Status of the Blackstripe Topminnow, *Fundulus notatus*, in Canada*

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The Blackstripe Topminnow, *Fundulus notatus*, is restricted in Canada to two southern Ontario counties, Lambton and Kent, in the Sydenham River watershed, where its range occupies a rectangle of less than 10 by 30 kilometres. The species is absent from a considerable proportion of stations within this range. It is rarely common at stations where it is known, and it averages only about 2.6% of the specimens of all species present. Canadian and American populations are separated by considerable expanses of unfavorable lentic habitat. Livestock destruction of stream edge-cover has reduced or extirpated some populations. Seepage from oil wells into one creek is probably inimical to one population of this surface-feeding species. Damage to streamside vegetation, which provides insect food, and to within-stream vegetation, which provides cover, is probably harmful to this species. Because of the highly restricted distribution of this species, its occurrence in only a portion of one watershed, its specialized surface-insect feeding habit, its need for in-stream and stream-side vegetation, and the occurrence of some habitat threats in its Ontario range, this species is judged to be rare in Canada.

Au Canada, on ne trouve le fondule rayé, *Fundulus notatus*, que dans deux comtés du sud de l'Ontario (Lambton et Kent), plus précisément dans le bassin de la rivière Sydenham, à l'intérieur d'un rectangle de moins de 10 km sur 30 km. L'espèce est absente d'un nombre considérable mais encore inconnue de sites d'observation dans les limites de cette aire. On la trouve rarement en grand nombre aux sites qu'elle fréquente habituellement, où elle représente en moyenne quelque 2,6% des spécimens présente de toutes les espèces observées. Les populations du Canada et des États-Unis sont séparées par d'importantes étendues d'habitat lentique non favorable à l'espèce. La destruction, par le bétail, de la végétation en bordure des cours d'eau a réduit ou même déraciné certaines populations. L'écoulement de pétrole dans un des ruisseaux nuit probablement à l'une des populations de cette espèce qui se nourrit en surface. L'altération de la végétation du bord de l'eau, où se trouvent les insectes dont il se nourrit, et celle des plantes aquatiques, qui lui servent d'abri, est vraisemblablement néfaste au fondule rayé. Étant donné sa répartition très restreinte, sa présence dans un seul secteur du bassin étudié, son régime axé sur les insectes de surface, son besoin de végétation aquatique et certaines menaces qui pèsent sur son habitat de l'Ontario, l'espèce est considérée comme étant rare au Canada.

Key Words: Blackstripe Topminnow, *Fundulus notatus*, Ontario, rare fish, killifish, Cyprinodontidae.

The Blackstripe Topminnow, *Fundulus notatus*, can be recognized by the prominent black horizontal band along the side of both body and head, the rounded tail fin, the flattened top of the head, and the large round scales on top of the head, cheek and gill covers (Figure 1). An opal-coloured spot on the top of the head makes this species easy to recognize in life, but the spot disappears after death. The related Banded Killifish, *Fundulus diaphanus*, which also occurs in Ontario, has 40 to 55 scales along the side instead of 32 to 35, and has vertical bars instead of a black horizontal band.

Distribution

The following account of the distribution of the Blackstripe Topminnow is based on Shute (1980), on results of recent studies (Parker and McKee 1982) and on a survey by Thomas A. Edge in 1982.

In the United States the Blackstripe Topminnow is widespread throughout the central eastern United States (Figure 2). It ranges in the Gulf states from the San Antonio River drainage in Texas to Mobile Bay tributaries in western Alabama. In the Mississippi River basin the species is found in many lowland areas from southern Mississippi to Illinois, Ohio, Michigan, Iowa, and Wisconsin. In the Great Lakes basin it has been collected from tributary streams of southern Lake Michigan, Lake St. Clair, and Lake Erie.

