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CANADA

OTTAWA (ONT.) K1A 0H3  
(819) 997-4991

STATUS REPORT ON THE CUTLIPS MINNOW  
*EXOGLOSSUM MAXILLINGUA*

IN CANADA

3611015F

BY

E.J. CROSSMAN

AND

E. HOLM

STATUS ASSIGNED IN 1994  
NOT AT RISK

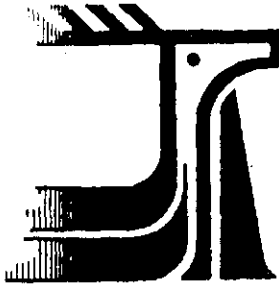
REASON:

THE CUTLIPS MINNOW, NEVER ABUNDANT IN CANADA, APPEARS TO BE IN DECLINE IN ONTARIO DUE TO HABITAT DEGRADATION, COMPETITION WITH INCREASING POPULATIONS OF COMMON SHINERS (RELATED TO HABITAT CHANGES WHICH FAVOUR THIS SPECIES) AND USE AS A BAIT FISH. SECURE IN QUEBEC AND OVERALL NOT AT RISK.

OCCURRENCE: ONTARIO AND QUEBEC

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Committee  
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of Endangered  
Wildlife  
in Canada

Comité sur le  
statut des espèces  
menacées  
de disparition  
au Canada

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**E. HOLM**  
**DEPARTMENT OF ICHTHYOLOGY AND HERPETOLOGY**  
**ROYAL ONTARIO MUSEUM**  
**TORONTO, ONTARIO**  
**M5S 2C6**

**STATUS ASSIGNED IN 1994**  
**NOT AT RISK**

## The Status of The Cutlips Minnow, *Exoglossum maxillina*, In Canada

E. J. CROSSMAN AND E. HOLM

Department of Ichthyology and Herpetology, Royal Ontario Museum, Toronto,  
Ontario M5S 2C6

Crossman, E. J., and E. Holm. Status of the Cutlips Minnow, *Exoglossum maxillina*, in Canada. Report to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Canadian Wildlife Service, Ottawa, Ontario K1A 0H3.

The Cutlips Minnow, *Exoglossum maxillina*, is a stout bodied minnow distinguished from all other members of the family Cyprinidae in North America by its unique trilobed lower jaw. It is common in many upland regions of the Atlantic coast drainage of northeastern North America. It is rare, and there is evidence that populations have declined from levels in the 1930s in Ontario. It is more widespread in Quebec where it has been found in numerous river systems from 1935 to 1989. Since 1977, there has been a significant decrease in the number of surveys in the limited area occupied by this species in Canada. Surveys might have provided more information on present status. There is, however, evidence of low and/or declining numbers in some river systems.

Le bec-de-lièvre, *Exoglossum maxillina*, est un miné au corps trapu qui se distingue de tous les autres membres de la famille Cyprinidae en Amérique du Nord par sa mâchoire inférieure trilobée. Il est répandu dans de nombreuses régions hautes du bassin versant de l'Atlantique dans le nord-est de l'Amérique du Nord. On le rencontre rarement en Ontario, où sa population enregistre une baisse par rapport aux chiffres des années 1930. Il est plus répandu au Québec où l'on a relevé sa présence dans nombre de réseaux

fluviaux de 1935 à 1989. Depuis 1977, le nombre d'études effectuées dans la région restreinte occupée par cette espèce au Canada a diminué de façon marquée. Si tel n'avait pas été le cas, nous disposerions probablement de plus de données sur la situation actuelle de l'espèce. Il semblerait toutefois que sa population est faible ou à la baisse dans certains réseaux.

**Key Words:** Cutlips Minnow, *Exoglossum maxillina*, *Bec-de-Lièvre*, cutlips, eye-picker, vulnerable, Cyprinidae, minnows

The Cutlips Minnow, *Exoglossum maxillina*, (Lesueur, 1817), is a stout bodied minnow which can reach a total length of about 150 mm (Pappantoniou et al. 1984a). It can be distinguished from all other North American minnows by its unique trilobed lower jaw consisting of a central bony tongue-like lobe, two lateral fleshy lobes, and no maxillary barbels. The Tonguetied Minnow, *Exoglossum laurae*, the only other species in the genus and known only from the United States, has a lower jaw which is not as obviously trilobed and frequently possesses a maxillary barbel.

