conducted within the Sydenham River in 2010.</p> <p>Research is ongoing to assess the impacts of an agricultural drain clean out on aquatic SAR in Little Bear Creek. Including ongoing research that explores the impacts of drain maintenance as well as potential mitigation measures such as fish exclusions (DFO 2015).</p> <p>The impacts of drain maintenance on SAR fishes was assessed through a modelling study conducted on Little Bear Creek. This study provided quantitative estimates of the amount of suitable habitat that is permanently and temporarily lost as a result of drain maintenance activities (Montgomery et al. 2016).</p> <p>The RPA for Pugnose Minnow (Bouvier and Mandrak 2013) includes a threat level assessment for all populations in Canada as well as mitigation approaches that can be implemented to address these threats.</p>	i, iv	DFO, OMNRF, UT
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Research	Pugnose Minnow	Research on the life-history requirements and the relationship of habitat quality (for example, patch size, stem density and plant species composition) to occurrence and density of Pugnose Minnow has been recommended (Dextrase et al. 2003; TRRT 2005). The significance of incidental harvest by bait dealers and aquarists in the Essex-Erie region and its impacts on the Pugnose Minnow need to be evaluated (EERT 2008).	2013 to 2016 ¹	In progress	<p>Although DFO targeted sampling did not specifically compare Pugnose Minnow density among habitats with varying degrees of macrophytes present, the RPA (Bouvier and Mandrak 2013) observed that the majority of sites where detections occurred were in open water away from dense vegetation.</p> <p>Drake and Mandrak (2014) released a primary publication documenting the potential for fish SAR to be harvested as bycatch within southern Ontario, including the Essex-Erie area; however, it is not likely feasible to investigate the specific impacts to Pugnose Minnow given the extremely low probability of detecting the species in this region.</p>	ii, iii, iv	DFO, UT
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Research	Spotted Sucker	<p>Research is required to determine age-specific seasonal habitat requirements and population sizes. Seasonal habitat use should be investigated, and spawning areas should be identified. Targeted sampling is required during the spring spawning period, and in the summer (when the species are believed to be occupying deep pool areas). To understand the species habitat use throughout its range, the movements of the Spotted Sucker need to be determined, either through marking or radiotelemetry. The impacts of incidental harvest on the Spotted Sucker, particularly with regard to commercial activities, are not known and should be investigated.</p>	2013 to 2016 ¹	Not started	No progress has been made regarding this measure	ii	
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Research	Spotted Sucker	Potential threat factors impacting extant populations need to be investigated and evaluated.	2013 to 2016 ¹	In progress	<p>DFO-funded surveys assessing the distribution of Round Goby within the Sydenham River were conducted in 2010.</p> <p>A recent study has demonstrated that alterations to streamflow can alter habitat suitability and availability, negatively affect reproductive success, and influence growth, survival, and recruitment of early life-history stages (Grabowski et al. 2012).</p> <p>Research is ongoing to assess the impacts of an agricultural drain clean out on aquatic SAR in Little Bear Creek. Including ongoing research that explores the impacts of drain maintenance as well as potential mitigation measures such as fish exclusions (DFO 2015).</p> <p>The impacts of drain maintenance on SAR fishes was assessed through a modelling study conducted on Little Bear Creek. This study provided quantitative estimates of the amount of suitable habitat that is permanently and temporarily lost as a result of drain maintenance activities (Montgomery et al. 2016).</p>	i, iv	DFO, OMNRF, UT
Research	Warmouth	Develop a standardized sampling protocol for Warmouth (not prescribed in management plan)	N/A	In progress	Research is currently underway to develop a detection and monitoring protocol for Warmouth and other wetland fishes at risk.		OMNRF