In Canada the Blackstripe Topminnow is limited to the Sydenham River watershed in southwestern Ontario (Figure 3). It has been captured in the North Sydenham River from Wallaceburg, Lambton County (42°38′20″N, 82°22′32″W), to Bear Creek at Petrolia, Lambton County (42°17′12″N, 82°08′55″). This species also occurs in Fox Creek (42°48′N, 82°09′W) and Crooked Creek (42°46′N, 82°16′W), both tributaries of Black Creek in Lambton County. A single collection of the Blackstripe Topminnow was made in Otter Creek, Kent County (42°36′58″N, 82°18′05″W), which enters the North Sydenham River at Wallaceburg. A single specimen in the

*Rare status approved and assigned by COSEWIC April 1985.

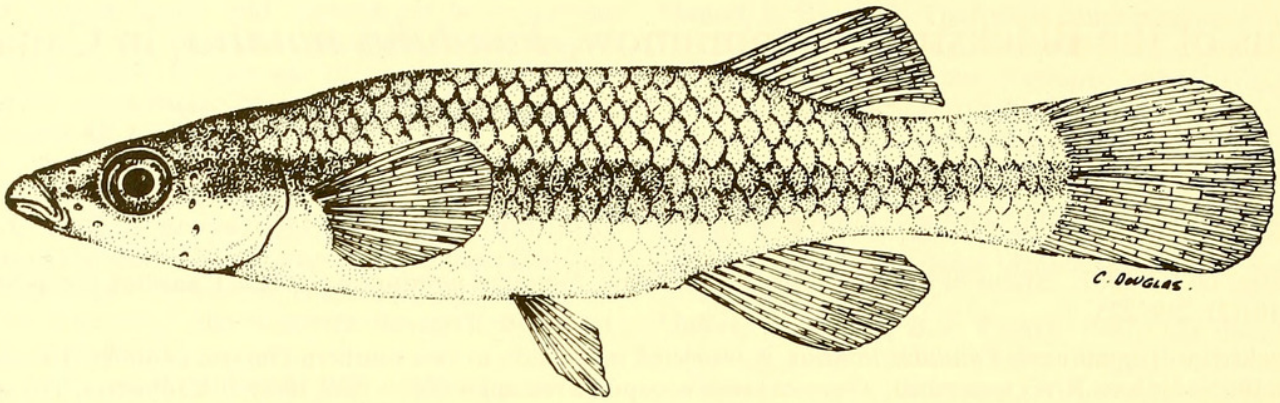

FIGURE 1. Blackstripe Topminnow, *Fundulus notatus* (drawing by C. H. Douglas, National Museum of Natural Sciences).

National Museum of Natural Sciences labeled Mollys Creek, Kent County (42° 36′N, 82° 10′W), which flows into the Sydenham River near Dresden, is open to some doubt as to its provenance (C. G. Gruchy, personal communication). The most recent collections of the Blackstripe Topminnow were made by Thomas A. Edge in June and July 1982. These were from the North Sydenham River 1 km east of Wilkesport (school of about 30 seen); Bear Creek, 17 km east of Bickford (about 10 seen); Black Creek about 12 km east of Brigden (about 50 observed at the surface). All of Edge's observations were in Lambton County, Ontario. Voucher specimens and records are deposited in the National Museum of Natural Sciences, Ottawa.

The known range of the Blackstripe Topminnow in Canada occupies an area of about 10 by 30 km and is located about 200 km north of the nearest population in the United States. Canadian and American populations are separated by considerable expanses of unfavorable lentic habitat.

Protection

No legal or other protection has been accorded the Blackstripe Topminnow in Canada other than the general protection of the habitat section of the Fisheries Act.

Population Size and Trend in Canada

No population estimates have been made of the Blackstripe Topminnow in Canada, and there is no direct evidence on population trends. The species was first discovered in Canada in 1972 (Gruchy et al. 1973).

Within its small known Canadian range Blackstripe Topminnow adults and young appear in moderate abundance. Individuals and groups of three to five were observed near the upstream and downstream limits of the species in Ontario. Pools in intermittent streams in the headwaters of Black Creek seemed to provide optimal habitat: 20 to 30 Topminnows were observed in a long, narrow pool of about 200 square metres. Destruction of aquatic vegetation and bank cover by livestock limits available habitat area in the headwaters of Black Creek. Few specimens were collected in these altered habitats.