Male and female Cutlips Minnows are approximately equal in size and outside the reproductive season there are no obvious external differences between the sexes. During the reproductive season, mature males develop tubercles on the paired fins (Pappantoniou 1983). Larval development of the Cutlips Minnow has been described by Fuiman and Loos (1978) and Buynak and Mohr (1980). The latter reference provides a key to six species of cyprinids, four of which are frequently found in association with *Exoglossum maxillina* in Canada.

*Exoglossum maxillingua* is currently considered to be derived from *Exoglossum laurae* (Gilbert and Lee 1980). Phylogenetic analysis indicates that the genus *Exoglossum* is most closely related to *Phenacobius*, a genus of minnows restricted to the Mississippi and Gulf of Mexico drainages of the United States (Coburn and Cavender 1992). Geographic variation in four morphometric and seven meristic characters has been investigated using 1247 specimens, including five individuals from the St. Lawrence drainage. Ten characters displayed significant geographic variation between populations, but this variation was not correlated with latitude (Pappantoniou 1983).

#### Distribution

The Cutlips Minnow is found in eastern North America (see inset map, Figure 2) in the Atlantic drainage from the St. Lawrence and lower Ottawa river systems in Quebec and Ontario south to North Carolina (Gilbert and Lee 1980). It is closely associated with upland areas such as the Allegheny, Catskill and Adirondack mountains and is not found in lowland coastal areas such as most of New Jersey and the Delaware Peninsula.

Canadian distribution records were obtained from the Service de l'Aménagement de la Faune, Ministère du Loisir, de la Chasse et de la Pêche, Quebec (MLCP) in Montréal (240 records), the Canadian Museum of Nature, formerly National Museum of Canada (NMC) (19), the Royal Ontario Museum (ROM) (18), MLCP in Trois Rivières (14), literature (4), a database obtained from the Ontario Ministry of Natural Resources (OMNR; edited by Nick Mandrak, Department of Zoology, University of Toronto and Department of Ichthyology and Herpetology, ROM) (2), and the database of the University of Michigan Museum of Zoology (1). These records were checked for

correspondence of locality description and coordinates, entered into a database, and plotted on 1:50 000 maps (all records in the database are listed in Appendix 1 which is on file with and available from COSEWIC on request). Records were plotted on a 1:1 000 000 rough base map from which Figure 2 was prepared.

In Canada, *Exoglossum maxillingua* is found in the St. Lawrence River and its tributaries, from a tributary of the Rivière St-Denis near Saint-Pascal, Quebec (the northern most record known) upstream in the St. Lawrence River to Ivy Lea, Ontario. It is known from the lower Ottawa River system as far upstream as Rivière du Diable in the Rivière Rouge system (see Table 1, Figure 2). Nash (1908) stated that the species occurred in Lake Ontario. There are no voucher specimens to substantiate its presence in the Ontario portion of that lake but it has been reported from New York tributaries (Crossman and Van Meter 1979).

### Protection

*Exoglossum maxillingua* is not legally protected in North America but it is listed as of Special Concern in North Carolina (Johnson 1987).

In Canada no specific legislation exists for the protection of this species, laws which protect the habitat of the species include: the Ontario Lakes and Streams Improvement Act which prohibits the impoundment or diversion of watercourses which leads to siltation; the voluntary Land Stewardship II program of the Ontario Ministry of Agriculture and Food which is designed to reduce the erosion of agricultural lands and thus reduce siltation of habitat.

In Quebec, habitat is generally protected by the Environmental Quality Act, and may be protected by the Ecological Reserves Act if a species is "threatened with disappearance or extinction." The species has been given little, or no attention, but could be given specific protection under provincial legislation (Endangered Species Act and law on faunic habitats) if required.

### Population Size and Trends

The Cutlips Minnow is reported fairly common in its United States range (Gilbert and Lee 1980). It is particularly abundant in Pennsylvania (Cooper 1983) and New York (Smith 1985).

