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Menhaden Tagging and Recovery: Part I—Field Methods for Tagging Menhaden, Genus *Brevoortia*

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ABSTRACT

This paper describes the methods and equipment used to mark over 1 million menhaden, Brevoortia tyrannus *and* B. patronus, *along the Atlantic and Gulf coasts of the United States from 1966-1971.*

INTRODUCTION

Menhaden occur in Continental Shelf waters from Nova Scotia in the Atlantic to Veracruz, Mexico in the Gulf of Mexico (Reintjes, 1960). By weight of catch, menhaden support the largest fishery in the United States.

The National Marine Fisheries Service (NMFS) expanded its menhaden studies in 1965. A tagging program for Atlantic menhaden, *Brevoortia tyrannus,* was initiated to provide direct evidence of migration patterns, discrete population groups, rates of interchange between fishing areas, mortality rates, growth rates, and identification of important menhaden nursery areas. In 1968 the program was expanded to include the Gulf menhaden, *B. patronus.* This paper describes the methods and equipment used to mark menhaden with an internal ferromagnetic tag.

MARKING MATERIALS

Because vast numbers of menhaden are caught, handled mechanically, and processed into fish meal, marking and recovery requirements are different than those for fish that are caught in smaller quantities and handled individually. Tags must be applied rapidly, so that large numbers of fish can be marked, and they must be recovered mechanically without examining individual fish.

Previous work suggested that an internal ferromagnetic, stainless steel tag, about 14.0 × 3.0 × 0.5 mm, having a specific six-character code, was best for menhaden over 100 mm (Carlson and Reintjes, 1972). Small Atlantic herring were marked with similar tags in Norway (Dragesund and Hognestad, 1960). For juvenile menhaden less than 100 mm, a smaller tag, 7.0 × 2.5 × 0.4 mm, identified with a three character code was needed. Unlike the larger tags, a hundred small tags have the same identifying code.

After testing various tag insertion methods (Kroger and Dryfoos, 1972), we found that inserting tags with a tagging gun designed by the Norwegian firm of Bergen-Nautik[1] yielded the best

[1]Mention of commercial firm does not imply endorsement of product by National Marine Fisheries Service.

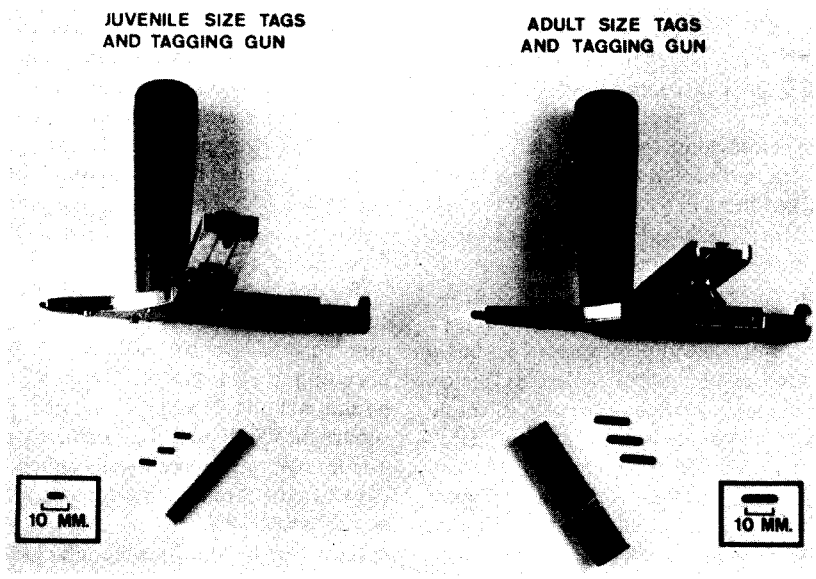


Figure 1.—Adult and juvenile tagging guns with tags and a series of 100 tags taped together.

results. A clip of 100 tags, constituting a series, is loaded into the magazine of the gun. Tags are fed into the barrel by a thumb-operated plunger. Four adult tags or eight juvenile tags fill the barrel with one tag protruding from the end. Each gun can be loaded in less than a minute under favorable conditions and an experienced tagger can tag 600 fish per hour. The adult tagging gun was modified to accommodate juvenile tags.

Tags can best be handled for field work by binding them in groups of 100 with semi-transparent or masking tape. The tape sufficiently adheres to the edge of the tags to hold them together when carefully handled (Figure 1.).

ACQUIRING AND RETAINING FISH

Methods of acquiring and holding fish varied depending upon the source and space available. Most fish were obtained from commercial purse seine catches, although we obtained some from commercial pound nets and caught some in our own pound net, purse seine, surface trawl, and beach seine when commercial sources were not available.