Intrusion of less turbid water from the St. Clair River into the North Sydenham River at Wallaceburg appears to limit the downstream movement of this species and may limit its further dispersal in the Lake St. Clair drainage. Riffles and increased gradient above Petrolia curtail its upstream dispersal in Bear Creek. Tolerance to turbid water might suggest that this species will expand its range elsewhere into existing turbid waters or into waters that become turbid. However, this assumes that other habitat requirements will be met. Loss of stream bank cover may increase turbidity but decrease the supply of terrestrial insects which constitute $> 50\%$ of foregut volumes in 13 Ontario specimens examined in 1979. Thus, although Trautman (1957) noted that this species is more tolerant of turbidity than the Banded Killifish and tended to replace it when turbidity increases, he reported marked decreases in the abundance of Blackstripe Topminnows in sections of Ohio which showed the greatest increases in turbidity from 1925 to 1950. Trautman further stated that the largest populations were found in relatively clear water.

Habitat

In Ontario the Blackstripe Topminnow occurs in permanent and intermittent sluggish creeks and rivers. Stream gradients in the North Sydenham River watershed range from 0.02 m/km to over 6 m/km. This species was found in permanent flowing waters with gradients less than 0.7 m/km and in intermittent streams with higher gradients. Specimens were collected from Crooked Creek with a gradient of about 5.6 m/km, and in the headwaters of Black

