

**DISTRIBUTION, ABUNDANCE, AND REPRODUCTIVE SEASON OF
STICKLEBACKS (GASTEROSTEIDAE) IN THE HUDSON RIVER MARSH
PRESERVES**

A Final Report of the Tibor T. Polgar Fellowship Program

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1. ABSTRACT

The assemblage composition and distribution of the fishes along the Hudson River estuarine marshes are poorly understood. The objectives of this study were: 1) to identify fish species found within the open water and vegetated habitats of the four Hudson River National Estuarine Research Reserve sites (HRNERR) encompassing a wide salinity gradient; and 2) to determine the breeding cycles of the fourspine (*Apeltes quadracus*) and ninespine (*Pungitius pungitius*) sticklebacks within each marsh. Bi-weekly sampling of the four HRNERR sites (encompassing over 100 miles) of the Hudson River began in late April 2002, ending in August 2002. Collection methods included two-person seine, fyke nets and a throw trap. Few *A. quadracus* and no *P. pungitius* were found. We believe the few four-spine sticklebacks collected are from isolated populations within the Hudson River. Observations in the field led to successful comparative sampling efforts in Connecticut where known populations of both species exist. Additionally, analysis of long-term beach seine data from the Hudson River Estuary Monitoring Program showed a significant decline in fourspine stickleback abundance.

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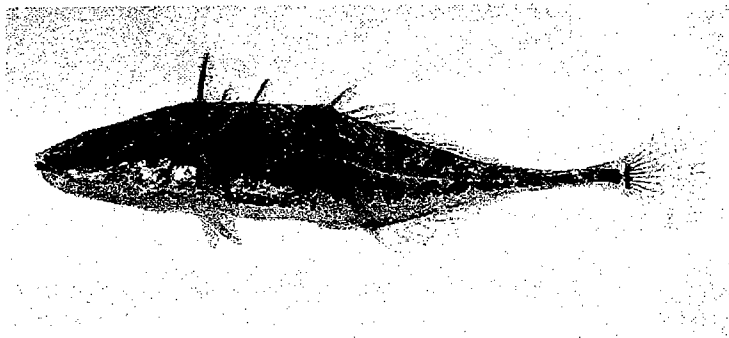
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3. INTRODUCTION

Estuaries are physically dynamic and biotically diverse. Nutrient and energy cycles are driven by a combination of tidal inputs of water from the ocean and runoff from the land. Consequent gradients in water chemistry (e.g., salinity, pH, temperature, etc.) and exposure to atmospheric conditions along the estuarine system support a diverse assemblage of flora and fauna. Marsh habitats in estuaries are especially productive, providing food and shelter to many organisms as well as a buffer to pollutants (Adam 1990; Helfman et al. 1997).

Many coastal fishes utilize the marsh habitat of the estuarine environment as a nursery area, which provides a place for rapid growth and refuge from predators. The assemblage composition and distribution of the fishes along the Hudson River estuarine marshes are poorly known. Of particular interest is the ecology of two stickleback species (family Gasterosteidae), the fourspine (*Apeltes quadracus*, Fig. 1) and ninespine (*Pungitius pungitius*, Fig. 2) sticklebacks. Remarkably little published information on the autecology of these species is available.

Figure 1. Fourspine Stickleback (*Apeltes quadracus*)



Size range: up to 6.4 cm
(Picture by Scarola, J.F.)

Figure 2. Ninespine Stickleback (*Pungitius pungitius*)



Size range: up to 9 cm

The fourspine stickleback can be found in the vegetative areas of euryhaline (Bigelow and Schroeder 1953) to freshwater (Rowland 1974) tidal marsh environments along the North Atlantic coast from Virginia to the Gulf of St. Lawrence. The ninespine stickleback is circumpolar in distribution with a range across much of the coastlines in the northern hemisphere (Maksimov and Tokranov 1995). Along the North Atlantic coast, it ranges from New Jersey to Newfoundland with an amphidromous population in New York (Smith 1985).

Sticklebacks are nesting brooders. Males construct nests (Wootton 1976) utilizing aquatic vegetation via adhesive type secretions from the kidneys, and defend the nest site vigorously (Worgan and FitzGerald 1981). The male lures a female to the nest to lay eggs. The male then fertilizes, flattens and covers the egg mass with additional vegetation and detritus, repairs the nest and courts another female. The cycle is repeated 4 - 7 times. The male then defends and ventilates the nest until the young leave a few days after hatching (Rowland 1974; Wootton 1976; Wootton 1984).

