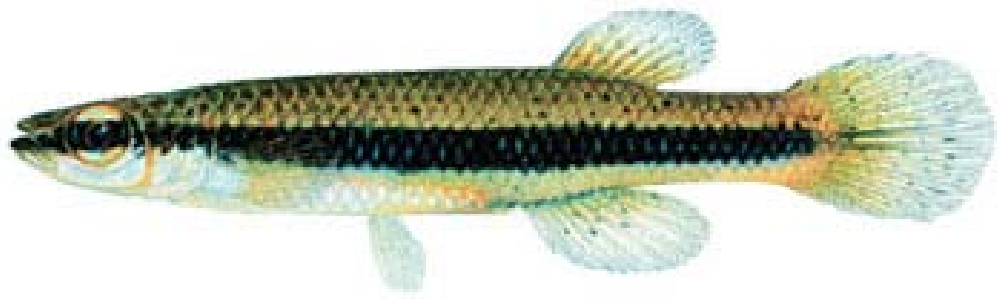
COSEWIC
Assessment and Status Report

on the

Blackstripe Topminnow
Fundulus notatus

in Canada



SPECIAL CONCERN
2012

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC. 2001. COSEWIC assessment and update status on report on the blackstripe topminnow *Fundulus notatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 14 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Mandrak, N.E. and E. Holm. 2001. Update COSEWIC status report on the blackstripe topminnow *Fundulus notatus* in Canada, *in* COSEWIC assessment and update status on report on the Blackstripe Topminnow *Fundulus notatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-14 pp.

McAllister, D.E. 1985. COSEWIC status report on blackstripe topminnow *Fundulus notatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 18 pp.

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COSEWIC
Assessment Summary

Assessment Summary – May 2012

Common name
Blackstripe Topminnow

Scientific name
Fundulus notatus

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 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.

Occurrence
Ontario

Status history
Designated Special Concern in April 1985. Status re-examined and confirmed in May 2001 and May 2012.

COSEWIC
Executive Summary

Blackstripe Topminnow
Fundulus notatus

Wildlife Species Description and Significance

The Blackstripe Topminnow, *Fundulus notatus*, is a small (74 mm maximum length) freshwater fish characterized by an upturned mouth, flat head and a black horizontal stripe extending from the snout to the caudal fin base. The species has a somewhat unusual diet composed in large part of terrestrial insects and is part of one of the most biologically diverse aquatic communities in Canada.

Distribution

Distribution includes part of the southern Great Lakes drainage (watersheds entering lakes Erie and Michigan) and much of the Mississippi River basin from Illinois to the Gulf of Mexico. The Canadian range is limited to an area of approximately 500 km^2 in the Sydenham River watershed, Little Bear Creek, Bear Creek, Black Creek, Maxwell Creek, and Whitebread Drain in southwestern Ontario.

Habitat

In Canada, the Blackstripe Topminnow occurs in small to medium-sized streams with clay/silt bottoms and turbid water. It prefers areas containing submerged and emergent aquatic vegetation and overhanging riparian vegetation.

Biology

The Blackstripe Topminnow spawns in the spring; adhesive eggs are deposited on filamentous algae or other aquatic vegetation. The species has a short lifespan. The oldest individuals in most populations examined were 2 to 3 years old. It is relatively tolerant of high temperatures and low oxygen concentrations. The species is not migratory and seasonal movement is limited to a shift from relatively deep water in the winter to more shallow reaches during summer months. The Blackstripe Topminnow spends much of its time swimming at the surface where it feeds largely on terrestrial arthropods.

Population Sizes and Trends

Quantitative population estimates are not available, but the Canadian population appears to be stable. Since 2001, the species has been recorded in an additional locality in Canada—Maxwell Creek. Range expansion has been reported in Ohio and Wisconsin. The species is common to abundant in most of its range in the United States.

Threats and Limiting Factors

The most serious threat to the Blackstripe Topminnow appears to be habitat degradation related to removal of aquatic and riparian terrestrial vegetation. Other reported threats include nutrient loading as well as wetland drainage and channelization, which may reduce stream water levels and increase intermittency of flow. Sedimentation and seepage from oil wells have also been suggested as potential threats of uncertain magnitude. Agricultural pesticides and invasive species may also threaten the Blackstripe Topminnow.

Protection, Status, and Ranks

The Blackstripe Topminnow is currently listed as Special Concern by COSEWIC and is listed on Schedule 1 of the Canadian *Species at Risk Act* as Special Concern. Globally, the species is ranked as G5 and nationally as N5 and N2 in the United States and Canada, respectively. The federal *Species at Risk Act* protects critical habitat of a number of aquatic species in the Sydenham River watershed including several freshwater mussels and at least three fish species. Although the Blackstripe Topminnow's current ranking in Canada does not result in direct protection, the species presumably benefits indirectly from Endangered and Threatened rankings applied to other species present in the Sydenham River watershed. A management plan has been developed for the Blackstripe Topminnow with the goal of maintaining and enhancing existing populations and their habitats. Under Ontario Fishing Regulations, the species may not be used as a baitfish. Habitat protection and recovery efforts have been undertaken by a number of agencies under the oversight of the Sydenham River Recovery Team.

TECHNICAL SUMMARY

Fundulus notatus
Blackstripe Topminnow Fondule rayé
Range of occurrence in Canada:Southwestern Ontario: Sydenham River watershed

Demographic Information

Generation time Maximum age is 2-3 yrs	1-2 yrs
Is there a continuing decline in number of mature individuals? No Quantitative Population Estimates Appears stable	Unknown
Estimated percent of continuing decline in total number of mature individuals within 2 generations Appears stable	Unknown
Percent reduction in total number of mature individuals over the last 3 generations. Appears stable	Unknown
Projected percent reduction in total number of mature individuals over the next 10 years. Appears stable	Unknown
Percent reduction in total number of mature individuals over any 10 year period, over a time period including both the past and the future. Appears stable	Unknown
Are the causes of the decline clearly reversible and understood and ceased? Appears stable	Not applicable
Are there extreme fluctuations in number of mature individuals?	Probably not

Extent and Occupancy Information

Estimated extent of occurrence Minimum Convex Polygon Method	1,120 km²
Index of area of occupancy (IAO) 2x2 grid value	516 km²
Is the total population severely fragmented?	No
Number of locations Sydenham River, North Sydenham River, Bear Creek, Little Bear Creek, Black Creek, Maxwell Creek, Whitebread Drain and a complex of four small, unnamed tributary streams considered as from one to three locations.	8-10
Is there an observed continuing decline in extent of occurrence?	No
Is there an observed continuing decline in index of area of occupancy?	No
Is there an observed continuing decline in number of populations?	No
Is there an observed continuing decline in number of locations?	No
Is there an observed continuing decline in area, extent and/or quality of habitat?	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Sydenham River, North Sydenham River,	Unknown
Little Bear Creek, Maxwell Creek, Whitebread Drain	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild	Unknown

Threats (actual or imminent, to populations or habitats)

Habitat degradation via removal of riparian vegetation, low water levels, and potentially sedimentation and oil seepage

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? Secure Widespread in U.S. although ranked as imperiled/vulnerable in Michigan	
Is immigration known or possible?	Unlikely
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely? At least 200 km of unsuitable habitat separates Canadian and U.S. populations	No

Current Status

COSEWIC: Special Concern (2012)

Recommended Status and Reasons for Designation

Recommended Status:	**Alpha-numeric code:**
Special Concern	NA

Reasons 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 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.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable, no data to assess criterion
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered for B1 as EO (1,120 km²) is below threshold (5,000 km²), meets Threatened for B2 as IAO (516 km²) is below threshold (2,000 km²), and meets sub-criterion a for Threatened as the number of locations (10) meets threshold (10), but there is no evidence of continuing declines in abundance, distribution, or habitat quality, and there is no evidence of extreme fluctuations.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable, no data to assess criterion
Criterion D (Very Small or Restricted Total Population): Not applicable. Exceeds all criteria.
Criterion E (Quantitative Analysis): Not applicable, no data to assess criterion.