When we obtained fish from the commercial fishery, we either went aboard the carrier vessels and tagged from "live" boxes or followed the vessels in small boats and tagged from holding nets.

When tagging aboard carrier vessels, we dip-netted fish from the purse seine and put them in "live" boxes (0.6 × 0.6 × 1.2 m) which had holes near the top to permit overflow and continuous circulation of water. From 100 to 600 fish, depending on their size, could be held for a short time without mortality. Either a portable water pump or deck hoses on the vessel provided seawater. A frame screen inside the box could be adjusted to various levels to concentrate the fish for quicker handling. (Figure 2). Figure 3 shows tagging aboard a menhaden vessel.

When we tagged aboard our boats, we held fish in a keep-net, 3.7 × 3.7 × 0.9 m, stretched between two 4.9 m cross boards, one of which was cut into two sections (Figure 4). The half pieces make assembly easier and permit the net to be disassembled one section at a time, concentrating the fish for easier removal. The keep-net had a weighted lead line along the bottom to stretch the net downward and help maintain its box shape against a current. The entire cork or float line was ringed with floats to form a barrier prohibiting fish from swimming over the net. This net was very similar to the keep-net used by Fridriksson and Aasen (1950) and from 1 to 2,000 fish could be successfully held for 1 to 2 hr.

Although we usually transferred fish from the purse seines or pound nets by dip-netting or brailing (Figures 5 and 6), we also used a third method when tagging with purse seiners, which we termed "in water". By holding the keep-net and purse seine cork lines together and submerged along one side and raising the opposite side of the purse seine, we forced fish into our net. When we released the cork lines the fish were trapped in our keep-net. About 2 min were required to fill our net (2,000 fish) by this method while brailing took about 5 min and dipping took about 10 min.

We usually held fish in 37.9-liter plastic tubs aboard pound net vessels because there was not enough room for "live" boxes. As fish were brought aboard, they were picked out of the hold of the vessel and placed in the tubs. Ten to 20 fish could be successfully held. Occasionally, when tagging in confined areas, it was necessary to tag fish directly from the hold.

To catch our own fish, we used a small purse seine (61.0 × 3.7 m, 15.9 mm square mesh) with two 4.6-m plywood purse boats (Figure 7), a pound net (45.7 × 15.2 m, 19.1 mm square mesh) (Figure 8), a surface trawl (6.7 m, 6.4 mm square mesh) pulled between two 4.9-m aluminum boats and a beach seine (30.5 × 1.8 m, 6.4 mm square mesh) that was anchored to shore at one end and pulled in a semicircle by an outboard motor boat (Figure 9). The latter method worked well when the fish were close to shore and the shoreline was clear of brush and debris.

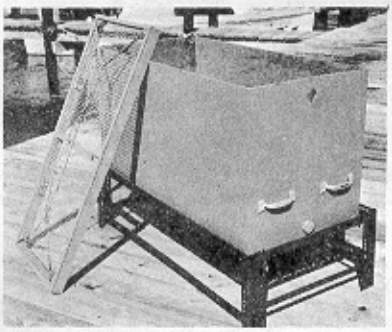
Juvenile menhaden were caught in estuaries with surface trawls and beach seines. They were held in small keep-nets (0.6 × 0.6 × 1.2 m, 6.4 mm square mesh) that held about 1,000 fish and were dipped out into 11.4-liter plastic tubs for tagging.

TAGGING FISH

We tagged fish by slipping the tag, protruding from the gun barrel, under the scales and then pushing it through the body wall. By keeping the barrel firmly against the body wall and fully depressing the plunger, the entire tag could be inserted into the body cavity. On fish over 100 mm we inserted the large tag anteriorly from about 13 mm above the origin of the pelvic fin on the right side of the fish (Figure 10); on smaller fish, we inserted the small tag posteriorly from just below the origin of the pectoral fin (Figure 11).

Experiments comparing the survival of fish tagged and released individually as opposed to those released in groups showed a higher survival rate (percent recaptured) for those released individually. Also the rate of survival of individually released fish decreased as the length of time they were held for marking increased. The more uniform, but lower, survival rate of fish tagged and released as a group confirms the importance of immediately releasing the tagged fish, a fact also noted by Mužinić (1965) and Jakobsson (1970). In our field tagging studies, we released fish individually and tried to keep the length of holding time as short as possible.