Research	Warmouth	Potential threat factors impacting extant populations need to be investigated and evaluated.	2011	Completed	The OCFA conducted a study looking into the impact of, and potential for, SAR to be caught as bycatch within the Long Point Bay area. While most commercial net sets did not result in the capture of SAR, Warmouth was the most frequently captured SAR (141/368 lifts); however, all SAR captured came out of the nets alive and were returned to the water without incident.	i, iv	OCFA
Research	Warmouth	Potential threat factors impacting extant populations need to be investigated and evaluated.	2013 to 2016 ¹	In progress	<p>An assessment of water quality parameters is underway to gauge the efficacy of the Rondeau Bay Restoration Project.</p> <p>The effects of Common Reed on Warmouth habitat is being investigated as a component of the evaluation of habitat restoration activities for SAR fishes within the Crown Marsh (Long Point Bay) as well as the efficacy of wetland restoration (removal of Common Reed), as a means of restoring Warmouth habitat (Rook et al. 2016). Recommendations were made regarding the design of constructed wetlands to maximize suitability for SAR, including the Warmouth. Guidance is provided that outlines potential threats that can arise from these restoration activities (for example, low dissolved oxygen levels, stranding, genetic isolation) as well as design solutions that would prevent these threats from occurring.</p>	i, iv	DFO, OMNRF, UT

					<p>The future impacts of climate change have been investigated through the development of a model that projects Common Reed expansion associated with water level fluctuations (W. Glass, DFO, pers. comm., 2016).</p> <ul style="list-style-type: none"> A model of available habitat within Long Point Bay is currently in development that will provide insight regarding threat impacts 		
Research	Warmouth	The significance of interspecific competition (for example, with Green Sunfish) should be investigated to help understand community dynamics and provide insight into species occurrence (EERT 2008).	2013 to 2016 ¹	Not started	No research has been conducted at this time that explores the potential impacts of interspecific competition with Green Sunfish (<i>Lepomis cyanellus</i>) on Warmouth.		
Management and coordination	All four species	Coordination with Implementation Partners	2013 to 2016 ¹	In progress	Ongoing cooperation with existing recovery implementation programs to conduct recovery actions with members of the following groups including: Ontario Freshwater Fish Recovery Team (OFFRT) ^{a, b, c, d} , Sydenham River Recovery Team ^{a, b, c} , Essex-Erie Fish Species at Risk Recovery Team ^{b, c, d} , and the Thames River Recovery Team ^{b, c} .	v	DFO, OMNRF, Conservation Authorities (CAs)
Outreach and communication	All four species	Raise awareness regarding these four species within the scientific and	2013 to 2016 ¹	In progress	Presentations have been given to landowners, cottagers, and farmers regarding environmental issues and	vi	DFO, OMNRF, UT

		<p>conservation communities that are involved in the management and monitoring of freshwater fishes in Ontario, as well as among the general public and landowners.</p>		<p>initiatives in Rondeau Bay, regarding SAR and critical habitat^d.</p> <p>Presentations have been given to environmental students at Fleming College regarding SAR, threats, critical habitat, and species recovery^{a, b, c, d}.</p> <p>Presentations have been given on threats and protection measures to Ontario Aboriginal Lands Association (OALA) and Ontario First Nations Economic Development Association (OFNEDA) on SAR found in their area^{a, b, c, d}.</p> <p>An outreach strategy was developed for SAR in southwestern Ontario targeting the following audiences: local municipal staff (managers, planners, engineers, field staff and consultants); development industries (representatives of local development industries, and/or their consultants); landowners (representatives of the local landowner, farmers and cottagers, as well as recreational groups such as ATV/trail users); conservation/environmental/stewardship organizations (fish and game clubs, naturalist and environmental protection organizations, students and stewardship councils)^{a, b, c, d}.</p> <p>Presentations regarding the evaluation of habitat restoration activities for SAR fishes within the Crown Marsh (Long Point Bay), the development of a</p>		
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					Warmouth monitoring protocol, and the impacts of drain maintenance on species 1 to 3 (Impacts of an agricultural drain clean out on aquatic SAR in Little Bear Creek) have been delivered to academic audiences at conferences including the Canadian Conference for Fisheries Research (CCFR), the International Association for Great Lakes Research (IAGLR), and the American Fisheries Society.		
Stewardship and habitat improvement	All four species	Stewardship should be promoted among landowners. Active promotion of stewardship activities will raise community support and awareness of conservation issues and increase awareness of opportunities to improve aquatic habitats.	2013 to 2016 ¹	In progress	<p>Multiple stewardship programs were conducted within the distributions of the four species including:</p> <ul style="list-style-type: none"> • Sydenham River Stewardship Project^{a, b, c} • Sydenham River Species at Risk Project^{a, b, c} • Saving Land and Saving Species at Risk in Ontario Program^{a, b, c} • Essex-Erie Fish Species at Risk Recovery Program^{a, b, c} • Thames River Aquatic Ecosystem Stewardship Initiative^{a, b} • Species at Risk Farm Incentive Program -F (SARFIP-F) for 2012 to 2015^a • Ecosystem Restoration on a Watershed Basis^d • Restoring Rondeau Bay's Ecological Integrity: The Rondeau Project^d • Rondeau Bay Watershed Restoration Project^d <p>These programs involved the promotion of best management</p>	iv, vi	DFO ^{a, b, c, d} , OMNRF ^{a, b, c, d} , SCRCA ^{a, b, c} , Ontario Land Trust Alliance (OLTA) ^{a, b, c} , Essex Region Conservation Authority (ERCA) ^{b, c} , UTRCA ^{b, c} , Lower Thames Valley Conservation Authority (LTVCA) ^{b, c} , Ontario Federation of Agriculture (OFA) ^{c, d}