PREFACE

Since the previous COSEWIC Update Status Review (Mandrak and Holm 2001), the Blackstripe Topminnow has been found in Maxwell Creek, Ontario, for the first time. Sampling in the Sydenham River watershed and nearby waterways in 2002 and 2003 revealed the species to be present at seven sites: East Otter Creek (83 specimens), Little Bear Creek (24), Maxwell Creek (4), Sydenham River (221), North Sydenham River (207), West Otter Creek (33) and Whitebread Drain (12) (Poos 2004; Mandrak *et al*. 2006). In 2010, specimens were captured at seven sites: Bear Creek (104 specimens), Black Creek (88), East Otter Creek (7), Fox Creek (1), Sydenham River (35), West Otter Creek (1) and Whitebread Drain (2) (Sarah Hogg pers. comm. 2010). Although quantitative estimates of population size are not available, catches were comparable to those reported in previous surveys, suggesting that the Canadian population is relatively stable in terms of abundance.

Efforts to mitigate habitat loss and degradation are in progress under the direction of the multi-agency Sydenham River Recovery Team. The ecosystem-based recovery strategy has four components: management, stewardship, research and monitoring, and awareness and outreach (Staton *et al.* 2003). The long-term goal of the management plan for Blackstripe Topminnow (Edwards and Staton 2009) is to maintain and enhance existing populations and their habitats. Six short-term objectives have been identified to achieve this goal: 1) develop understanding of the health and extent of existing populations, 2) enhance knowledge of the species' biology, ecology and habitat needs, 3) determine population and habitat trends, 4) maintain and enhance existing populations, 5) ensure efficient use of resources, and 6) enhance public awareness and engagement.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2012)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Blackstripe Topminnow

Fundulus notatus

in Canada

2012

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

The Blackstripe Topminnow, *Fundulus notatus* (Rafinesque, 1820), is one of three species of *Fundulus* occurring in Canada. All three species occur in eastern Canada. The Banded Killifish (*F. diaphanus*) is present throughout the lower Great Lakes drainage, Manitoba, northwestern Ontario, Hudson Bay drainage, and the Maritime provinces while the Mummichog (*F. heteroclitus*) occurs in coastal waters, especially estuaries and salt marshes, of the Maritime provinces and Gulf of St. Lawrence (Scott and Crossman 1973). *Fundulus* was formerly included in the family Cyprinodontidae, but Parenti (1981) and most recent authors referred the genus to the family Fundulidae (Nelson *et al.* 2004). The French common name is Fondule barré.

Morphological Description

Like other species of *Fundulus*, the Blackstripe Topminnow has a protractile upper jaw, partially scaled head, spineless fins, rounded caudal fin, single dorsal fin situated at or posterior to the middle of the body, abdominal pelvic fins, and a flattened area anterior to the dorsal fin (Figure 1; Scott and Crossman 1973). It is a small fish with a maximum total length of 74 mm (Shute 1980). The largest Canadian specimen measured 67 mm total length (Holm *et al*. 2010). The species has a small, upturned mouth. It can be distinguished from the Banded Killifish and Mummichog by the placement of the dorsal fin, the origin of which is posterior to the origin of the anal fin and by the prominent black lateral stripe extending forward from the caudal fin base through the eye to the snout. Below the lateral stripe the fish is silvery-white; above the stripe the fish is olive-brown with small dark spots. The Blackstripe Topminnow is sexually dimorphic; males have dark vertical bars above and below the lateral stripe and yellow pigmentation in the fins. Females lack vertical bars and have white fins and rounded dorsal and anal fins (Shute 1980).

Figure 1. Blackstripe Topminnow. Illustration by J. Tomelleri. Adult fish approximately 70 mm total length.

Population Spatial Structure and Variability

There is very little information available regarding population structure. Tatum *et al.* (1981) examined variation in isozymes in some southeastern U.S. populations. In addition, Black and Howell (1978) and Howell and Black (1981) described karyotypic variation in populations of the Blackstripe Topminnow. They noted some variation in chromosome number; most populations have 2n=40, while those in the Tombigbee River in Alabama and Mississippi have 2n=44. No information is available about population structure in Canada, although, in light of the highly restricted distribution, the existence of genetically differentiated populations is unlikely.

Designatable Units

No subspecies are recognized for the Blackstripe Topminnow. In light of the lack of information regarding population structure across the range and the extremely restricted Canadian distribution within a single National Freshwater Biogeographic Zone, only a single designatable unit is recognized.

Special Significance

The Blackstripe Topminnow is one of three *Fundulus* species occurring in Canada. Unlike almost all other Canadian fishes, it spends much of its time at the water's surface where it feeds to a large extent on terrestrial arthropods. In Canada it has a limited range in southwestern Ontario. Despite its narrow distribution, the species is a component of one of Canada's most biologically diverse aquatic communities (Staton *et al.* 2003).

DISTRIBUTION

Global Range

Most of the global range of this species is centred on the Mississippi River basin from Michigan, Wisconsin and northern Iowa south to the Gulf of Mexico (Figs. 2 and 3). It extends as far west as central Kansas, Oklahoma and Texas. In the east the range extends through Ohio, Kentucky, Tennessee and central Alabama. The most northerly portion of the range includes streams flowing into Lake Michigan, Lake Erie, and Lake St. Clair.

