

Range Extension for the Fourspine Stickleback, *Apeltes quadracus*, to Thunder Bay, Lake Superior

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An unusual range extension for the Fourspine Stickleback, *Apeltes quadracus*, is reported. Fifty-one specimens collected between August 1986 and October 1987 from Thunder Bay, Lake Superior, are approximately 2200 km from the nearest recorded population. Live-transport in the bilge of a sea-faring ship is considered the probable mechanism of distribution. Discussed is the ability of *Apeltes quadracus* to tolerate, survive and breed in waters of low conductivity.

Key Words: Fourspine Stickleback, *Apeltes quadracus*, Thunder Bay, Lake Superior, Batiscan River.

The Fourspine Stickleback, *Apeltes quadracus*, is known to occur on the Atlantic coast of North America, primarily in marine and brackish water and occasionally in fresh water. The shading on the distribution map in Bergeron and Brousseau (1983) indicated that *A. quadracus* is known to occur up in the St. Lawrence as far as Quebec City. Burgess and Lee (1978) reported a few isolated freshwater populations "far upstream in Hudson, Delaware and Susquehanna drainages." Livingstone (1953) recorded specimens "far removed from the sea" (approximately 30 km based on the distribution map). The population previously known to occur farthest from salt water is apparently located approximately 350 km from the sea in Harvey's Lake, Luzerne County, Pennsylvania, in the Susquehanna drainage (Cooper 1983).

This note reports on two range extensions for this species, one of which is unusual because it is approximately 2200 km via the Great Lakes from the nearest published record in Quebec City. The other record is from the Batiscan River approximately 85 km upstream from Quebec City and apparently the closest to the Thunder Bay record. Discussed are the mechanism of dispersal and the probability for the survival of the Fourspine Stickleback in Thunder Bay.

Methods and Results

A total of fifty-one specimens of *Apeltes quadracus*, were captured between 16 August 1986 and 6 October 1987 in Thunder Bay, Lake

Superior (See Table 1). Specimens from Neebing Marsh were collected at night with an electrofishing boat by B. A. R. Environmental in 1986 and Ecocern in 1987. They came from four areas from just north of the mouth of the Kaministiquia River to Keefer terminal at the original outlet of the Neebing River. Sticklebacks appeared to be most abundant over open sandy bottoms adjacent to short submerged macrophytes (R. Dalziel, personal communication). At the time of sampling in 1986 conductivity in the marsh was 140-150 uS/cm and the surface water temperature was approximately 18C. Water clarity varied from clear to turbid. Two seine collections by W. Momot, C. Hartviksen and students at Lakehead University yielded nine specimens in 1987 (Table 1). One record (ROM 54909) extends the range of the species into Mission Marsh, 3 km south of the original captures in Neebing Marsh.

The *Apeltes quadracus* specimens captured in 1986 comprised 0.9% of 452 total individuals at the two sites combined which included 16 different species. *Apeltes quadracus* was one of 19 species captured by Ecocern in 1987 and specimens of it comprised 7% of 540 total individuals at four sites in Neebing Marsh.

The four individuals captured in 1986 had apparently been feeding recently. Gut contents of the two largest specimens consisted of amphipods (*Gammarus fasciatus*), mayfly nymphs (*Caenis* sp.) and a chironomid larva (*Endochironomus subtendens*) all invertebrates typically occurring in freshwater marshes and known to occur in the

TABLE 1. Captures of *Apeltes quadracus* in Thunder Bay

| Location | Coordinates | Capture Date | Number | Total Length Range | Catalogue Number |
|---------------------------|----------------------------|------------------|--------|--------------------|------------------|
| Neebing Marsh (Site 1) | 48° 23' 56"N; 89° 13' 04"W | 16 August 1986 | 2 | 30-53 | ROM 51699 |
| Neebing Marsh (Site 2) | 48° 24' 14"N; 89° 13' 05"W | 19 August 1986 | 2 | 36-40 | ROM 51698 |
| Neebing Marsh (Site 1) | 48° 23' 56"N; 89° 13' 04"W | 16 August 1987 | 20 | 25-46 | ROM 54890 |
| Neebing Marsh (Site 2) | 48° 24' 14"N; 89° 13' 05"W | 22 August 1987 | 10 | 25-35 | ROM 54889 |
| Neebing Marsh (Site 3) | 48° 23' 48"N; 89° 12' 52"W | " | 7 | 26-37 | ROM 54888 |
| Neebing Marsh (Site 4) | 48° 24' 04"N; 89° 12' 53"W | " | 1 | 32 | MNR 87-003 |
| Kaministiquia R. mouth | 48° 23' 30"N; 89° 13' W | 7 September 1987 | 6 | — | |
| Mission Marsh-McKellar R. | 48° 22' N; 89° 13' W | 6 October 1987 | 3 | 40-43 | ROM 54909 |

Thunder Bay area (William Morton, Ontario Ministry of Natural Resources, Fisheries Branch, personal communication).

In a search of the ROM ichthyology collection, a record of *A. quadracus* was discovered from fresh water approximately 85 km upriver from Quebec City. Six individuals, two males and four females (ROM 42180) were seined on 8 June 1981 by E. Holm and G. Coker in the Batiscan River, approximately 1 km up from its mouth in the St. Lawrence River, 46° 31' 16"N, 72° 15' 05"W. This record, to our knowledge, is the closest to the Thunder Bay records, the distance between them, via the Great Lakes, being approximately 2100 km.