In Ontario, the Cutlips Minnow has been collected on 14 occasions at 12 different sites (see Table 1). No voucher specimens are known before 1936.

*Exoglossum maxillingua* was captured at six sites between 1936 and 1938 from the Delisle River, Lake St. Francis, the St. Lawrence River, and two small tributaries of the St. Lawrence River, Hoasic Creek and an unnamed creek. In 1943, bait dealers considered it to be common in the St. Lawrence around Ivy Lea and in the Delisle River below Alexandria (Toner 1943).

The Cutlips Minnow has not been captured recently at any of the six sites in Ontario where it was taken in 1936-1938. Attempts to capture it in Hoasic Creek (ROM Accessions 1276 and 5501) in 1967 and 1989 were unsuccessful. Surveys by the OMNR in the Ontario portion of the Delisle River system in 1973 and 1978 (ROM Accessions 2364 and 3765) also failed to capture the species. Attempts to capture the species in the St. Lawrence River at Ivy Lea in 1967 (ROM Accession 1276) were also unsuccessful. Relatively intensive sampling was conducted by OMNR, ROM and NMC from the late 1960s to the mid 1980s (Mandrak and Crossman 1992). Despite the much larger scale of



sampling, compared to that in the 1930s, the surveys captured the species at only six additional sites in the Raisin River system, Little Rideau Creek, and at one site in the St. Lawrence River. The unsuccessful capture attempts and the scarcity of records after 1970 suggest that populations in Ontario have declined in abundance from former levels.

The species is more widely distributed in Quebec where 284 collections have been made at 274 sites. The species was first recorded in 1935 from the upper section of the Ulverton River (Saint-François river system) and in a few streams of the Nicolet system. At that time, *Exoglossum maxillingua* was considered to be one of the rarest minnows in the Eastern Townships (Richardson 1935). In 1941, the species was also recorded from below the Rapides du Rocher Fendu, Lac Saint-Louis, and the Châteauguay, Chaudière, and Saint-Denis river systems.

Surveys conducted by MLCP in several major St. Lawrence River systems from 1960 to 1982 captured the species in many of the rivers where it was formerly known and found it at numerous other sites in the St. Lawrence River of Quebec (see Table 1). Distribution records indicate that *Exoglossum maxillingua* occurs at the greatest number of locations in the Rivière Châteauguay system (82 records, 1941 to 1989) and in the St. Lawrence River below Rapides de Lachine in the Montréal region (36 records, 1967 to 1989). In the Châteauguay it is particularly common in the streams of the upper half of the drainage. It ranked 22 out of 53 different species in relative frequency of occurrence in the collections in a 1975 to 1976 survey of the entire river system (Mongeau et al. 1979). It was captured in 1973 at 20 of 108 seining stations in a 25 km stretch of the St. Lawrence River below the Jacques-Cartier bridge at Montréal. At a few of these sites it was captured in

considerable numbers (Massé and Mongeau 1976). Further upstream, immediately below the Rapides de Lachine, it was captured in 8 of 114 seining stations in 1977 (Mongeau et al. 1980). However, it is not currently considered common in the Montréal region (Dumont and Roy, personal communication, 1989).

It is moderately abundant in the drainage of the Rivière Chaudière (24 records, 1949-1977), Rivière du Chêne (20 records, 1971), and Rivière Nicolet (13 records, 1935-1977). In other river systems it is not as common. For example, it was captured at only four of 159 fishing stations in the Rivière Richelieu in 1970 (Mongeau 1979b). It is known from only two sites in the Saint-François river system (Mongeau and Legendre 1976, Richardson 1935) and from only four sites sampled between 1963 and 1975 in a tributary of the Rivière Yamaska (Mongeau 1979a). It was taken in 1980 from below the Rapides du Rocher Fendu but has not been captured again in Lac Saint-Louis despite attempts in 1965 and 1968 (Mongeau and Massé 1976).

Knowledge of the distribution of the Cutlips Minnow in Quebec increased dramatically. However, little sampling has been carried out since 1977 (P. Dumont and G. Roy, Ministère de l'Environnement et de la Faune, Montreal, Quebec; personal communication). Therefore, because most sites have been sampled only once, it is difficult to determine the current status of most populations in Quebec.