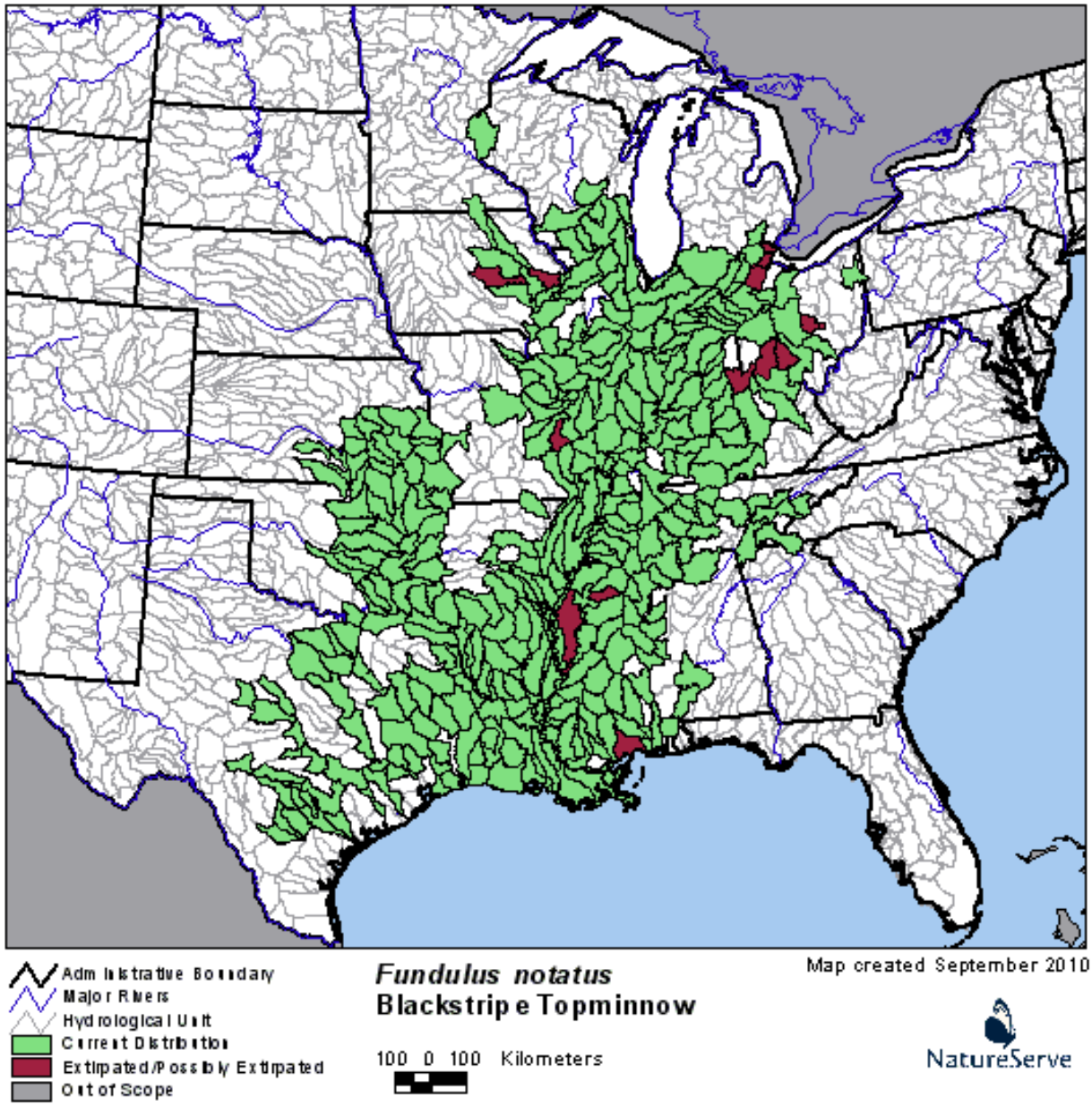

Figure 2. Distribution of watersheds in the United States containing Blackstripe Topminnow. Map provided by NatureServe 2010 (Copyright © 2010 NatureServe, 1101 Wilson Boulevard, 15th Floor, Arlington, Virginia 22209, U.S.A. All Rights Reserved.).

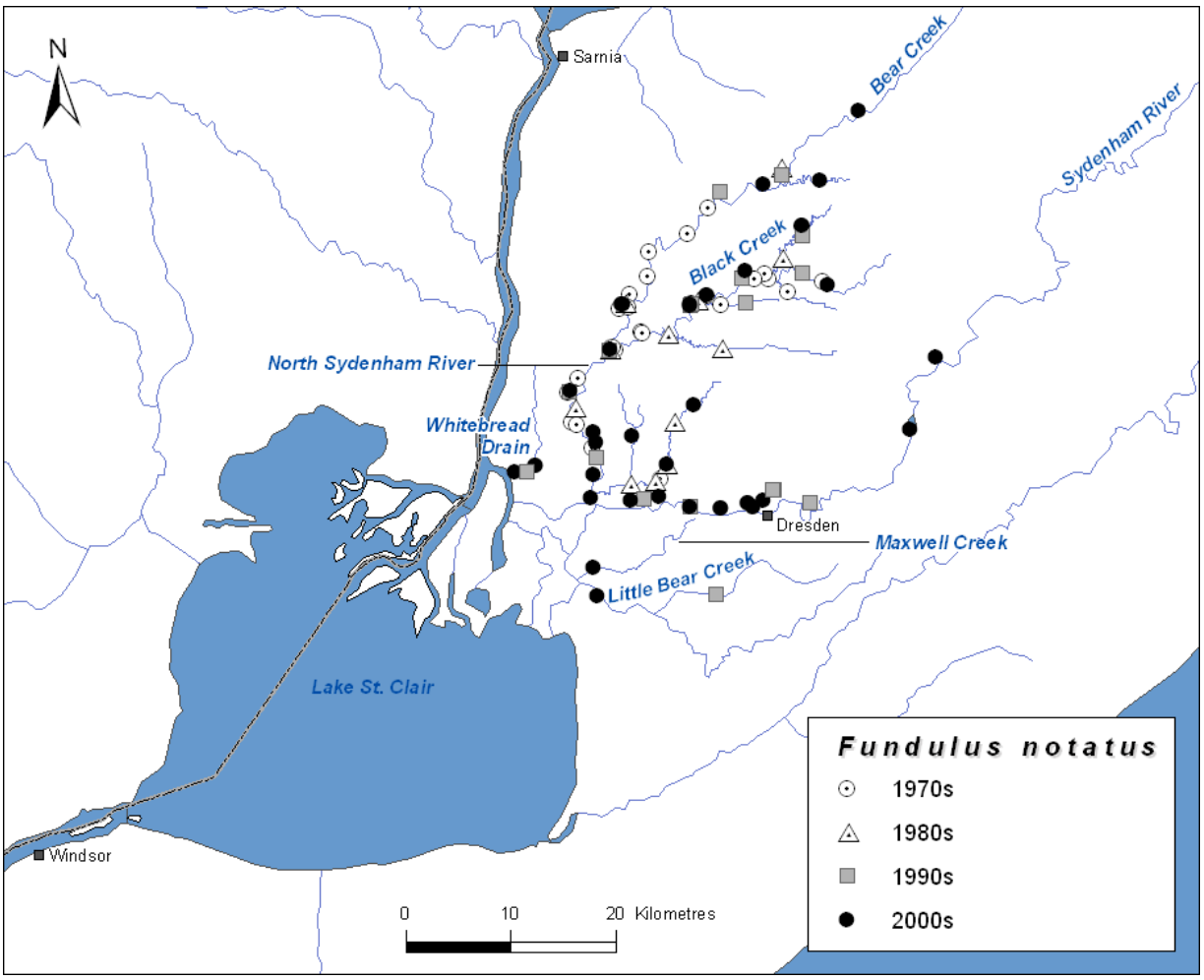

Figure 3. Sites in southwestern Ontario where Blackstripe Topminnow has been collected. Symbols on map denote approximate timing of collections.

Canadian Range

In Canada, the Blackstripe Topminnow is found only in the Great Lakes-Upper St. Lawrence National Freshwater Biogeographic Zone. The species was first collected in Canada in 1972 (Gruchy *et al*. 1973). It is restricted to an area of approximately 500 km^2 in the Sydenham River watershed and a small number of nearby watercourses (Figure 3). Early records revealed the species to be present at a number of sites along the Sydenham River and North Sydenham River as well as several tributaries. More recently, it has been found to be more widespread in the Sydenham River watershed and it has been found in Little Bear Creek, Maxwell Creek, and Whitebread Drain (Leslie and Timmins 2000; Mandrak and Holm 2001; Dextrase *et al.* 2003; Mandrak *et al.* 2006) (Figure 3). For instance, sampling in the Sydenham River watershed and nearby waterways in 2002 and 2003 revealed the species to be present at seven sites: East Otter Creek (83 specimens), Little Bear Creek (24), Maxwell Creek (4), Sydenham River (221), North Sydenham River (207), West Otter Creek (33) and Whitebread Drain

(12) (Poos 2004; Mandrak *et al*. 2006). In 2010, specimens were captured at seven sites: Bear Creek (104 specimens), Black Creek (88), East Otter Creek (7), Fox Creek (1), Sydenham River (35), West Otter Creek (1) and Whitebread Drain (2) (Sarah Hogg pers. comm. 2010). Although quantitative estimates of population size are not available, catches were comparable to those reported in previous surveys, suggesting that the Canadian population is stable.

