

Occurrence of Juvenile Atlantic Menhaden, *Brevoortia tyrannus*, in the Annapolis River, Nova Scotia

MICHAEL J. W. STOKESBURY¹
*Atlantic Reference Centre
Huntsman Marine Science Centre
St. Andrews, New Brunswick E0G 2X0
Canada*

KEVIN D. E. STOKESBURY
*Department de Biologie et G.I.R.O.Q.
Université Laval
Saint Foy, Quebec G1K 7P4
Canada*

ABSTRACT: This is the first report of juvenile (age 0+) Atlantic menhaden, *Brevoortia tyrannus*, in the Annapolis River, Nova Scotia. Juvenile Atlantic menhaden were incidentally collected during a 3-yr study of the effects of the STRAFLO hydro-power turbine at Annapolis Royal on alosine fishes. Length distribution and time of capture of collected fish suggest that Atlantic menhaden may spawn in the Bay of Fundy.

Introduction

The Atlantic menhaden, *Brevoortia tyrannus*, is a pelagic, marine-migratory clupeid fish that depends on estuaries as nursery areas for its larvae (Nelson et al. 1977). Larvae enter estuaries, progress to lower salinity waters, and develop into juveniles (Ahrenholz et al. 1987). Aerial observations and sample catches of Atlantic menhaden have established the use of estuaries from Florida to Maine as nursery areas (Kroger and Guthrie 1973). Atlantic menhaden have been captured along the Atlantic coast of North America from northern Florida to the Gulf of St. Lawrence. Atlantic menhaden are treated as one stock. Even if separate spawning groups do exist, apparently similar movement patterns have rendered potential populations inseparable in the fishery (Ahrenholz et al. 1987; Epperly 1989). Until recently Atlantic menhaden captured in Canadian waters, north of the Gulf of Maine, were considered strays from more southern populations (Liem and Scott 1966). However, breeding populations may exist in the Saint John and Kennebecasis rivers in New Brunswick where ripe males and females have been captured as late as August 24 (Scott and Scott 1988).

Adult Atlantic menhaden have occurred in Canadian waters in places other than the Saint John and Kennebecasis rivers (Fig. 1). In the Bay of Fundy, hundreds of Atlantic menhaden were caught in weirs and otter trawls in Passamaquoddy Bay, New Brunswick, in 1983 (Scott and Scott 1988), and over 100 were caught in weirs off Deer Island, New Brunswick, in 1960 (Liem and Scott 1966). Single collections in the Bay of Fundy have been reported from Hagerty Cove (1952) and off Digdeguash in 1954 (Liem and Day 1959). In the Gulf of St. Lawrence, ten specimens were captured in a floating salmon trapnet in Chaleur Bay, New Brunswick, in 1973 (Peppar 1974) and a single collection occurred in South Kouchibouguac Bay, New Brunswick in 1970, (Lear and Pippy 1971). Juvenile Atlantic menhaden have never been reported from Canadian waters.

In this paper we report on the occurrence of 209 juvenile Atlantic menhaden in the Annapolis River, Nova Scotia.

Materials and Methods

Alosid fishes were sampled at the hydropower dam at Annapolis Royal in the upper Bay of Fundy in August 27–October 19, 1985, August 1–November 3, 1986 (Stokesbury and Dadswell 1989, 1991), and September 26–November 1, 1989. In all 3 yr fish were sampled with two ichthyoplankton nets 1 m in diameter, 6 m long, with 0.35-mm

¹ Present address: Department of Biology, University of New Brunswick, Bag Service Number 45111, Fredericton, New Brunswick E3B GE1, Canada.