To determine the age and size of fish tagged, scale samples and fork length measurements were routinely taken from 5 to 25 percent of the tagged fish or from a 20-fish sample taken from the group. A scale-envelope holding board facilitated scale collecting (Figure 12). About 25 scale envelopes were placed on the board which was designed to fit



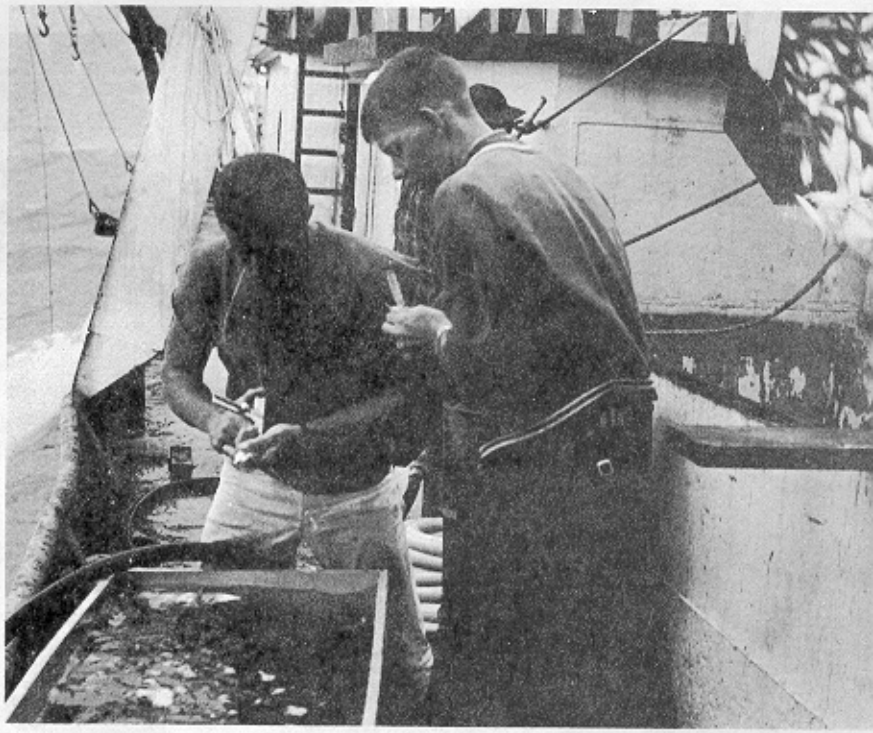


Figure 2 (above).—Live box, stand, and frame screen to concentrate fish for easy handling.

Figure 3 (top right).—Tagging aboard a menhaden vessel.

Figure 4 (below).—Assembled keep-net in water.

Figure 5 (bottom right).—Dip-netting fish from purse seine.

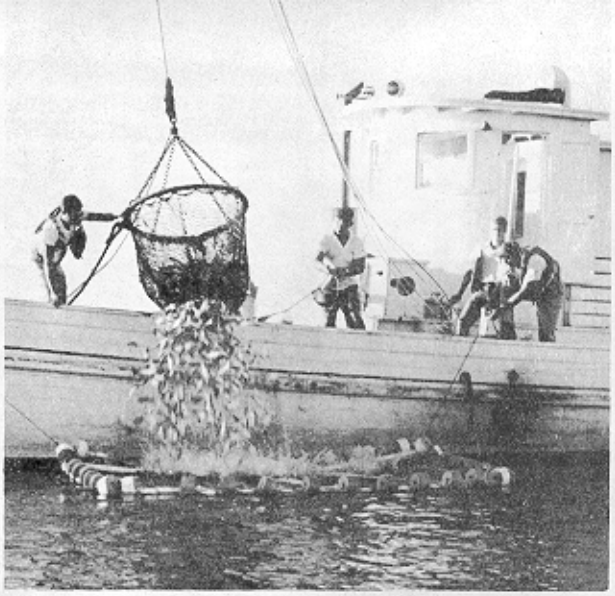
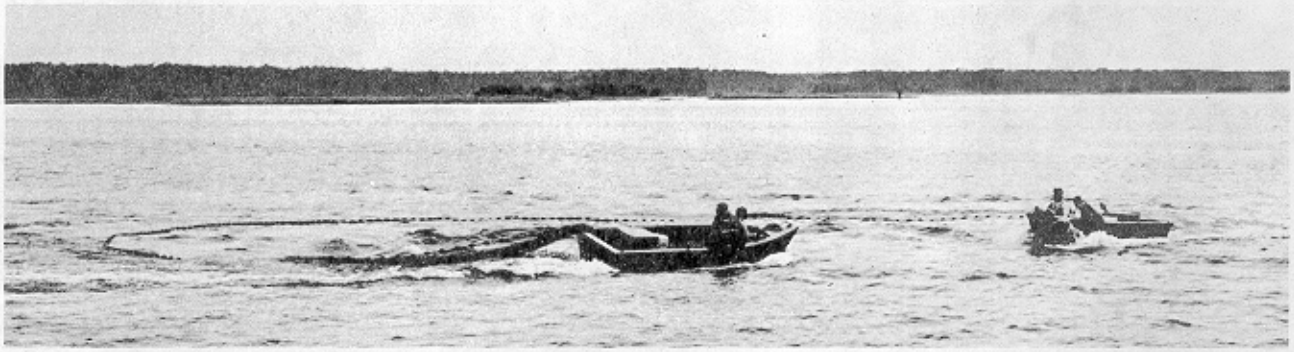