Whether the more widespread distribution noted in recent years represents an actual range expansion or just broader sampling effort is not known. Extent of occurrence is estimated to be 1,120 km^2 using the minimum convex polygon method. The index of area of occupancy is estimated to be 516 km^2 (2 km x 2 km grid) or 305 km^2 (1 km x 1 km grid). The latter estimate is the more realistic, although still an overestimate, because larger grids contain a higher proportion of unoccupied area (i.e., dry land) than smaller grids.

The number of locations in the Canadian range is estimated to be eight to ten based on the most serious and plausible threat of localized agricultural spills (largely manure) across seven locations and water level declines common to four remaining sites (= one location). Although the extent of occurrence in Canada is small, the anthropogenic threats challenging Blackstripe Topminnow act over relatively small scales (see below). Threats such as removal of terrestrial and aquatic vegetation, sedimentation, and toxic spills originate at numerous independent sources throughout the watercourses, and contributions from individual sources do not always affect habitat quality in other streams. Similarly, mitigation of such threats requires actions directed individually at these sources. Hence, streams containing Blackstripe Topminnow that are largely isolated from one another are considered to be separate locations. The locations (N = 10) defined include: (1) Sydenham River, (2) North Sydenham River, (3) Little Bear Creek, (4), Maxwell Creek, (5) Black Creek, (6) Whitebread Drain, (7) Bear Creek, and (8-10) a complex of four, small unnamed tributary streams between Little Bear Creek and Whitebread Drain. The latter were considered as a comprising from one to three locations owing to their close proximity to each other over a small area where the major threats of drought, poor water quality from land use practices, and vegetation removal are probably shared in terms of their scope and timing across sites.

Search Effort

The first collections of Blackstripe Topminnow in Canada were made in the North Sydenham River (Black Creek and Sombra Township) in 1972 (Gruchy *et al.* 1973). Subsequent sampling in the 1970s was conducted in 1974 (Canadian Museum of Nature, CMN), 1975 (Royal Ontario Museum, ROM, and Ontario Ministry of Natural Resources, OMNR), 1976 (OMNR) and 1979 (Canadian Museum of Nature, CMN). All specimens collected in the 1970s were from the Sydenham River and North Sydenham River (main stems and various tributaries; Appendix 1).

All sampling in the 1980s was conducted in 1982 (ROM) in the Sydenham River and tributaries.

During the 1990s, sampling was conducted by ROM personnel. In 1996, sampling effort was concentrated in Black Creek, while in 1997 effort was concentrated on Bear Creek, Sydenham River, and the North Sydenham River (Mandrak and Holm 2001). In 1997, the Blackstripe Topminnow was found at new sites in Bear Creek and Molly's Creek (tributary to Sydenham River).

Poos (2004) compared the effectiveness of backpack electrofishing to seining for capturing Blackstripe Topminnow at a number of sites in the Sydenham River watershed in 2002/2003. Specimens were caught at 14 sites on Black Creek, 11 sites on Bear Creek, and 4 sites on the Sydenham River. In 2003, Fisheries and Oceans Canada (DFO) personnel found Blackstripe Topminnow in Maxwell Creek, Little Bear Creek, and Whitebread Drain (Mandrak *et al.* 2006). The most recent sampling effort took place in 2010 by OMNR. Presence of the Blackstripe Topminnow in Whitebread Drain was confirmed and the species was also sampled at other sites of the Sydenham River and North Sydenham River (Sarah Hogg, pers. comm. 2010; Appendix 1).

Limited information is available about catch per unit effort. Dip netting in Bear Creek in 1996 by the ROM resulted in a mean of 11 specimens per hour (range 0 - 48). Seining in Black Creek tributaries (Crooked Creek and Fox Creek) in 1997, also by the ROM, produced 0 - 5 specimens per seine haul (Mandrak and Holm 2001). Dip net sampling in 2010 in Bear Creek by OMNR produced 52 Blackstripe Topminnow in approximately 30 minutes (Sarah Hogg, pers. comm. 2010). Seining also produced specimens in 2010 by OMNR at other sites. Catch per unit effort is not comparable among these sampling dates because protocols were not standardized.

HABITAT

Habitat Requirements

This species is most commonly observed in quiet surface waters of small, low gradient (sometimes intermittent) rivers and pools with intact aquatic and riparian vegetation. It occurs in turbid waters with substrates ranging from silt to rubble/boulder and a variety of water qualities (Braasch and Smith 1965; McAllister 1987; Mandrak *et al*. 2006). Water clarity in Black Creek was determined to be 13 cm (Secchi disc) and temperature 22°C in late September 1999 (Leslie and Timmins 2000). Mandrak and Holm (2001) reported water clarity in Canadian capture sites to be 5 - 40 cm. Secchi disc transparency was reported to be 10 cm in areas of the North Sydenham River where Blackstripe Topminnow is most numerous (McKee and Parker 1982). Water depths at Blackstripe Topminnow collection sites in Black Creek have been reported to be approximately 20 cm (Leslie and Timmins 2000) and 1 - 2 metres (McAllister 1987). The Blackstripe Topminnow has been reported to occupy sluggish watercourses of variable size (McAllister 1987) and has been captured in lentic habitat in Michigan

(Carranza and Winn 1954). Braasch and Smith (1965) noted that, in the Upper Mississippi drainage, Blackstripe Topminnow is distributed in low-gradient streams and sloughs while the closely related Blackspotted Topminnow (*F. olivaceous*) occurs in upland areas with more rapid water flow rates. Alldredge *et al.* (2011) noted that Blackstripe Topminnow occupy stream margins near structures and backwaters of large rivers. McKee and Parker (1982) reported that emergent and floating aquatic macrophytes and low, overhanging terrestrial plants were used by the Blackstripe Topminnow as cover. These authors also observed that in the North Sydenham River, cover was found only near the river edges and that the Blackstripe Topminnow was rarely found in open water (i.e., beyond the cover provided along stream edges). In smaller tributaries, Blackstripe Topminnows were only found in midstream areas when protective cover was nearby (McKee and Parker 1982).

Habitat Trends

Staton *et al.* (2003) described changes that have occurred in the Sydenham River watershed as a result of agricultural practices and urbanization. In pre-agriculture times, the watershed consisted of 70% forested areas and 30% wetland areas. By 1983, the forest cover had been reduced to 12% of the landmass and almost all of the wetland areas had been drained. Approximately 85% of the watershed had been converted to agricultural use. The combined growth of both intensive agriculture and several urban areas has resulted in significant changes to various aspects of the aquatic habitat. Streamside cover appears to have recovered somewhat over the last several years, but overall cover remains low (ranged from 11-26% depending on area, SCRCA 2008 Appendix).