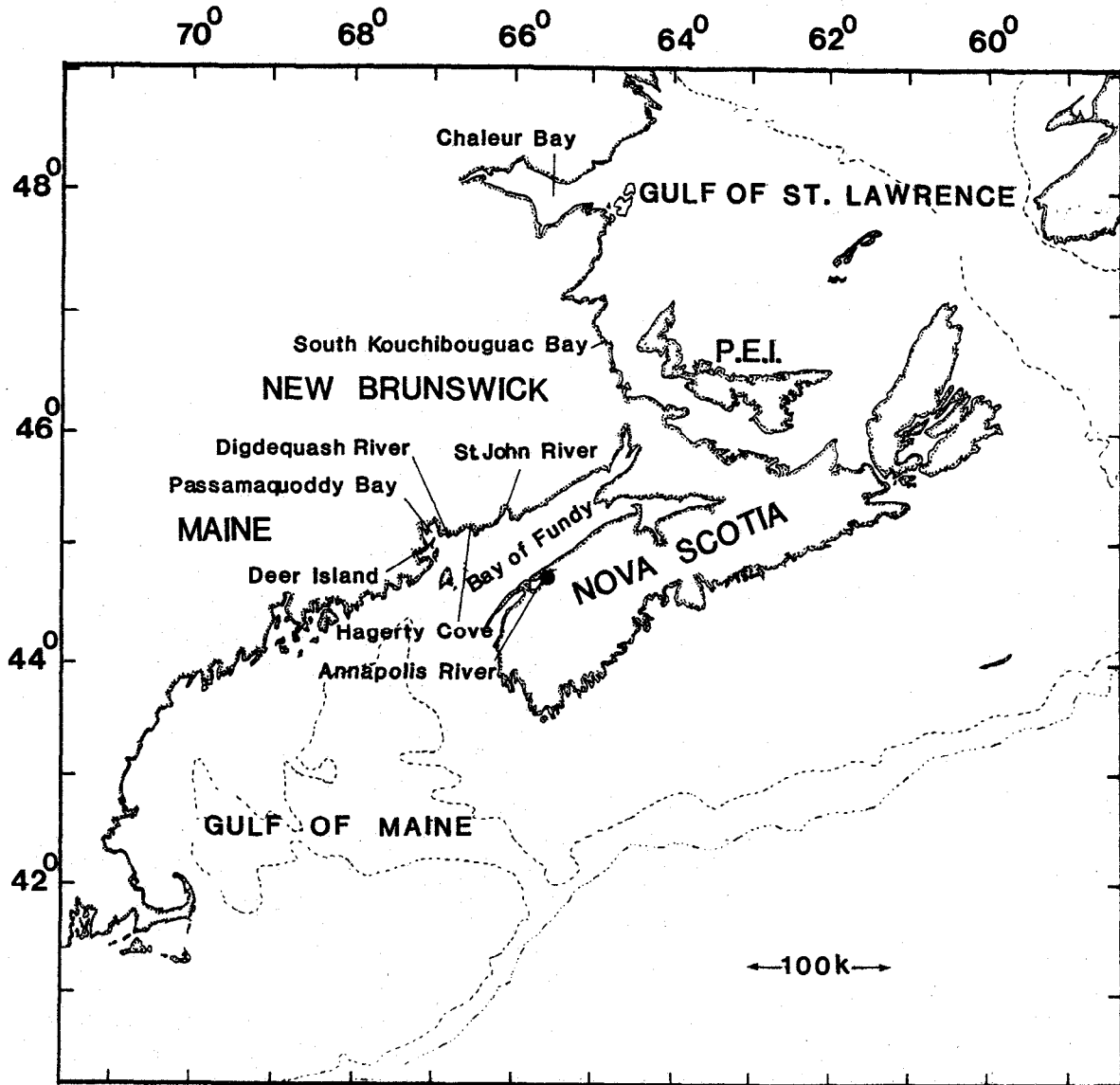


Fig. 1. Map showing reported locations of Atlantic menhaden captured in Canadian waters.

mesh. Nets were set in the top 1 m of the tail-race approximately 50 m from the turbine on the seaward side. Preliminary sampling determined that maximum catches occurred at twilight; therefore, nets were set for 5 h from late afternoon to early evening.

In 1985 and 1986 fish were seined at three sites in and above the estuary on the river side of the Annapolis power dam. The shore seines used were 2 × 30 m in length with 1-cm stretch mesh wings and a 0.5-cm stretch mesh bag. The seine was set by boat in a U-shape, and hauled to shore by hand with the bag at a depth of 1.5 m. Fish were seined at ½-h intervals during optimal fishing periods. Juvenile menhaden were removed from nets, mea-

sured, placed in air tight plastic bags, and frozen. Specimens were later thawed, and fixed in 10% formalin for 3 mo. Specimens were then preserved in 50% isopropyl alcohol for storage. A representative sample was deposited in the collection of the Atlantic Reference Centre (ARC 9211751), St. Andrews, New Brunswick.

Results

A total of 209 juvenile Atlantic menhaden (mean total length = 66.25 mm, range = 41–109 mm) (Fig. 2) was captured on the seaward side, and above the estuary on the river side of the hydropower turbine facility at Annapolis Royal, Nova Scotia.