Table 1 summarizes our knowledge of where, in what year, and how frequently *Exoglossum maxillingua* has been captured. It summarizes 298 records representing 286 different sites in 38 river systems, 82 rivers and creeks in those systems, and three lakes. Two sites were sampled on three separate occasions and eight sites were sampled on two separate occasions.

Information on sampling effort is not shown but investigators which have this information can use Table 1 to better assess the status of the species in each river system.

### Habitat

In the United States, the Cutlips Minnow is usually found in small to moderately sized clear streams, 4.6 to 15m in width. It prefers quiet pools or channels with gentle to moderately swift current. It has been found in depths of 0.15 to 1.2m, in water with temperatures ranging from 0 to 26°C, and over firm bottoms of rubble, gravel, boulders, and cobbles. Instream cover such as large rocks, logs, vegetation, or overhanging banks is an important component of the habitat of this species (Hankinson 1922; Van Duzer 1939; Haase and Haase 1975; Cooper 1983; Pappantoniou 1983; Smith 1985). In Connecticut, total alkalinity ranged from 7 to 137 and hardness 22 to 184 both mg/l equivalent  $\text{CaCO}_3$ . Bottom type (percent occurrence) consisted of stone or rubble (35%), gravel (30%), silt (13%), rock (9%), muck (9%), and sand (4%) (Whitworth et al. 1968).

In Canada, *Exoglossum maxillingua* is found primarily in clear or tea-coloured rivers or creeks, on firm rocky bottoms, frequently mixed with one or more combinations of gravel, sand, and mud. In Quebec, they are frequently found on hard clay and shale bottoms (Dumont and Roy, personal communication). Aquatic vegetation is frequently present and water current varies from still to fast, but is most frequently described as slow. It has been found in water up to 26°C in June and July. Streams are usually small with a width of 1-20 m, but populations have also been found in the St. Lawrence River and its lake-like expansions several kilometres wide. In the St. Lawrence, it was most commonly found at the lower end of rapids. The Cutlips

Minnow is also known from lakes at elevations of up to 380m in the Laurentians in Quebec.

### General Biology

There is no information on the biology of Canadian populations, but several studies have been carried out in New York and Pennsylvania. Age at spawning is unknown but sizes are reported. In central New York, nest building by a 76 mm (three-inch) male was reported. However, spawning males usually averaged 102 to 140 mm (4 to 5½ inches). Females were usually not over 76 mm (3 inches). Spawning season in the Susquehannah river system of central New York lasted approximately seven weeks in one year (1930?). It began around 25 May and lasted to the middle of July. Spawning occurred in the daytime, peaking at mid-day and late afternoon at temperatures of 17 to 21.5°C. Length of spawning period varied from one to eight days depending on the period during the spawning season (Van Duzer 1939). Spawning may occur later in Quebec. Richardson (1935) indicated that specimens captured in the Eastern Townships in the latter half of August and early September had well-developed ovaries and testes.

In New York and Pennsylvania, females outnumbered males in collections during July 1979 and monthly collections from the winter of 1979/1980 to the winter of 1980/1981. The ratio of males to females ranged from 1:1:1 to 1:1.8. The lower number of males in the collections was attributed to higher male mortality caused by nest building and defense activities (Pappantoniou 1984a,b).

In suitable areas, nests are often built very close to each other. Observations by Van Duzer (1939) indicated that the nest is built by a lone

male. After spawning, it may be driven off by a larger male which may or may not continue nest building prior to spawning. The smaller male may attempt to continue to add stones to the nest or spawn in the absence of the larger male. During spawning from one to 12 females may congregate on one nest, but only one pair spawns at a time.

Age composition of populations in New York and Pennsylvania has been shown to differ considerably. Predominant age classes vary from I+ in eastern Pennsylvania (Pappantoniou 1984a) to III+ in southeastern New York (Pappantoniou 1984b). The following sizes at annulus formation were determined for age classes in the Waccabuc River in eastern Pennsylvania: I, 37 to 52 mm; II, 63 to 81; III, 88 to 108; IV, 110 to 126 (Pappantoniou 1984b). Previous studies indicated that overlap in sizes occur between year classes (Breder and Crawford 1922; Haase and Haase 1975). Maximum age is usually IV+, but specimens have been found to be V+ in a fertile stream in Pennsylvania (Haase and Haase 1975).