Using data gathered over approximately 30 years of monitoring by the Ontario Ministry of Environment and Energy (1967-1996), Staton *et al.* (2003) described changes in nutrient profiles in the Sydenham River watershed as determined at seven sampling stations (three on the North Sydenham River and four on the Sydenham River). Total phosphorus was elevated throughout the system to levels considerably above the provincial water quality objective (<0.03 mg/L). Similarly, in the Sydenham River, total nitrogen was elevated and chloride concentration was generally low, but slowly increasing. In contrast, the North Sydenham River had highly elevated chloride levels, likely the result of discharge of brine from oil wells in the area into surface waters. When this practice was stopped (about 1990), chloride declined to levels similar to those observed in the Sydenham River (Staton *et al.* 2003).

Turbidity is high, especially in the North Sydenham River. During the approximately 30-year monitoring period, suspended solids were usually present at concentrations of 50-90 mg/L; values approximately twice those observed in the Sydenham River. Turbidity is probably a result of agricultural runoff, which is facilitated by the widespread use of tile drainage throughout the watershed. Removal of riparian vegetation, land tillage to the river's edge, and access by livestock to the river have occurred commonly in the watershed and are also sources of suspended solids in both branches of the watershed (Staton *et al.* 2003).

Efforts to mitigate turbidity levels by reducing runoff from agricultural and urban lands have begun since the previous COSEWIC assessment. Whether these efforts have succeeded in improving water quality in the Sydenham River watershed is not yet known (Muriel Andreae pers. comm. 2010). Similarly, the effect of reduction in turbidity on Blackstripe Topminnow in the Sydenham River watershed cannot be predicted. Several authors have noted a tolerance of (or even preference for) turbid conditions in this species, including McAllister (1987), McKee and Parker (1982), and Shute (1980). Poos (2004) suggested that a reduction in turbidity resulting from improved erosion control would benefit some fishes in the Sydenham River watershed but might be detrimental to Blackstripe Topminnow. In contrast, Trautman (1981) reported that Blackstripe Topminnow was most abundant in relatively clear waters in Michigan. Survey work by Braasch and Smith (1965) in the upper Mississippi River valley revealed the species to be present in a variety of habitats, all characterized by low water velocity. This observation suggests that low current velocity is a more important feature of Blackstripe Topminnow habitat than high turbidity.

Overall, the Sydenham River and its tributaries continue to rate well below standards set by the provincial government for acceptable levels of key parameters such as total phosphorus and *E. coli*, which could impact fishes via their influence on dissolved oxygen levels (SCRCA 2008).

BIOLOGY

The general biology of the Blackstripe Topminnow is not well known despite the species' abundance and widespread distribution in the United States. Information about life history, diet, and movement is provided by a small number of studies based on populations in Canada and the United States (e.g., Carranza and Winn 1954; Atmar and Stewart 1972; Braasch and Smith 1965; Neiman and Wallace 1974; McKee and Parker 1982; Leslie and Timmins 2000).

Life Cycle and Reproduction

The Blackstripe Topminnow spawns in the springtime. Spawning was reported to occur from early May through August in Lake Whitmore, Michigan (Carranza and Winn 1954), and during June/July in Wisconsin (Becker 1983). Males defend a loosely defined territory and attempt to exclude other males. Adhesive eggs are attached individually to algal filaments following a brief spawning embrace (Carranza and Winn 1954). Additional information about reproduction is provided by Holm *et al.* (2010).The lifespan of Blackstripe Topminnow is short. The oldest individuals found in the Sydenham River watershed were 2+ years of age, i.e., between 2 and 3 years old (McKee and Parker 1982; McAllister 1987). Nieman and Wallace (1974) also found the oldest fish in the Huron River, Michigan, to be 2+ years old.

Physiology and Adaptability

Some information is available on physiology and adaptability of the Blackstripe Topminnow. McKee and Parker (1982) reported that water temperature at capture sites ranged from 20 - 25°C in August 1979, although temperatures in isolated pools supporting Blackstripe Topminnow in Black Creek were higher. As the species' global distribution is centred on the Mississippi River basin, the Blackstripe Topminnow can be considered a warm water species. It is tolerant of warmer temperatures than are the norm in southwestern Ontario; Rutledge and Beitinger (1989) have reported the critical thermal maximum (temperature at which equilibrium is lost and righting response fails) for fish from Denton Creek, Texas, to be 41.6°C under high oxygen concentrations and 37.5°C under low oxygen concentrations. The Sydenham River contains the most northerly population of Blackstripe Topminnow and it is possible that this population has a lower thermal tolerance than more southerly populations due to local adaptation. Presently, there are no data to support this hypothesis.

The Blackstripe Topminnow also has high tolerance of hypoxic conditions. Lewis (1970) found the species functioned at extremely low oxygen concentrations (0.0 $mg \cdot L^{-1}$ subsurface) and attributed this ability to morphological features (superior mouth and flat head) that permit the fish to exploit the thin surface layer of oxygenated water.

The ability to tolerate high temperatures and low oxygen concentrations is consistent with the persistence of the species in stagnant pools of turbid, intermittent streams. McKee and Parker (1982) found Blackstripe Topminnow to be most common in reaches of the North Sydenham River that had the highest turbidity and suggested that its downstream distribution in this watershed is limited by reduced turbidity near Wallaceburg, Ontario, caused by the influx of relatively clear water from the St. Clair River.

Blackstripe Topminnow is an opportunistic feeder that consumes a variety of items. An unusual feature of the diet of Blackstripe Topminnow is the large proportion of terrestrial insects. Other items identified in dietary studies include aquatic insect larvae, molluscs, spiders, cladocerans, ostracods, copepods and filamentous algae (Atmar and Stewart 1972; McKee and Parker 1982; Becker 1983). The importance of terrestrial insects in the diet of Blackstripe Topminnow was noted by Gillette (2007), who manipulated the availability of different food items for fish held in experimental streams. Blackstripe Topminnow denied access to terrestrial insects shifted their food intake to other items, but experienced a reduction in body fat.

Dispersal and Migration

There is little information about long-distance migration in this species. Directed movement appears to be seasonal and limited to dispersal between deeper and relatively shallow waters (Carranza and Winn 1954). During the summer months, fish occupying intermittent portions of the Sydenham River watershed can become concentrated in pools during periods of low water (McAllister 1987). The Canadian population is isolated from populations in the United States by a distance of approximately 200 km; much of the intervening area consists of unsuitable habitat (McKee and Parker 1982). At smaller spatial scales, the Blackstripe Topminnow is capable of large daily movements. In the Cahokia Creek study (Alldredge *et al.* 2011), marked individuals moved more in a year with lower densities than in a year with high densities. Generally, minimum movement rates (m/day) were 0-8 m. The same individuals demonstrated maximum daily movement rates of a few metres to 80 m in the high-density year (2008) versus a few metres to 200+ m in the low-density year (Alldredge *et al.* 2011). These daily movement rates demonstrate that the Blackstripe Topminnow is capable of moving among stream segments and, at a minimum, point to a capacity to move throughout streams of low order in a season. Individuals alternated between low daily movement rates for most days to large step movements (50-200 m per day) and a new occurrence within Cahokia Creek.

Interspecific Interactions

Aquatic biodiversity in the Sydenham River is among the highest in Canada. Historically, 80 fish species and 34 freshwater mussel species were present in the system (Staton *et al.* 2003). A number of predatory fishes are present (e.g., Largemouth Bass (*Micropterus salmoides),* Northern Pike (*Esox lucius*), and Grass Pickerel (*Esox americanus)* (Mandrak *et al.* 2006) and Blackstripe Topminnow is probably prey for these species, although specific reports are lacking. The habit of lying at the surface also exposes the Blackstripe Topminnow to avian predators such as Belted Kingfisher (*Megaceryle alcyon,* Atmar and Stewart 1972) and herons.