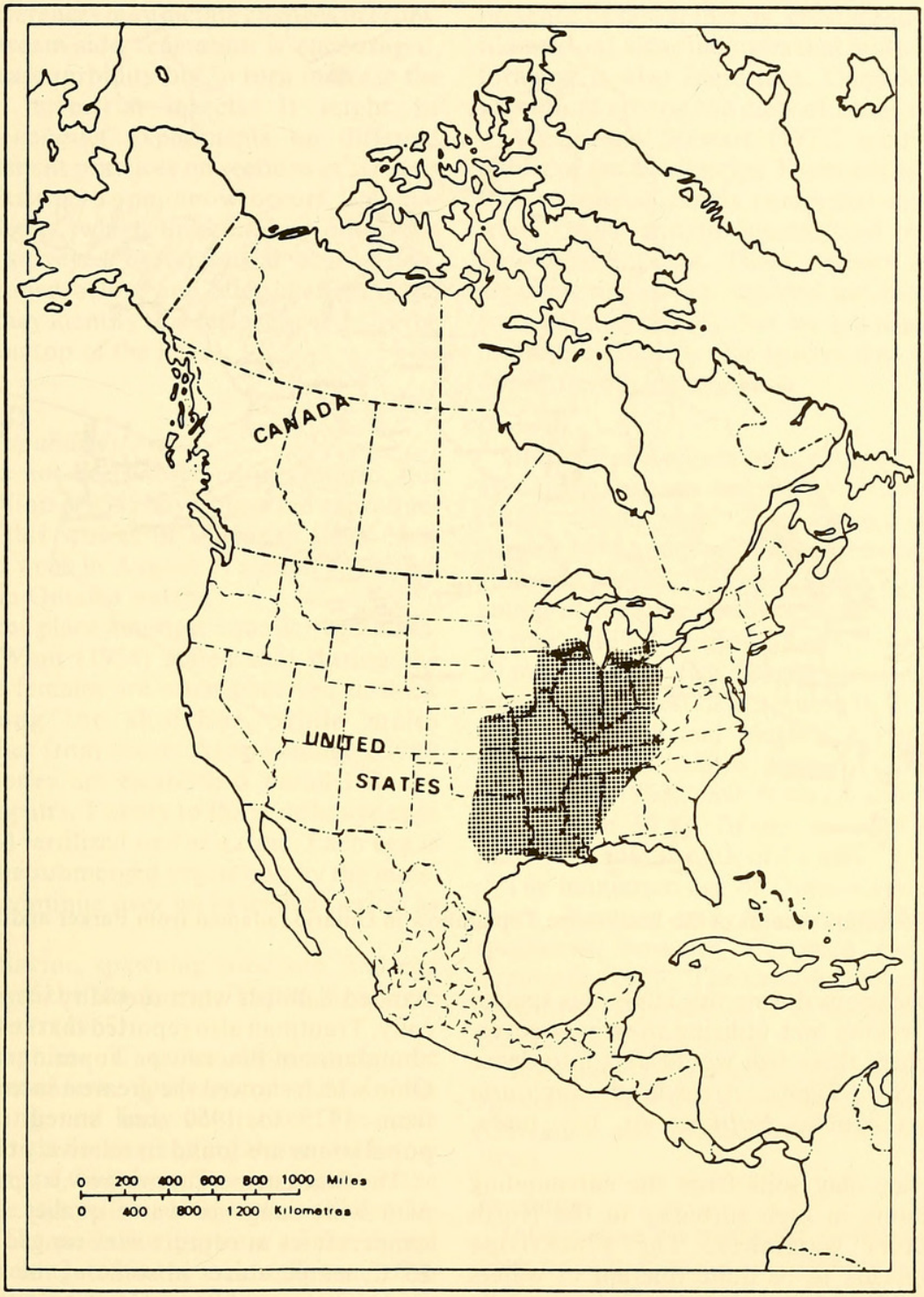

FIGURE 2. North American distribution of *Fundulus notatus* (adapted from Shute 1980).

Creek where the gradient averages 1.4 m/km. Isolated pools of water, 1 to 2 metres deep and separated by dry stream bed, characterize the upper reaches of Black Creek during the late summer. Water flow is virtually absent between these pools.

Trautman (1957) and Shute (1980) also reported that the Blackstripe Topminnow prefers small to large low-gradient streams, and Atmar and Stewart (1972) mentioned that this species was found in pools in intermittent streams, as in Black Creek.

Emergent and floating aquatic macrophytes and low overhanging terrestrial plants are extensively used as cover by the Blackstripe Topminnow. In the North Sydenham River, cover is available only near the river edges. This species was rarely observed beyond this edge cover in open waters. Blackstripe Topminnows were observed in midstream in smaller tributaries, but protective cover was always nearby. In areas where edge-cover had been destroyed by livestock, the Blackstripe Topminnow was less numerous or absent.