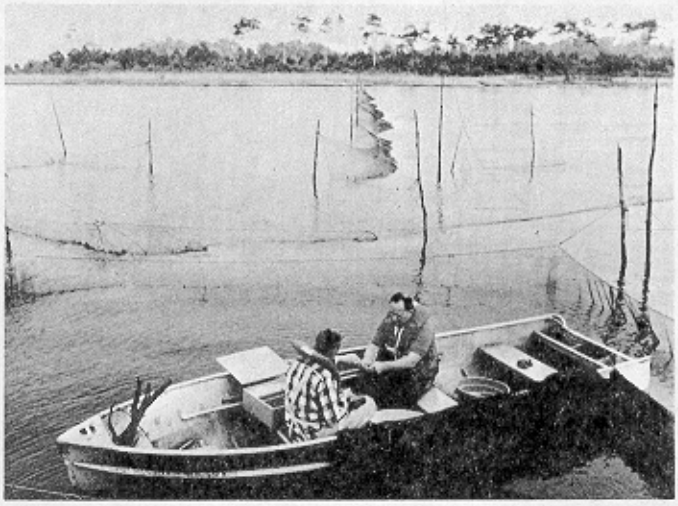
Figure 6 (top).—Brailing fish from a commercial purse seining vessel into our net.

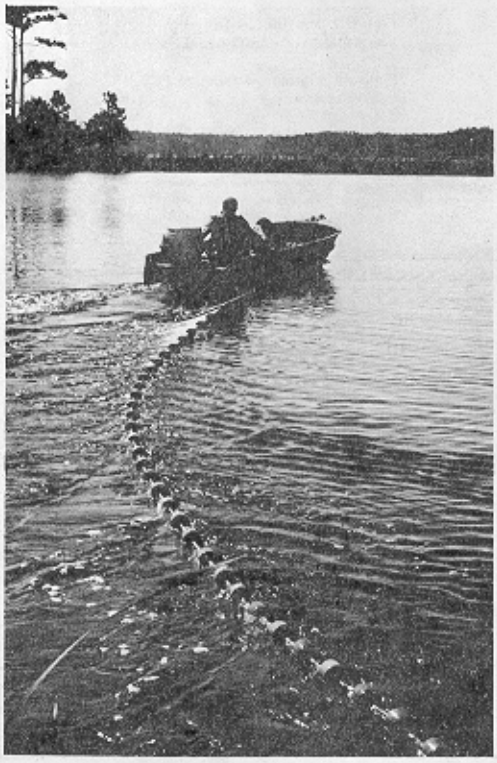
Figure 7 (center).—NMFS purse boats and purse seine being set.

Figure 8 (bottom left).—NMFS pound net.

Figure 9 (bottom right).—Collecting juvenile menhaden with a haul seine.







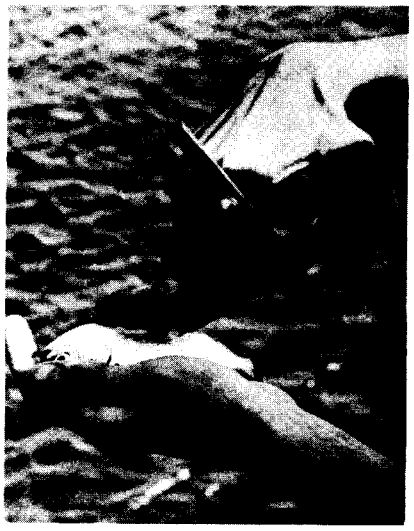


Figure 10.—Tagging young-of-year menhaden.

Figure 11.—Tagging juvenile menhaden.

across the back top of a "live" box, so scales could be inserted through the top.

Figure 12.—Scale envelopes mounted on scale envelope holding board.

A flat measuring board was used to obtain fork lengths. Although a trough type measuring and tagging board was later devised to facilitate handling and measuring menhaden larger than 250 mm, we had limited opportunity to use this board and evaluate its effectiveness.

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