					practices (BMPs) on rural properties, including livestock restrictions, milkhouse washwater system installations, riparian buffers, streambank stabilization, wetland creation or enhancement, well decommissioning, septic upgrades, and sediment control/trapping.		
Stewardship and habitat improvement	All four species	Direction, technical expertise/contacts and information on financial incentives (that is, existing funding opportunities for private landowners), should be provided.	2013 to 2016 ¹	In progress	<p>The Saving Land and Saving Species at Risk in Ontario Program^{a, b, c}:</p> <ul style="list-style-type: none"> • Provided support for the associated costs of SAR habitat protection (appraisal fees, land planning survey costs, legal fees, planning and approval fees, environmental audit costs, land transfer taxes and Baseline Documentation Report expenses) • Provided financial support for costs associated with restoring habitat on damaged sites and for preventing further damage (for example, fencing, signage, trail re-alignments, invasive management and other mitigation actions specified in management plans) <p>The Thames River Aquatic Ecosystem Stewardship Initiative provided technical and financial assistance to landowners for projects that improved water quality and habitat</p> <p>The Species at Risk Farm Incentive Program-F for 2012 to 2015^{b, d} provided cost-share funding to support</p>	iv, vi	DFO ^{a, b, c, d} , OMNRF ^{a, b, c, d} , OLTA ^{a, b, c} , LTVCA ^{b, c} , UTRCA ^{b, c} , OFA ^{c, d}

					on-farm BMP projects under the five specified BMP categories.		
Stewardship and habitat improvement	All four species	In addition to ecosystem-based recovery programs, there are other initiatives such as source water protection planning, watershed planning and Environmental Farm Plans, among others, that could provide additional benefits to these species through large-scale habitat improvements (for example, riparian zone restoration, septic system upgrades, wetland creation).	2013 to 2016 ¹	In progress	<p>The Sydenham River Stewardship and Species at Risk Projects involved a number of restoration activities^{a, b} including:</p> <ul style="list-style-type: none"> • livestock fencing • riparian planting • wetland construction/enhancement • stream bank stabilization • creation of sediment traps <p>The Essex-Erie Fish Species at Risk Recovery Program included^{b, c, d}:</p> <ul style="list-style-type: none"> • shoreline stabilization and erosion control projects • riparian plantings/wetland restoration projects <p>The Thames River Aquatic Ecosystem Stewardship Initiative^{b, c} undertook projects through the Clean Water Program that promoted the use of BMPs to improve ground and surface water quality.</p> <p>The Ecosystem Restoration on a Watershed Basis involved^d:</p> <ul style="list-style-type: none"> • restoration projects to create continuous corridors of habitat by planting grassed buffers and reforestation between headwaters habitats and downstream marshes • enhancement of marshes by creating open water habitat 	iv, vi	DFO ^{a, b, c, d} , OMNRF ^{a, b, c, d} , SCRCA ^{a, b, c} , ERCA ^{b, c, d} , LTVCA ^{c, d} , UTRCA ^{c, d} , OLTA ^{c, d} , OFA ^{c, d} , UT ^d