There are species differences in breeding behavior. Nest site location selection (Courtenay and Keenleyside 1983) and shape (Rowland 1974) differ; the fourspine

stickleback builds a cup-shaped nest predominately at the base of aquatic vegetation whereas the ninespine constructs a barrel shaped nest above the base of aquatic vegetation. It has also been observed, in tidal pools of New Brunswick, that the males of the fourspine will tend multiple nest sites simultaneously (Courtenay 1985). Males ventilate the nest in different ways. The fourspine is the only stickleback known to use opercular pumping action for this purpose (Rowland 1974). The ninespine fans the nest with the pelvic fins. Spawning males of both species exhibit sexual dimorphism through noticeable coloration patterns, the fourspine with bright red pelvics and the ninespine with jet black on the belly and white pelvic fins (Smith 1985).

The reproductive season of sticklebacks in the northeast U.S. is not known. It has been suggested that the fourspine and ninespine breed in early April through May and June based on times when the smallest size classes were collected (Able and Fahay 1998). The reproductive season and behavior for both species has been extensively documented in the St. Lawrence estuaries (Poulin and FitzGerald 1989; Wootton 1976; Wootton 1984; Worgan and FitzGerald 1981).

Sticklebacks migrate into tidal marshes in St. Lawrence estuaries to spawn in early spring (late March or early April) and continue through summer (July), and it has been suggested that the fourspine and ninespine also reproduce in late summer (early August; Poulin and FitzGerald 1989). The timing of reproduction may be influenced by inter- and intraspecific competition for breeding habitat. Evidence collected in tidal pools on the St. Lawrence estuaries has indicated selective or multiple breeding cycles within the reproductive season of both species of sticklebacks (Courtenay and Keenleyside 1983) that may be affecting the variation in distribution. One study

suggested that the ninespine sticklebacks had distinct early and late breeding cycles, possibly to avoid competition with another stickleback (*Gasterosteus aculeatus*; Lachance et al. 1987). Interestingly, Worgan and FitzGerald (1981) showed that ninespine sticklebacks reproduced early where they coexisted with fourspine sticklebacks, and hypothesized that in this case the ninespine was the competitively dominant species.

Two primary objectives of this study were: 1) to identify fish species found within the open water and vegetated habitats of the four HRNERR sites; and 2) to determine the breeding cycles of the fourspine (*A. quadracus*) and ninespine (*P. pungitius*) sticklebacks within each marsh. The four marshes are Piermont, Iona Island, Tivoli Bays, and Stockport Flats and together they constitute the HRNERR system. Information about the reserve program can be found on the web (National Estuarine Research Reserve 2002).

Piermont Marsh is the most southern marsh, situated approximately 23 miles upriver from the Atlantic Ocean, and therefore has the highest salinity (about half that of seawater). It is the largest brackish wetland on the Hudson River with roughly 1,000 acres of salt marsh. Iona Island (45 miles upriver from the ocean) is bordered by slightly brackish tidal marshes. The two bays (Tivoli North and Tivoli South) are located 100 miles upriver from the ocean and are freshwater habitats. Twenty-three miles further upriver, Stockport Flats consists of 1,500 acres of freshwater tidal marshes and dredge spoil islands.

4. METHODS

Multiple sites within the HRNERR sites (Fig. 3) marshes were repeatedly sampled on a bi-weekly schedule beginning in late April 2002 and ending in August 2002. All sampling efforts were oriented around the tidal fluctuations (high and low tide) for each site according to the collection method(s) employed.

Three collecting methods were employed to sample the fish assemblage. The first method used a two-person seine (4 m long x 1 m deep with 5 mm mesh). This was principally performed at low tide and when little underwater obstruction was evident that would deter effort. The second method employed fyke nets (1 m hoop x 2 m length with 1 m x 2 m wings off the inlet hoop, all constructed using 5 mm nylon mesh). Each net (two used in a marsh) was set during high tide conditions inside various channels within the marsh. Thus capitalizing on the outward flow of water as the tide receded, the fishes in the water column would move through the mouth of the net trapping fish inside. Collection of fish from the net occurred at low tide conditions. The final method utilized a throw trap (open bottom net approximately 1 m² x 1 m deep with 3 mm nylon mesh) for areas of dense vegetation prohibiting adequate seine sampling (Kushlan 1981).

Precipitation during parts of the summer was high and made a few sampling efforts too difficult due to excessive runoff from the watershed. A few of these storm events had also scoured the submerged aquatic vegetation (SAV) from key sample sites.

Figure 3. Map of Hudson River Estuary.

Defined into 13 geographic regions (with river mile boundaries) by the HREMP. Stars show the rough locations of the four HRNERR sites on the river.