In various areas particularly in the Mississippi River basin, the Blackstripe Topminnow is sympatric with other *Fundulus* species including the closely related Blackspotted Topminnow (*F. olivaceus)* and the Broadstripe Topminnow (*F. euryzonus*) (Braasch and Smith 1965; Vigueira *et al.* 2008). Hybridization and mitochondrial DNA introgression has been documented between wild Blackstripe and Blackspotted Topminnows (Duvernell *et al.* 2007). Furthermore, Vigueira *et al.* (2008) reported viable F_1 and F_2 offspring between all three hybrid crosses under laboratory conditions. Although *Fundulus diaphanus* is present in the Sydenham River watershed (Mandrak and Holm 2001), hybridization with the Blackstripe Topminnow has not been reported. Similarly, competitive interaction between these species is possible (Trautman 1981) but has not been documented in Canada. Two invasive species, the Common Carp (*Cyprinus carpio*) and the Round Goby (*Neogobius melanostomus*) are established in the Sydenham River drainage, but their effects on the persistence of the Blackstripe Topminnow are unknown.

The Blackstripe Topminnow is parasitized by a number of organisms. Two individuals out of a sample of 16 from the Sydenham River were infected with *Lernaca* copepods (McAllister 1987). Populations from other parts of the range were reported to be hosts for cestodes, nematodes, acanthocephalans and freshwater mussel glochidia (McAllister 1987 and references therein).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Sampling in the Sydenham River watershed has occurred on a number of occasions since 1972 by personnel from different agencies (Figure 3, Appendix 1). Sampling methods employed were variable and consisted of seining, dip netting, and electrofishing.

Abundance and Trends

Rigorous quantitative population estimates are not available for Canadian populations. Population density estimates for the Blackstripe Topminnow are available for only one stream in Illinois, Cahokia Creek (Alldredge *et al.* 2011). Densities in one year (2008) were 20-50 fish per 100 m of stream (width approximately 5-10 m) while in the subsequent year densities declined to between 1-10 fish per 100 m of stream. Alldredge *et al.* (2011) suggested that winter mortality may have played a role in the decline of abundance from one year to the next. Movement of tagged individuals differed between the two years. In 2008, at relatively high densities, mean movement of Blackstripe Topminnow was 7.6 m (±2.6m SE) while in 2009 at low densities mean movement was 23.0 m (±3.1m SE). In most areas in the United States, the Blackstripe Topminnow is considered to be common to abundant although the species is less common in Michigan, Iowa and Alabama (NatureServe 2010, see below). Recent range expansions have been reported in Ohio (Ohio Division of Natural Areas and Preserves 1999) and Wisconsin (Becker 1983).

Edwards and Staton (2009) indicated that most sites in Ontario where fish were captured in the 1970s yielded specimens in the late 1990s. Furthermore, while the Blackstripe Topminnow was not found in the 1990s at some sites that yielded fish in the 1970s, fish were found in several new areas. Similarly, sampling in the 2000s resulted in records from several new areas (Mandrak *et al.* 2006; Sarah Hogg, pers. comm. 2010). Capture records since the 1970s do not suggest a decline in abundance, although direct comparison of catch statistics is complicated by a lack of sampling standardization. Edwards and Staton (2009) concluded that the Blackstripe Topminnow population in the Lake St. Clair drainage is stable.

Rescue Effect

There is little information available about dispersal/gene flow in Blackstripe Topminnow but, given the species' small body size and preference for low-velocity reaches of small rivers, the probability of unassisted long-distance movement from at least 200 km away to southern Ontario is low.

In addition to the long distance, dispersing fish would have to negotiate large expanses of unsuitable habitat, including at least one large river and one large lake, to reach the occupied drainages in Ontario. Nonetheless, as long as adjacent populations persist, rescue is not impossible.

THREATS AND LIMITING FACTORS

The most serious threat to the Blackstripe Topminnow in the Sydenham River watershed relates to habitat loss and degradation. One well characterized form of habitat degradation is removal of in-stream and riparian vegetation, an important component of habitat for many aquatic species (Richardson *et al.* 2010). Because the diet of the Blackstripe Topminnow consists largely of terrestrial arthropods, the species is highly dependent on intact riparian vegetation as a food reservoir. Riparian vegetation and aquatic plants are also important sources of cover due to the species' habit of swimming at the surface. McAllister (1987) noted that few Blackstripe Topminnow specimens were collected in portions of the Sydenham River watershed (e.g., Black Creek) where vegetation had been destroyed by livestock having access to the river. The same author also observed that the species was rarely seen far from cover provided by aquatic and overhanging plants.

Less certainty is attached to the negative impact of wetland drainage and channelization (Edwards and Staton 2009). These practices may result in reduced water levels and increased intermittency of water flow in parts of the watershed. Similarly, oil seepage from production wells in the Black Creek area has also been suggested as a threat (Edwards and Staton 2009). The most recent potential threat to emerge is the presence of the invasive and disruptive Round Goby, which is now present in the Sydenham River (Poos *et al.* 2010). Because the Blackstripe Topminnow is a surface feeder, however, the Round Goby is probably a greater threat to benthic species. Finally, capture of the Blackstripe Topminnow as bycatch in the bait fishery for various species in Ontario may represent a source of mortality. This threat, however, is likely minimal because bycatch modelling indicates that 1,233 harvest events must occur in Ontario tributaries for a single harvest event to have at least a 95% chance of capturing the species. As substantially fewer harvest events likely occur in the Sydenham River watershed, the chance of capture is low unless areas containing Blackstripe Topminnow are specifically targeted (Andrew Drake, Fisheries and Oceans Canada, pers. comm. 2012).

The COSEWIC Threats Calculator, adapted from the IUCN-CMP threats classification system, was used to assess threats faced by the Blackstripe Topminnow; the overall impact of all threats was assessed as high (Appendix 2).

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

The Blackstripe Topminnow was last assessed as Special Concern in Canada by the Committee on the Status of Endangered Wildlife in Canada and is listed as such on Schedule 1 of the federal *Species at Risk Act* (SARA). As a species of Special Concern, it does not benefit directly from legal protection provided to Endangered and Threatened species under SARA. The species may derive some indirect protection under SARA regulations due to the presence in the system of other species that are listed as Endangered or Threatened (e.g., several mussels and Eastern Sand Darter, *Ammocrypta pellucida*). Furthermore, Special Concern status mandates the development of a federal management plan for the species (Edwards and Staton 2009). The Blackstripe Topminnow is protected under two Ontario statutes, the *Conservation Authorities Act* and the *Endangered Species Act* 2007. The species is also protected from use as a baitfish under Ontario Fisheries Regulations. In the United States, the species has no legal protection.

Non-Legal Status and Ranks

While conservation rankings for Blackstripe Topminnow in Canadian and American jurisdictions (Table 1, NatureServe 2010) vary, globally the species appears secure. The exceptions are populations in the northern part of the range including Ontario and Michigan. The latter includes populations that are the closest potential sources for rescue of Canadian populations.

Table 1. Global (G), federal (N), provincial and state (S) ranks for Blackstripe Topminnow (NatureServe 2010).