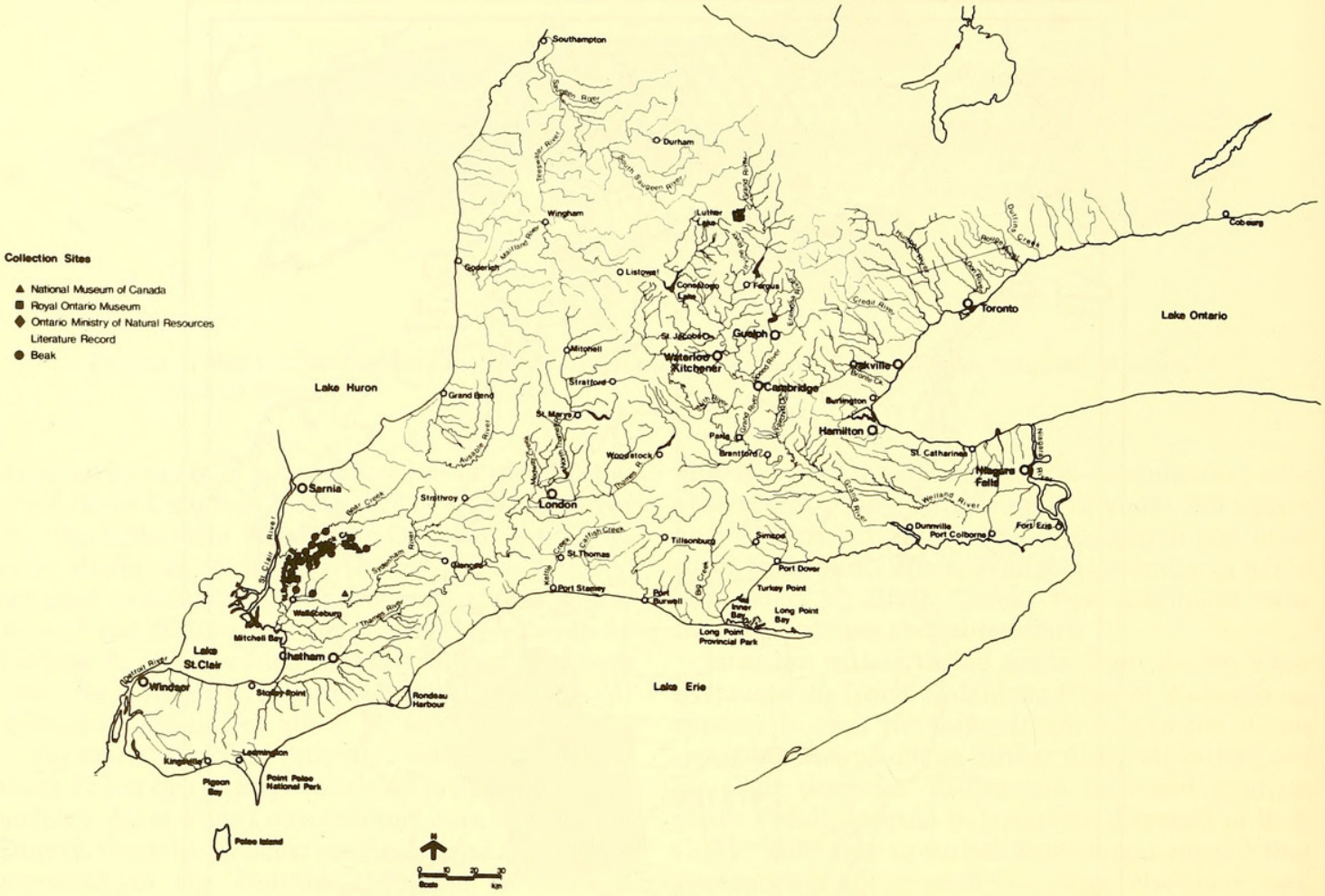

FIGURE 3. Collection records of the Blackstripe Topminnow in Ontario (adapted from Parker and McKee 1980).

On several occasions during this study this species was observed seeking and utilizing in-stream cover. When approached, these fish would dart into dense growth of cattails, *Typha*; Arrowhead, *Sagittaria latifolia*; spatterdock, *Nuphar*; or lily pads, *Nymphaea*.

Erosion of fine clay soils from the surrounding countryside results in high turbidity in the North Sydenham River watershed. The Blackstripe Topminnow appears to be quite tolerant of waters with high turbidity, and may prefer, or preferentially survive, in such habitats. It becomes more numerous in the North Sydenham River as turbidity increases. Inflow of clear St. Clair River water into the North Sydenham River increased water transparency from approximately 10 cm 4.5 km upstream, to approximately 35 cm near Wallaceburg. It is over this 4.5 km stretch of river that the downstream distribution of Blackstripe Topminnows ends. Shute (1980) also reported that this species occurs in streams of moderate to high turbidity. Trautman (1957) observed that this species is more tolerant of turbidity than is the Banded Killifish and tends to replace the Banded Killifish when turbidity increases. Paradoxically, Trautman also reported marked decreases in the abundance of Blackstripe Topminnows in sections of Ohio which showed the greatest increases in turbidity from 1925 to 1950 and stated that the largest populations are found in relatively clear water.