Fecundity varied between 345 to 1177 eggs/female ( $\bar{x}=792 \pm 2$  standard deviations of 281.3) in Waccabuc Creek in southeastern New York. Fecundity was considerably lower in the Titicus River, New York ( $\bar{x}=371.9 \pm 182.6$ ). The fecundity of the female is apparently not directly correlated with size (Pappantoniou 1983).

Some migration into deeper water may occur in extremely cold or wet winters (Miller 1964). Haase and Haase (1975) found that the numbers of Cutlips Minnows declined in fall collections. During the spawning season, *Exoglossum maxillingua* moves to suitable areas.

*Exoglossum maxillingua* is a relatively specialized bottom feeder, but is apparently able to shift to other food resources when its preferred food is

unavailable. Several studies have been conducted on its diet in New York and Pennsylvania (Breder and Crawford 1922, Haase and Haase 1975, Johnson 1981, Johnson and Johnson 1982, Pappantoniou 1983, Pappantoniou et al. 1984a,b).

The studies indicated that *Exoglossum maxillingua* consumes a variety of aquatic invertebrates, but chironomids, trichopteran larvae, and oligochaetes are the most important items. Younger individuals consume a much larger proportion of chironomids, whereas older individuals favour larger food items such as trichopterans, oligochaetes and plecopterans. Breder and Crawford (1922) found, in addition to unidentified insect remains (34%), a large proportion of oligochaetes and polychaetes (30%), and the gut contained diatoms and plant remains (15%) which they believed were being digested. Seasonal variation of the benthos was reflected in the diet in the Delaware River in Pennsylvania. When chironomid and trichopteran populations were low in September, they fed more on molluscs (Haase and Haase 1975).

Successful reproduction of the Cutlips Minnow depends on availability of a specific type of habitat. Spawning habitat in the Susquehannah River system in central New York consisted of a firm rubble bottom overlain by an abundance of gravel. Depending on its size, the male selects flat stones with angular margins or thin edges that are 6 to 24 cm wide. Large flat rocks and submerged logs will offer protection during nest-building, spawning, and defence of eggs and fry (Van Duzer 1939). The Cutlips Minnow avoids the stronger current sought by other mound-building cyprinids such as the Creek Chub, *Semotilus atromaculatus*, and the River Chub, *Nocomis micropogon* (Miller 1964). Apparently, current must be sufficiently strong to insure a constant change of water and prevent excessive siltation, but gentle enough to prevent the removal of stones as small as 6 cm.

The Cutlips Minnow is sometimes called the eye-picker because it is known to deliberately attack the eyes of other species. Pappantoniou (1983) suggested that the incidence of eye-picking behaviour in Cutlips Minnows apparently increases with intra-specific density. He suggested that in crowded conditions such as those which occur in pools in the summer, the Cutlips Minnow can increase access to limited resources by attacking the eyes of other species.

### Limiting Factors

The presence of the Common Shiner, *Luxilus cornutus*, may adversely affect the reproduction of the Cutlips Minnow. The Common Shiner has been known to breed on the nest of the Cutlips Minnow while the Cutlips Minnow attempted to spawn. The presence and nervous motion of the shiners on the nest always lessened and sometimes stopped the spawning of the Cutlips Minnow. Attempts by the male Cutlips Minnow, occasionally assisted by the female, to drive the shiners off the nest were seldom successful (Van Duzer 1939). Miller (1964) noted, however, that *Exoglossum maxillingua* selects quiet channels not usually frequented by breeding shiners and chubs and spawned in late May, whereas the Common Shiner spawned in the first half of May. However, he also noted that the Common Shiner preferred the nest of the Cutlips Minnow over the nests of the chub, *Nocomis*, and Fallfish, *Semotilus corporalis*.