Jurisdiction	Rank
Global	G5
Canada	N2
Ontario	S2
United States	N5
Alabama	S3
Arkansas	S4
Iowa	S3
Illinois	S5
Indiana	S5
Kansas	S5
Kentucky	S4S5
Louisiana	S5
Michigan	S2S3
Missouri	SNR
Mississippi	S5
Ohio	S4
Oklahoma	S5
Tennessee	S5
Texas	S5
Wisconsin	S4

2 = imperiled
3 = vulnerable to extirpation/extinction
4 = apparently secure
5 = demonstrably widespread, abundant, secure

Habitat Protection and Ownership

The provincial *Conservation Authorities Act* is intended to protect aquatic habitat under regulation 171/06. Most of the land comprising the Sydenham River watershed, including the floodplain, is privately owned and under intensive agricultural use (Staton *et al.* 2003). The Sydenham River Recovery Team, a multi-agency group, was formed in 1999 to ensure the continued survival of this species and a number of other Canadian species at risk residing in the watershed. The Recovery Team conducted an ecosystem-based assessment of the status and trends of the watershed and developed a Recovery Strategy incorporating four components: management, stewardship, research/monitoring and awareness/outreach (Staton *et al.* 2003). The assessment concluded that the river remains in fair to good physical condition with processes, such as sediment transport and water flow, functioning relatively normally. With the exception of two dams on the Sydenham River, the river flows relatively unimpeded through most of the drainage basin. Four Action Plans have been developed, one for each of the four components of the Recovery Strategy, which spell out a series of recovery activities. Implementation of these activities is overseen by four Recovery Action Groups (Sydenham River Recovery Action Groups 2003).

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Tim Birt is a Research Associate and Adjunct Assistant Professor at Queen's University. His research activities have mostly involved studies of population genetics and evolution of seabirds and Atlantic Salmon. Tim has authored or co-authored two COSEWIC reports.

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COLLECTIONS EXAMINED

None

Appendix 1. Capture Records for Blackstripe Topminnow in Southwest Ontario.

Site	Latitude	Longitude	Date	Source*
Bear Creek	42.87689	-82.14769	1982	McAllister 1987
Bear Creek	42.85861	-82.21972	1996-09-26	ROM Acc. 6448:RHG96-28;D
Bear Creek	42.72954	-82.35003	1979-09-27	CMNFI 1979-1206
Bear Creek	42.82375	-82.25878	1979-08-23	CMNFI 1979-1049
Bear Creek	42.80929	-82.30547	1979-08-22	CMNFI 1979-1044
Bear Creek	42.76194	-82.34083	1979-08-22	CMNFI 1979-1042
Bear Creek	42.76333	-82.33083	1979-08-22	CMNFI 1979-1043
Bear Creek	42.84583	-82.23444	1979-08-22	CMNFI 1979-1045
Bear Creek	42.77418	-82.32860	1972-08-13	CMNFI 1972-0204
Bear Creek	42.76667	-82.33334	1982-07-22	CMNFI 1982-0591
Bear Creek	42.72938	-82.35139	1979-08-22	CMNFI 1979-1041
Bear Creek	42.87028	-82.14694	1997-08-05	ROM Acc. 6500:CR97-10
Bear Creek	42.92351	-82.054348	2010-07-12	OMNR
Bear Creek	42.86522	-82.102703	2010-08-10	OMNR
Bear Creek	42.76517	-82.339083	2010-08-12	OMNR
Bear Creek	42.76517	-82.338889	2010-10-05	OMNR
Bear Creek	42.7655	-82.33725	2010-10-06	OMNR
Bear Creek	42.86356	-82.168778	2010-08-10	OMNR
Black Creek	42.78333	-82.18333	1974-10-22	CMNFI 1974-0318
Black Creek	42.78639	-82.12722	1996-09-26	ROM 70792
Black Creek	42.80000	-82.15000	1982-07-22	CMNFI 1982-0594
Black Creek	42.77167	-82.14500	1976-06-23	OMNRS82
Black Creek	42.80000	-82.15000	1979-08-21	CMNFI 1979-1028
Black Creek	42.78417	-82.19833	1996-09-26	ROM Acc. 6448:RHG96-18;D
Black Creek	42.77861	-82.10417	1979-08-21	CMNFI 1979-1032
Black Creek	42.74028	-82.31528	1979-08-22	CMNFI 1979-1038
Black Creek	42.72656	-82.34750	1979-08-22	CMNFI 1979-1039
Black Creek	42.78333	-82.16667	1972-08-10	CMNFI 1972-0184
Black Creek	42.76389	-82.25833	1979-08-21	CMNFI 1979-1030
Black Creek	42.77011	-82.23972	1979-08-21	CMNFI 1979-1029
Black Creek	42.76667	-82.25000	1982-07-22	CMNFI 1982-0592
Black Creek	42.78692	-82.17169	1972-08-10	ROM 28312
Black Creek	42.76200	-82.25912	1996-09-26	ROM Acc. 6448:RHG96-22;D
Black Creek	42.74166	-82.31667	1975-08-05	ROM 31071
Black Creek	42.77558	-82.098944	2010-07-10	OMNR
Black Creek	42.79078	-82.193167	2010-08-04	OMNR
Black Creek	42.76344	-82.259333	2010-08-05	OMNR
Black Creek	42.76344	-82.259333	2010-10-04	OMNR
Black Creek	42.76211	-82.259333	2010-10-07	OMNR
Black Creek	42.77053	-82.23946	2010-08-04	OMNR
Black Creek (2 sites)	42.6025	-82.17111	1999-09/11	DFO
Booth Creek	42.72500	-82.22334	1982-11-05	ROM Acc. 4571:8282-021-02
Booth Creek	42.73857	-82.28545	1982-11-04	ROM Acc. 4571:8282-021-01
Crooked Creek	42.76278	-82.19556	1996-09-26	ROM Tissue Collection
Crooked Creek	42.76278	-82.25723	1996-09-26	ROM Acc. 6448:RHG96-21;R