					<ul style="list-style-type: none"> • creation of headwater wetlands/sediment basins to improve water quality and create wetland habitat <p>The Restoring Rondeau Bay's Ecological Integrity: The Rondeau Project included^d:</p> <ul style="list-style-type: none"> • restoration and/or enhancement of degraded wetland habitat • creation of new ponds to capture agricultural drainage • installation of water control structures and/or rock spillways at all of the sites, which are immediately adjacent to Rondeau Bay or a significant tributary, and will be managed/designed to allow fish passage during spawning periods <p>The Rondeau Bay Watershed Restoration Project included^d:</p> <ul style="list-style-type: none"> • riparian planting • wetland construction/enhancement • control of Common Reed in order to allow for natural regeneration of plant species that increase the biodiversity, health and resiliency of coastal wetland habitat <p>An evaluation of habitat restoration activities for SAR fishes within the Crown Marsh (Long Point Bay)^d included:</p> <ul style="list-style-type: none"> • common Reed removal/control 		
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					<ul style="list-style-type: none"> wetland habitat creation 		
Stewardship and habitat improvement	All four species	Guidance provided for the control of invasive species	2009 to 2015	In progress	<p>Guidelines and effective strategies for the control and removal of Common Reed are described for invasive species mitigation and wetland restoration projects (OMNRF 2011)^d.</p> <p>The OMNRF, in partnership with the Ontario Federation of Anglers and Hunters (OFAH), has developed the Early Detection Distribution Mapping System that allows the general public and citizen scientists to share their information regarding the distribution of Common Reed and provides guidance and direction on how to control this invasive species.</p>		OMNRF, OFAH

^a indicates information specific to Blackstripe Topminnow

^b indicates information specific to Pugnose Minnow

^c indicates information specific to Spotted sucker

^d indicates information specific to Warmouth

4 Concluding statement

Overall, management activities conducted during this reporting period have helped to provide a clearer understanding of the range and extent of Blackstripe Topminnow, Pugnose Minnow, Spotted Sucker, and Warmouth in Canada. Furthermore, investigations into the efficacy of gear types and sampling techniques for the detection of Blackstripe Topminnow have provided insight regarding the development of a standardized, species-specific sampling protocol that will lead to a better assessment of distribution and abundance.

The management activities have also allowed for the evaluation of the effects of threats, specifically the invasive species Common Reed on Warmouth habitat, as well as the efficacy of related restoration projects. Additionally, a number of restoration projects and the promotion of best management practices (BMPs) have led to reduced sedimentation and nutrient loading in locations such as **Rondeau** and Long Point bays. Lastly, awareness and outreach activities, including info sessions focused on species at risk and their habitat, have been provided to conservation authorities, drainage supervisors, contractors, consultants, and municipal planners.

Taken together, these ongoing and/or completed activities indicate that progress has been made towards the goal of conserving these four species in Canada; however, there are still a number of areas where further information is required. For instance, it is difficult to establish viable estimates of population size and distribution in the absence of detailed abundance records; therefore, further monitoring and assessment should be conducted to refine the extent of the distributions for these species and determine their abundance. In terms of surveying and monitoring, targeted sampling is still pending for Warmouth and Spotted Sucker (none completed to date). Specifically, targeted sampling is needed in: Duck Creek (Essex County), Long Point Bay, Turkey Point, **Rondeau** Bay, and Point Pelee National Park for Warmouth; and the Belle, Canard, Thames and Sydenham rivers, and Whitebread Drain for Spotted Sucker. Further sampling could be conducted within waters that have not recently been searched where these species were historically detected including: Booth Creek, Wheatley Provincial Park Creek, and Wetland for Spotted Sucker; McDougal Drain and Bear Creek for Pugnose Minnow.

Further research is also needed to investigate the suitability of gear types for the detection of Pugnose Minnow, Spotted Sucker, and Warmouth. The results of these studies would serve to develop standardized sampling protocols for these species, allowing for greater comparability of data between organizations and geographic regions. Furthermore, the habitat requirements for each life stage of all four species need to be characterized. Although some sampling/data collection has been implemented for Blackstripe Topminnow and Pugnose Minnow, little research has been conducted in this regard. Once there is a clearer understanding of habitat use by these species at each life stage, and the gear and degree of effort needed to capture Pugnose Minnow, Spotted Sucker, and Warmouth, sampling efforts can be focused within areas that possess these key features, and threat mitigation can be more accurately applied.

There are still a number of species-specific research questions stemming from the management plan that remain unanswered. For example, no research has been conducted at this time that explores the potential for interspecific competition between Warmouth and Green Sunfish. Furthermore, investigations into the potential impacts of contaminated sediments and pesticides on Warmouth have not been undertaken at this time. For this reason, it may be beneficial to focus future management activities on filling these knowledge gaps.

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