The Blackstripe Topminnow is apparently tolerant of a wide range in water quality. Although water temperatures at capture sites ranged only from 20 to 25° C, temperatures in some of the isolated pools in the headwaters of Black Creek were warmer as a result of decreased waterflow during hot weather. Oxygen levels of 7 and 8.5 mg/L were measured in two pools in Black Creek, but oxygen levels in the shallow isolated pools likely decrease at night since aeration is minimal.

In winter the Blackstripe Topminnow abandons its surface swimming habitat and moves to deeper waters among vegetation and plant debris.

The trends in quality and quantity of critical habitat are unknown. These will depend to a large degree on changes in agricultural practices which may be relatively stable. On the other hand, the changing

economy, development of new agricultural products, or consumer preferences may dictate changes in crops. If permanent stream-side vegetation is encouraged, this might decrease turbidity but in turn increase the availability of terrestrial insects. It might be worthwhile to conduct experiments on different farming management practices on sections of streams where the Blackstripe Topminnow occurs. Populations of this species, which unlike many other fish species can be surveyed by terrestrial observation, could be determined before and after changes (even the uninitiated may identify this surface species by the iridescent spot on top of the head).

General Biology

Reproductive Capability

Spawning has not been observed in Ontario, but Carranza and Winn (1954) have observed reproductive activity of this species in Michigan from early May to the third week in August. A similar spawning period is likely in Ontario waters.

Spawning takes place amongst aquatic vegetation. Carranza and Winn (1954) stated that during the breeding season females are often observed in thick vegetation along the shoreline, while males congregate further from shore. As spawning activity increases, territories are established parallel to the shore by mating pairs. Twenty to thirty adhesive eggs are extruded and fertilized one at a time. Each egg is propelled into the submerged vegetation by the male. Spawning may continue over an extended period as more eggs ripen.

Spawning behavior, spawning substrate, and egg and larval stages of the Blackstripe Topminnow were described by Foster (1967).

Sexual dimorphism is quite apparent in the Blackstripe Topminnow. Differences exist in fin shape, fin marking, and body coloration. The male exhibits dark vertical bars extending above and below the mid-lateral stripe, but these bars are absent in the female. The male has yellowish fins while the female has white fins. The posterior portions of the dorsal and anal fins are elongated in the male and rounded in the female. Coloration and fin shape are related to sex recognition, display, and the reproductive set. A full description of reproductive behaviour is provided by Carranza and Winn (1954).

Feeding Behaviour

Blackstripe Topminnows were often observed feeding alone or in small groups just under the water surface. The upturned mouth of this species also suggests a surface feeding habit. The foregut contents of 13 specimens collected during 1979 were composed primarily of adult terrestrial insects ($>$ 50% by volume, 100% frequency of occurrence), indicating that surface feeding is important to this species. The presence of larval insects, crustaceans, molluscs, and filamentous algae indicates that midwater and bottom foraging is also important. Considerable variation was found among the diets of fishes examined.

Atmar and Stewart (1972) studied the feeding habits of the Blackstripe Topminnow and also found that terrestrial insects comprised much of the diet, while snails, aquatic insects, and microcrustaceans accounted for less. These authors also found that algae are apparently ingested incidentally during the consumption of prey, but are not digested. Variation in prey selected by this species was attributed to an opportunistic feeding habit.

Growth

Blackstripe Topminnows collected in Ontario were aged using scales as described by Nieman and Wallace (1974). Scales from 15 specimens captured during August 1979 and from 8 specimens captured between June and August 1972 were aged. Standard lengths of young-of-the-year of this species ranged from 15 to 32 mm, while fish aged 1+ years ranged from 38 to 50 mm, and 2+ fish ranged from 41 to 51 mm in length. The largest fish captured in 1979 was 51 mm in standard length and weighed 2.3 grams (preserved weight). Total lengths given by Trautman (1957), Carlander (1969), and Nieman and Wallace (1974) range from 50 to 70 mm in total length, with a maximum total length of 74 mm.

The maximum age of Ontario specimens was two years. Nieman and Wallace (1974) reported 3+ specimens; however, Carranza and Winn (1954), Trautman (1957), Thomerson (1966), and Atmar and Stewart (1972) reported 2+ as the maximum age of the Blackstripe Topminnow.