Site	Latitude	Longitude	Date	Source*
Crooked Creek	42.76250	-82.22361	1979-08-21	CMNFI 1979-1031
East Otter Creek	42.66333	-82.28167	1982-10-26	ROM Acc. 4571:8282-017-02
East Otter Creek	42.61167	-82.33500	1982-10-21	ROM Acc. 4571:8282-017-03
East Otter Creek	42.61333	-82.30666	1982-10-22	ROM Acc. 4571:8282-017-01
East Otter Creek	42.62752	-82.29215	1982-10-25	ROM Acc. 4571:8282-017-04
East Otter Creek	42.62778	-82.29275	2010-08-13	OMNR
East Otter Creek	42.67684	-82.25827	2003-09	DFO
Fox Creek	42.82750	-82.12556	1979-08-21	CMNFI 1979-1033
Fox Creek	42.81778	-82.12639	1996-09-26	ROM Acc. 6448:RHG96-15;T
Fox Creek	42.82750	-82.12556	1982-06-06	ROM 9800658
Fox Creek	42.82750	-82.12556	1996-09-26	ROM 70793
Fox Creek	42.82708	-82.125722	2010-07-15	OMNR
Little Bear Creek	42.51734	-82.37794	2003-09	DFO
Little Bear Creek (10 sites)	42.515	-82.2417	1999-09/11	DFO
Maxwell Creek	42.54122	-82.38110	2003-09	DFO
Molly's Creek	42.60169	-82.16936	1997-10-02	ROM 70976
Molly's Creek	42.60169	-82.16936	1972-08-10	CMNFI 1972-0186
Otter Creek	42.61611	-82.30139	1972-09-25	CMNFI 1979-1155
Ryan's Creek	42.67924	-82.39640	1982-11-03	ROM Acc. 4571:8282-019-01
Sydenham River	42.59847	-82.32046	1997-10-01	ROM Acc. 6520: ESR97-04
Sydenham River	42.59000	-82.12889	1997-10-02	ROM 70980
Sydenham River	42.59028	-82.26722	1997-08-07	ROM Acc. 6500: CR97-21
Sydenham River	42.59000	-82.12889	1997-10-02	ROM 70978
Sydenham River	42.70993	-81.97602	2010-06-29	OMNR
Sydenham River	42.59391	-82.182399	2010-06-10	OMNR
Sydenham River	42.64982	-82.009114	2010-06-10	OMNR
Sydenham River	42.59763	-82.33649	2003-09	DFO
Sydenham River	42.60011	-82.30342	2003-09	DFO
Sydenham River	42.59085	-82.26687	2003-09	DFO
Sydenham River	42.59200	-82.20095	2003-09	DFO
Sydenham River	42.58902	-82.19484	2003-09	DFO
Sydenham River	42.58827	-82.23257	2003-09	DFO
Sydenham River	42.59203	-82.20031	2003-09	DFO
Sydenham River	42.58840	-82.19444	2003-09	DFO
Sydenham River	42.58810	-82.23186	2003-09	DFO
Sydenham River	42.60011	-82.30342	2003-09	DFO
Sydenham River	42.59085	-82.26687	2003-09	DFO
North Sydenham River	42.74166	-82.31667	1975-08-05	OMNRS82
North Sydenham River	42.72750	-82.35333	1982	McAllister 1987
North Sydenham River	42.64357	-82.37899	1979-09-25	CMNFI 1979-1051
North Sydenham River	42.69167	-82.40417	1979-09-27	CMNFI 1979-1207
North Sydenham River	42.70364	-82.39147	1972-08-12	CMNFI 1972-0199
North Sydenham River	42.69167	-82.40417	1997-08-06	ROM Acc. 6500:CR97-14
North Sydenham River	42.63472	-82.37417	1997-08-07	ROM Acc. 6500:CR97-18
North Sydenham River	42.66389	-82.39583	1979-08-23	CMNFI 1979-1050
North Sydenham River	42.72750	-82.35333	1979-08-22	CMNFI 1979-1040
North Sydenham River	42.72750	-82.35333	1997-08-06	ROM Acc. 6500:CR97-12AB

Site	Latitude	Longitude	Date	Source*
North Sydenham River	42.72750	-82.35333	1997-08-06	ROM Acc. 6500:CR97-12C
North Sydenham River	42.72750	-82.35333	1997-08-06	ROM Acc. 6500:CR97-13B
North Sydenham River	42.72750	-82.35333	1975-08-06	ROM 34407
North Sydenham River	42.66667	-82.40166	1975-08-07	ROM 34405
North Sydenham River	42.72611	-82.35583	1993-08-18	ROM 67790
North Sydenham River	42.69194	-82.40305	1997-08-06	ROM Acc. 6500:CR97-15
North Sydenham River	42.78833	-82.30666	1975-08-05	OMNRS82
North Sydenham River	42.65737	-82.37566	2003-09	DFO
North Sydenham River	42.72730	-82.35361	2003-09	DFO
North Sydenham River	42.69357	-82.40117	2003-09	DFO
North Sydenham River	42.65737	-82.37566	2003-09	DFO
North Sydenham River	42.64879	-82.37357	2003-09	DFO
North Sydenham River	42.60131	-82.38165	2003-09	DFO
North Sydenham River	42.64879	-82.37357	2003-09	DFO
North Sydenham River	42.62074	-82.37754	2003-09	DFO
North Sydenham River	42.60131	-82.38165	2003-09	DFO
West Otter Creek	42.65236	-82.331139	2010-07-15	OMNR
West Otter Creek	42.39213	-82.19871	2003-09	DFO
Whitebread Drain	42.60000	-82.38333	1986-1997	DFO
Whitebread Drain	42.63072	-82.445083	2010-08-09	OMNR
Whitebread Drain	42.62529	-82.46907	2003-09	DFO
Whitebread Drain	42.63054	-82.44516	2003-09	DFO

*ROM, Royal Ontario Museum; CMNFI Canadian Museum of Nature Fishes; OMNR, Ontario Ministry of Natural Resources; DFO, Fisheries and Oceans Canada

Appendix 2. COSEWIC Threats Calculator for Blackstripe Topminnow.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	*Fundulus notatus*		
Element ID		**Elcode**	
Date (Ctrl + ";" for today's date):	12/14/2011		
Assessor(s):	Tim Birt (rollup corrected April 26, 2012 by E. Taylor)		
References:			

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	0	0
C	Medium	2	2
D	Low	3	3
Calculated Overall Threat Impact:		High	High

Assigned Overall Threat Impact:	**B = High**
Impact Adjustment Reasons:	
Overall Threat Comments	Removal of streamside vegetation from urbanization, industrialization and some livestock farming is judged to be the most important threat applying to all known site occurrences, but with variable impacts at each. Allowing livestock access to the river results in destruction of aquatic and riparian vegetation. Resulting stresses include reduced availability of spawning sites and food availability (i.e. terrestrial insects), elevated water temperature due to loss of shade, elevated predation risk due to reduced cover, and siltation. The threat from oil production is most relevant to Black Creek. Fishing is a minor threat as Blackstripe Topminnow is not permitted as a bait fish in Ontario. Two dams in the upper reaches of the Sydenham River represent a minor threat. The threat from invasive species may become more apparent if round goby becomes more widespread throughout the Sydenham River watershed. Common carp is widespread throughout the system. Agricultural effluents result in eutrophication (nitrates and phosphates) and possibly toxic effects (pesticides).

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development						
1.1	Housing & urban areas						
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas						
2	Agriculture & aquaculture	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	
2.1	Annual & perennial non-timber crops						
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching			Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	decreased food availability, increased predation risk, elevated water temperature due to loss of aquatic and riparian vegetation
2.4	Marine & freshwater aquaculture						
3	Energy production & mining		Not Calculated (outside assessment timeframe)	Small (1-10%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs/3 gen)	
3.1	Oil & gas drilling		Not Calculated (outside assessment timeframe)	Small (1-10%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs/3 gen)	potential mortality due to oil seepage
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors						
4.1	Roads & railroads						
4.2	Utility & service lines						
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources		Not Calculated (outside assessment timeframe)	Small (1-10%)	Slight (1-10%)	Low (Possibly in the long term, >10 yrs/3 gen)	potential mortality due to bait fishery
6	Human intrusions & disturbance						
6.1	Recreational activities						
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression						
7.2	Dams & water management/use	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	habitat loss due to two dams in upper reaches of Sydenham River; applies to one location only
7.3	Other ecosystem modifications						
8	Invasive & other problematic species & genes	D	Low	Small (1-10%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
8.1	Invasive non-native/alien species	D	Low	Small (1-10%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	potential direct competition, trophic disruption, habitat degradation due to invasive round goby, common carp
8.2	Problematic native species						
8.3	Introduced genetic material						
9	Pollution	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	
9.1	Household sewage & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents	C	Medium	Pervasive (71-100%)	Moderate (11-30%)	High (Continuing)	reduced dissolved oxygen and algal blooms due to nitrate/phosphorus loading; possible toxic effects from pesticides
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
11.1	Habitat shifting & alteration						
11.2	Droughts	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
11.3	Temperature extremes						
11.4	Storms & flooding						

Classification of Threats adopted from IUCN-CMP, Salafsky *et al*. (2008).