No menhaden juveniles were collected in 224

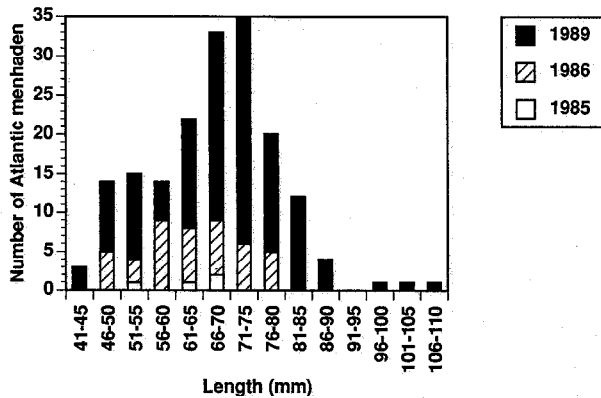


Fig. 2. Length distribution by year of juvenile Atlantic menhaden collected in the Annapolis River, Nova Scotia.

seine sets and only four were captured in ichthyoplankton nets during approximately 540 h of fishing in 1985, while in 1986, 43 were collected in 130 sets and 42 were captured in ichthyoplankton nets during 740 h of fishing. In 1989, 120 were captured in ichthyoplankton nets during 600 h of fishing. Seines were not used in 1989.

Discussion

In a study conducted by the United States National Marine Fisheries Service from 1967 to 1973, over 1,052,200 Atlantic menhaden (including 84,000 juveniles) were marked with internal ferromagnetic tags. Nicholson (1978) concluded from this study that during autumn young-of-the-year menhaden (length range 55 mm to 140 mm) leave their natal estuaries and migrate along with most juvenile and adult menhaden to the waters off North Carolina, where they disperse for the winter and early spring. In the late spring and summer menhaden then stratify by age along the coast from Florida to the Gulf of Maine, with the youngest and smallest keeping to the southernmost reaches of their range.

Juvenile Atlantic menhaden collected during autumn 1985, 1986, and 1989 in the Annapolis River were young of the year. Their lengths (mean length 66.25 mm) and time of migration coincide with Nicholson's observations on young-of-the-year migrations from natal estuaries to the open ocean in autumn. The presence of ripe adults in the Saint John and Kennebecasis rivers of New Brunswick and young-of-the-year juveniles in the Annapolis

River of Nova Scotia strongly suggests that Atlantic menhaden spawn in the Bay of Fundy.

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LITERATURE CITED

- AHRENHOLZ, D. W., W. R. NELSON, AND S. P. EPPERLY. 1987. Population and fishery characteristics of Atlantic menhaden, *Brevoortia tyrannus*. *United States National Marine Service Fisheries Bulletin* 85:569-600.
- EPPERLY, S. P. 1989. A meristic, morphometric and biochemical investigation of Atlantic menhaden, *Brevoortia tyrannus* (Latrobe). *Journal of Fish Biology* 35:139-152.
- KROGER, R. L. AND J. F. GUTHRIE. 1973. Migrations of tagged juvenile Atlantic menhaden. *Transactions of the American Fisheries Society* 102:417-422.
- LEAR, W. H. AND J. H. PIPPY. 1971. A record of the Atlantic menhaden, *Brevoortia tyrannus*, from Northumberland Strait. *Journal of the Fisheries Research Board of Canada* 16:503-514.
- LIEM, A. H. AND L. R. DAY. 1959. Records of uncommon and unusual fishes from eastern Canadian waters, 1950-1958. *Journal of the Fisheries Research Board of Canada* 28:461-462.
- LIEM, A. H. AND W. B. SCOTT. 1966. Fishes of the Atlantic Coast of Canada. *Bulletin of the Fisheries Research Board of Canada* 23:461-462.
- NELSON, W. R., M. C. INGHAM, AND W. E. SCHAAF. 1977. Larval transport and year-class strength of Atlantic menhaden, *Brevoortia tyrannus*. *United States Fish and Wildlife Fisheries Bulletin* 75:23-41.
- NICHOLSON, W. R. 1978. Movements and population structure of Atlantic menhaden indicated by tag returns. *Estuaries* 1: 141-150.
- PEPPAR, J. L. 1974. Northern extension of known range of Atlantic menhaden, *Brevoortia tyrannus*. *Journal of the Fisheries Research Board of Canada* 31:471-472.
- SCOTT, W. B. AND M. C. SCOTT. 1988. Atlantic fishes of Canada. *Canada Bulletin of Fisheries and Aquatic Sciences* 219:1-731.
- STOKESBURY, K. D. E. AND M. J. DADSWELL. 1989. Seaward migration of juveniles of three herring species, *Alosa*, from an estuary in the Annapolis River, Nova Scotia. *Canadian Field-Naturalist* 103:388-393.
- STOKESBURY, K. D. E. AND M. J. DADSWELL. 1991. Mortality of juvenile clupeids during passage through a tidal, low-head hydroelectric turbine at Annapolis Royal, Nova Scotia. *North American Journal of Fisheries Management* 11:149-154.

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