We attempted to establish whether *A. quadracus* may have been captured near Thunder Bay in the past, but not recognized, by checking previous collection records. Neebing Marsh has been sampled on several occasions in the last five years. W. T. Momot, C. Hartviksen and students at Lakehead University sampled Neebing Marsh every year in September or October from 1983 to 1986. A few sticklebacks were captured and identified as *Culaea inconstans* (Brook Stickleback) and *Pungitius pungitius* (Ninespine Stickleback), the latter deposited at the ROM (ROM 50263). The Lakehead Region Conservation Authority sampled fishes in the marshes at Thunder Bay between 1982–1985 but also reported only *Culaea* and *Pungitius*. We confirmed the identification of one of the *Culaea* specimens.

Discussion

The number of specimens captured at six different sites indicates that *A. quadracus* is well established in the marshes of Thunder Bay. The fact that *Apeltes quadracus* has not been captured in regular yearly collections by Lakehead University or in the collections of the Lakehead

Region Conservation Authority suggests that it has been introduced relatively recently. Although there is over a seven-fold increase in numbers captured between 1986 and 1987, a large part of this increase may be caused by factors other than a growth in the Fourspine Stickleback population over one year. Netting was conducted by different persons who were aware of the previous *Apeltes quadracus* captures. Water levels were lower and therefore the same habitat could not be sampled. The percentage of all species of sticklebacks captured at all sites in Neebing Marsh increased dramatically from 3.3% of the total number of specimens in 1986 to 35% in 1987. However, the ratio of Fourspine Sticklebacks to other sticklebacks did not differ significantly (13.3% in 1986 vs. 19.8% in 1987).

Fourspine Sticklebacks are small and the colour pattern is similar to other stickleback species in the Great Lakes. Therefore, they may be missed when sorting quickly through small fish collections. When closely examined, *A. quadracus* can be easily recognized in having usually 2 large and 2–3 small dorsal spines, inclined alternately from one side to the other as are the spines of *P. pungitius*. This species, however, has more than 7 small spines. Other stickleback species have their spines vertical and not inclined to the left and right. Fourspine Sticklebacks have usually from three to five dorsal spines with four spines being the most common. Approximately thirty percent of the Thunder Bay specimens had five spines.

It has been suggested (Emery and Teleki 1978; Nepszy and Leach 1973) that unusual records in the Great Lakes of marine animals such as the European Flounder (*Platichthys flesus*) and the Chinese Mitten Crab (*Eriocheir sinensis*) have resulted from transport in the ballast tanks of ships. This method of dispersal is probable for *A. quadracus* and would explain the remoteness of the

Thunder Bay record from other populations. Ships can take in or expel ballast water anywhere along a ship's route from the Atlantic Ocean to northwestern Lake Superior. Strainers on bilge pipes may occasionally be broken to allow entry of larger fish, but nevertheless are normally coarse enough to allow passage of small minnows (M. O'Dowd, sailor for 25 years, presently with the Canadian Coast Guard, personal communication).

It is unlikely that the specimens come from a relict population since the distribution of Fourspine Sticklebacks is restricted to the Atlantic coast and they have not been captured during extensive sampling in the past. However, the possibility of an intentional introduction by man should not be discounted. *A. quadracus* is small and would make an interesting aquarium resident. Moreover, because of its short life span and rapid growth, it would make a useful experimental animal (Schwartz 1965). However, apparently no research at Lakehead University has involved the use of this stickleback (Don Barnes, Forestry Section, personal communication).

The Fourspine Stickleback is known to have the widest range of salinity tolerance of any North American stickleback (Nelson 1968). Under experimental circumstances it apparently preferred brackish water of 7 ppt (Audet et al. 1985) but there was some indication in the data that it did not avoid fresh water. There is a suggestion in the literature, however, (Blouw and Hagen 1981; Livingstone 1953) that *A. quadracus* cannot tolerate the low salt content of water in granitic areas and is present only in the soft rock regions of Nova Scotia.

We attempted to establish whether the Fourspine Stickleback could tolerate and breed in waters such as those in Neebing Marsh. Since salts constitute part of the electrolytes which can be measured as conductivity (Wetzel 1975), low conductivity can be used as an indication of a low level of salinity. We know of two populations of *A. quadracus* which breed at conductivities considerably less than that measured in Neebing Marsh. Conductivity measurements at the time of sampling and in September 1983 (J. Entwistle, Thunder Bay harbour marshes study summary report. Lakehead Region Conservation Authority, Thunder Bay, Ontario, 1986) indicate conductivity in the marsh ranges from 137 to 279 $\mu\text{S}/\text{cm}$. Coad and Power (1973) describe a population of Fourspine Sticklebacks in the Matamek River, Quebec, isolated between two waterfalls, which breeds at 10–20 $\mu\text{S}/\text{cm}$ (Power et al. 1973). *A. quadracus* were presumably breeding in the

Batiscan River since they contained ripe eggs or testes in advanced stages of development and, at the time of capture, they had "bright red fins". Conductivity was not measured at the time of sampling in the Batiscan River but measurements of conductivity throughout 1983, 10 km from the mouth (J. P. Gelin, Ministère de l'Environnement at Trois Rivières, Quebec, personal communication) and estimates of conductivity of the near shore areas of the St. Lawrence near the mouth of the Batiscan River (Don McGirr, Surveys and Interpretive Services, Environment Canada, personal communication) suggest that the conductivity at the Batiscan site is somewhere between 22 to 107 $\mu\text{S}/\text{cm}$.

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