Nothing is known about the susceptibility of the Cutlips Minnow to predation. Its sluggish nature may make it more vulnerable than other small fishes, but its habit of hiding under rocks and logs and in beds of aquatic vegetation would protect it.

Temperature is probably an important limiting factor. It was noted (Pappantoniou et al. 1984b) that, in general, Cutlips Minnows in New York State were more long-lived and robust than Pennsylvania counterparts. This was attributed to the generally milder climatic conditions in southeastern New York State. Harsher climatic conditions, probably also adversely affects the life-span of Canadian populations. Scott and Crossman (1973) stated that the Cutlips Minnow prefers warm streams. This preference may limit its northward dispersal.

The Cutlips Minnow is probably intolerant of turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973). Flooding may increase mortality of eggs and fry if they are carried downstream beyond the nest during spawning and early development of the species. Flooding may have caused the reduced 1972 year-class of Cutlips Minnows in the Delaware River in eastern Pennsylvania. High water increases turbidity and scours the benthos which adversely affects food availability (Haase and Haase 1975).

#### Special Significance of the Species

The Cutlips Minnow possesses some unique morphological and behavioural characteristics. Its lips are unlike any other North American minnow. It is known to attack and consume the eyes of other species of fishes, a behaviour useful in experiments on the effectiveness of eye camouflage (Pappantoniou 1983). This species is one of few minnows which demonstrate post-hatching care of fry (Smith 1991).

#### Evaluation



Canadian populations are at the northerly fringe of the range of the species. It has been found in 82 rivers or creeks and 3 lakes in Ontario and Quebec from Ivy Lea, Ontario to Saint-Pascal, Quebec (Table 1). Although it has been captured at numerous sites in Québec from 1960 to 1980, most of these waters have not been surveyed in the last 15 years and there is little information on their present status. In Ontario and some areas of Quebec, evidence indicates that it has declined. Although the Cutlips Minnow has been found in numerous river systems, it has shown decline in some. Possible reasons for this decline may include both natural and cultural factors such as species competition, predation, flooding, turbidity, siltation, cold temperatures, and over-harvest by bait fisherman.

The species, never abundant in Canada, is rarer in Ontario than Quebec. Although surveys in Quebec have been limited since 1977 there is no evidence to indicate the species is in decline there (M. Huot, Ministère de l'Environnement et de la Faune, Québec, Québec; personal communication).

Although surveys have been limited since 1977 there is evidence to suggest the species is in decline in Ontario mainly due to habitat degradation and competition with increasing populations of Common Shiners.

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## FIGURES

Figure 1. Cutlips Minnow, *Exoglossum maxillingua*, 84 mm TL, ROM 9213. St. Lawrence River, Leeds Co., Ontario. Drawn by Anker Odum, from Scott and Crossman (1973), by permission.

Figure 2. Distribution of the Cutlips Minnow in Canada, *Exoglossum maxillingua*. A point may represent more than one capture at different sites within the area of the circle. Inset: North American distribution modified from Gilbert and Lee (1980).