Sex-related differences in size in this species are not apparent except when females are distended with eggs (Carranza and Winn 1954; Nieman and Wallace 1974).

Predation

Information on predation of Blackstripe Topminnows is scant. Piscivorous fish were apparently absent in many of the isolated pools of Black Creek during the 1979 survey. Piscivorous species captured in Bear Creek and the North Sydenham River with the Blackstripe Topminnow were Longnose Gar, *Lepisosteus osseus*, Northern Pike, *Esox lucius*, Rock Bass, *Ambloplites rupestris*, White Crappie, *Pomoxis annularis*, and Largemouth Bass, *Micropterus salmoides*. Predation by some of these fish on the Blackstripe Topminnow is very likely. Atmar and Stewart (1972) suggested that low numbers of larger Blackstripe Topminnows in Texas may be due to selective predation by the Belted Kingfisher, *Megaceryle alcyon*.

Parasites

Parasite copepods of the genus *Lernaca* infested 2 of 16 Blackstripe Topminnows examined from the 1979 survey. Hoffman (1967) listed cestodes, nematodes and Acanthocephala as parasites of this species, and Shira (1913), as cited by Hart and Fuller (1974), found this species was parasitized by unionid glochidia.

Species Movement

There is little information on seasonal movement in Ontario. Individuals may become concentrated in pools by partial drying of the stream bed in summer, and may move into deeper water of pools. The concentration into pools of drying stream beds in summer does increase the risks of exposure to agricultural chemicals or other pesticides, as well as to avian predation.

Behaviour/Adaptability

The Blackstripe Topminnow has survived despite current farming practices in southern Ontario. However, livestock destruction of edge-cover has reduced or extirpated some populations. Human disturbance reducing the emergent and floating aquatic macrophytes or overhanging terrestrial plants that serve as cover, as a source of terrestrial insect food, or as substrate for egg deposition or nursery areas may be detrimental to the success or survival of the species. The species does appear fairly euryphagus, but terrestrial insects taken from the surface of the water supply a very significant portion of the food intake. Measures such as spraying of insecticides and reduction in stream bank vegetation, which reduce this food supply may be expected to have detrimental effects.

The species is able to survive for periods in pools when other portions of the stream bed dry up. Land use practices which result in completely dry stream beds would obviously extirpate populations. Channelization, which results in more rapid flow to which this species is ill-adapted, may be expected to be inimical.

Limiting Factors

It has not been established whether or not populations are declining in southern Ontario. However, population size is probably limited by the amount of stream-side vegetation, aquatic vegetation, and stream-side terrestrial insect fauna may limit population size. Channelization and drainage of wetlands may produce inimical changes in stream flow patterns. Blackstripe Topminnows extend only part way up the lower Michigan Peninsula, just as they are found only in southernmost Ontario. Given time, one might have expected them to have dispersed further north had ecological conditions been suitable. It is deduced that some climatic factor, such as severity of winter conditions, limits northward range extension.

The seepage of oil wells into Black Creek in the vicinity of Oil Springs is expected to have especially damaging potential for a species which feeds to such a high degree on surface food in summer.

Special Significance of the Species

The Blackstripe Topminnow is one of three species of the genus *Fundulus* found in Canadian waters. Along with populations in northern Michigan, the southern Ontario populations comprise the northernmost range of the species and may have special genetic characteristics. Ecologically the topminnows play an important role in the exclusivity with which they feed on surface insects in summer. Other fishes do feed on surface insects but do not rely on them to the same extent.

Evaluation

The Canadian population probably occupies a small area because the species is at the northern end of its range. Riparian plant cover, aquatic macrophytes, and stream-side terrestrial insect food may be limiting population size. Destruction of stream bank cover and oil well seepage may be reducing or extirpating some populations. The species should be considered rare in Canada.

Acknowledgments

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Some of the original recommendations by Parker and McKee (1980) have been modified in this report.

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