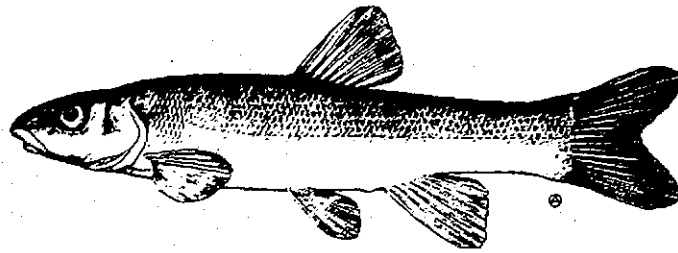


FIG. 1 Cutlips Minnow



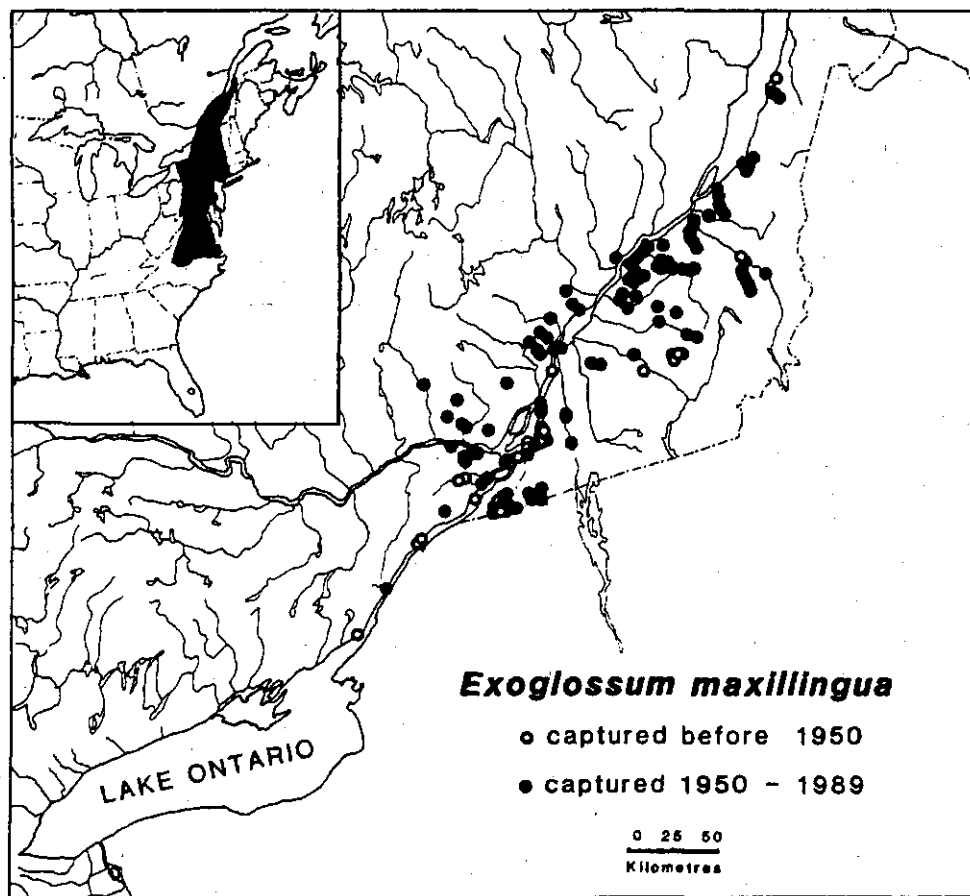


Table 1. Canadian rivers and river systems in which *Exoglossum maxillingua* has been captured 1935-1989. Year(s) of capture are followed by number of distribution records for each year in brackets. Names according to Répertoire Toponymique du Québec (1978. Editeur Officiel du Québec), and Gazetteer of Canada, Ontario (1988, Energy, Mines and Resources Canada. Ottawa). (DR=Division de Recensement; NL=not listed in gazetteer, underlined records are from Ontario; the rest are from Quebec)

River system	Year (No. of records)
Rivière Saint-Denis system	
Creek (NL)	1941(1)
Rivière Ouelle	1964(3),1968(4)
Bras Saint-Nicholas	1975(2)
Rivière du Sud	1964(7)
Rivière Etchemin	1962(1)
Rivière Boyer system	
Rivière Boyer	1971(5)
Rivière Boyer Sud	1971(2)
Rivière Boyer Nord	1971(3)
Rivière Chaudière system	
Rivière Chaudière	1949(1),1976(3)
Rivière Saint-Victor	1965(8),1971(1)
Rivière Beaurivage	1964(9)
Rivière du Cinq	1977(1)
Ruisseau Tring	1977(1)
Rivière du Chêne system (DR: Lotbiniere)	
Rivière du Chêne	1971(8)
Rivière Huron	1971(1)
Rivière Henri	1971(2)
Bras d'Edmond	1971(1)
Rivière du Bois Claire	1971(2)
Rivière aux Chevreuils	1971(5)
Creek (NL)	1971(1)
Petite Rivière du Chêne system (DR: Lotbiniere)	
Petite Rivière du Chêne	1982(2)
Rivière du Creux	1982(2)
Ruisseau l'Espérance	1982(1)
Creek (NL)	1982(1)
Rivière Sainte-Anne system	
Rivière Sainte-Anne	unknown (between 1979-1980)(1)
Rivière Charest	unknown (between 1979-1980)(1)
Rivière aux Orginaux system	
Rivière aux Orginaux	1982(3)
Ruisseau Santorio	1982(1)
Rivière Gentilly system	
Rivière Gentilly	1982(3)
Rivière Gentilly Sud-Ouest	1982(1)
Rivière Bécancour	1964(1)
Rivière Yamachiche	1972(6),1973(1)

Table 1 (Continued)

River system	Year (No. of records)
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Table 1 (cont'd)

River system	Year (No. of records)
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Rivière Nicolet system	
Rivière Nicolet	1977(3)
Rivière Nicolet Centre	1977(1)
Rivière Nicolet Nord-Est	1977(1)
Rivière Nicolet Sud-Ouest	1935(1),1977(2)
Rivière des Rosiers	1935(1)
Ruisseau Francoeur	1935(1)
Rivière Bulstrode	1977(2)
Creek (NL)	1977(1)
Rivière Saint-François system	
Rivière Saint-François	unknown (between 1964 and 1974)(1)
Rivière Ulverton	1935(1)
Rivière Maskinongé	1967(1)
Rivière Yamaska system	
Rivière Saint-David	1970(4)
Rivière du Chicot system	
Rivière du Chicot	1971(5)
Ruisseau Saint-Andre	1971(1)
Creek (NL)	1971(1)
Rivière Bayonne system	
Rivière Bayonne	1971(5)
Ruisseau Bibeau	1971(1)
Rivière la Chaloupe	1971(1)
Channels above Lac Saint-Pierre	
Chenal aux Ours	1971(2)
Chenal du Nord	1971(1)
Rivière Richelieu	1965(1),1970(4)
Rivière L'Assomption system	
Rivière de l'Achigan	1968(1)
Lac Saint-Louis	1941(2),1942(1)
Rivière Châteauguay system	
Rivière Châteauguay	1941(7),1942(2),1946(2),1960(3),1961(1),1963(1),1976(21)
Ruisseau Dewitt	1970(1),1976(2)
Creek (NL)	1977(1)
Rivière aux Anglais	1976(5)
Ruisseau Robson	1976(1)
Ruisseau Allen	1976(4)
Rivière aux Outardes	1976(2)
Ruisseau Mitchel	1963(3),1976(3)
Creek (NL)	1976(4)
Rivière Hinchinbrook	1961(1),1963(2),1976(4),1989(2)
Rivière Trout	1941(1),1976(7)
Ruisseau Oak	1967(1),1976(1)
Rivière du Chêne system (DR: Deux Montagnes)	
Petite Rivière du Chêne	1970(1)
Lac des Deux Montagnes tributaries	
Rivière à la Raquette	1964(1)
Rivière Rigaud	1964(1),1965(1),1966(1),1972(1)

Table 1 (Continued)

River system	Year (No. of records)
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Table 1 (cont'd)

River system	Year (No. of records)
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Rivière du Nord system	
Lac Saint-Denis	1966(1)
Lac Gémont	1967(1)
Lac La Rivière	1967(1)
Rivière Dalesville	1976(1)
Rivière de l'Ouest	1975(2), 1976(2)
Rivière Rouge system	
Rivière du Diable	1968(1)
Little Rideau Creek	1978(1), 1989(1)
Rivière Delisle	1936(1), 1938(1), 1946(1), 1970(1)
Rivière Baudette	1970(1)
Lake St. Francis	1938(1)
Raisin River system	
Raisin River	1973(1)
North Raisin River	1973(1), 1989(1)
St. Lawrence creek (NL)	1938(1)
Hoasic Creek (Nash Creek)	1938(1)
St. Lawrence River (from a point downstream of Rivière Richelieu upstream to Ivy Lea)	
downstream of Rivière Richelieu	1971(1)
Montréal-below Rapides de Lachine	'41(2), '67(3), '72(1), '73(20), '77(8), '83(1), '89(1)
below Rapides du Rocher Fendu	1942(1), 1980(5)
at Cardinal	1981(1)
at Ivy Lea	1936(2), 1937(1)