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A METHOD FOR TAGGING IMMATURE HERRING

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ABSTRACT

A technique for tagging juvenile herring is described. The tag is made of polyvinyl chloride tubing sealed by friction with a V-shaped nylon plug. A hypodermic needle is used to insert the tag through the anterior dorsal musculature. During the 1960 Maine fishing season 8,300 tagged herring were released in lots of 100 to 500 and were recovered at a rate of 0 to 5 percent. Greatest known distance traversed before recovery was approximately 50 nautical miles; greatest speed of travel was 10 miles per day and longest time to recovery was 391 days. The average length of time to recovery was 18 days.

INTRODUCTION

Most of the herring *(Clupea harengus harengus)* caught along the Maine coast of the United States are immature fish 4- to 8-inches long and are packed as sardines. The young herring are harvested among the bays and islands of the coast with stop seines, and, to a lesser extent, with weirs and purse seines. The fish are canned at 31 plants located along the Maine coastline. When the fish are captured, they are usually pumped through a descaling machine into the hold of a carrier vessel, transported to a canning plant, and repumped into the cannery. Infrequently, the carrier vessels transfer the catches to trucks for overland transportation to a cannery. The vigorous handling of the herring required the design of an especially tenacious tag.

McKenzie and Skud (1958) described a celluloid opercular tag they considered suitable for short-term studies of sardine (herring) migrations. In 1959, experiments were begun at the Bureau of Commercial Fisheries Biological Laboratory, Boothbay Harbor to develop a long-term tag, preferably one that would persist through two fishing seasons.

MATERIALS AND METHODS

The chief qualities required of a tag for Maine sardines are:

1. Inertness. The tag should be nontoxic and made of a soft material so that the tagging wound would heal cleanly.

2. Visibility and tactility. The tag should be highly visible through all stages of processing, especially in the canning plants, and should be apprehended by the sense of touch as well as sight by persons handling the fish for canning. Thus, an external tag of conspicuous color was desirable.

3. Retention. The tag should be attached firmly to withstand the vigorous handling of the fish from capture to final processing.

4. Speed of attachment. The tag should be suited to quick attachment with the minimum possible handling of the fish. Herring lose their scales from slight finger pressure, and as Hodgson (1957) noted, a herring losing 50 percent of its scales will not survive.

5. Durability. The material of the tag should be sufficiently durable to resist the chemical action of sea water and should retain its code markings in a legible manner.

Nontoxic yellow polyvinyl chloride tubing of the conventional "spaghetti" appearance was chosen for the body of the tag. The tubing had an outer diameter of 0.051 inches and an inner diameter of 0.027 inches. The length was set at 2.125 inches. The thick dorsal musculature of the herring midway between the nape and the insertion of the dorsal fin was selected as the point of attachment. To avoid knotting or tying the ends of the tubing after the tag had been inserted through the fish, a small nylon V-shaped plug was devised as a seal. Translucent nylon rod 0.045 inches in diameter and 1 inch long was chosen for the seal. The ends of the rod were cut to a point, and the rod was then heated and bent to an angle of approximately 45 degrees. When the vinyl tubing was inserted with a hypodermic needle through the dorsal musculature of the herring, the nylon rod afforded a quickly applied friction seal that firmly joined the free ends of the tubing and formed the tag into a teardrop shape.

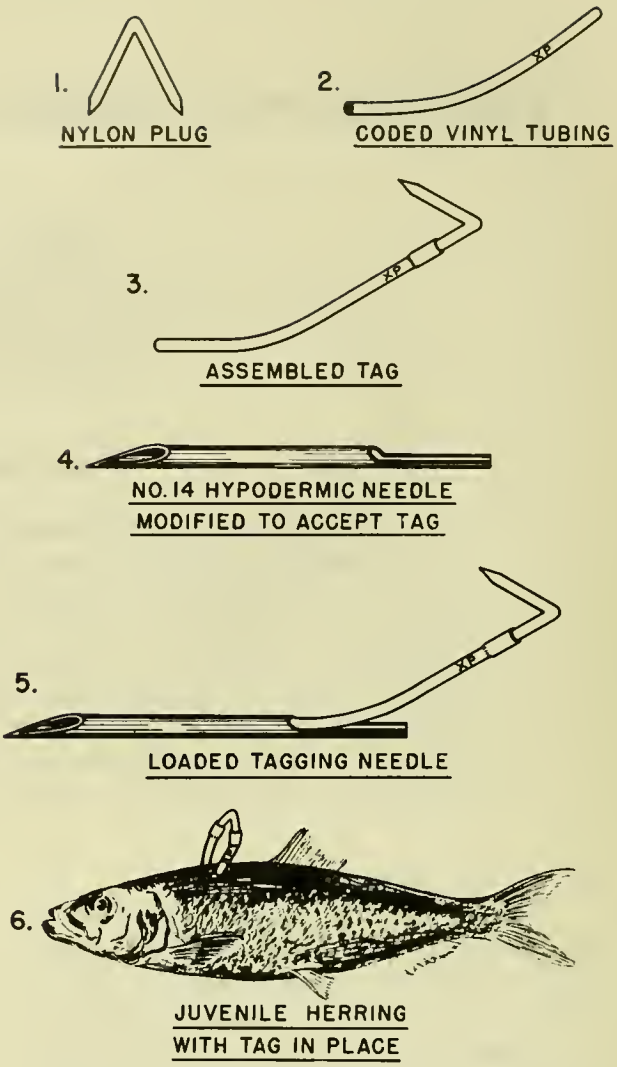

Figure 1.--Component parts and position of Maine sardine tag.

The tags were coded with two- and three-letter permutations of commercial Gothic letters. The letters were engraved in the tag and were filled with black vinyl ink. The tag was assembled as shown in figure 1. The tags were coded in lots of about 500 each. Later, when only a portion of a coded lot of tags was used in the field, the remainder was re-coded by adding a dashed line.

Herring for tagging were procured from a fisherman at the site of capture and placed in a 3- by 4-foot oblong by 5-foot deep holding pocket made of 3/16-inch bar measure nylon mesh (fig. 2). Dip nets were used initially to transfer the fish from the fisherman's net to the holding pocket, but were subsequently replaced with polyethylene pails because the netting scraped scales from the struggling fish. Fish were removed from the holding pocket, about 15 at a time, in 10-quart polyethylene pails. Two men did the actual tagging: one man held the fish and inserted the loaded needle through the dorsal musculature, and the second man drew the needle through the herring's body, leaving the tag in position, and forced the free end of the nylon plug into the open end of the polyvinyl tubing. The tagged fish was then placed in a second holding pocket for release with several hundred tagged fish as a school.

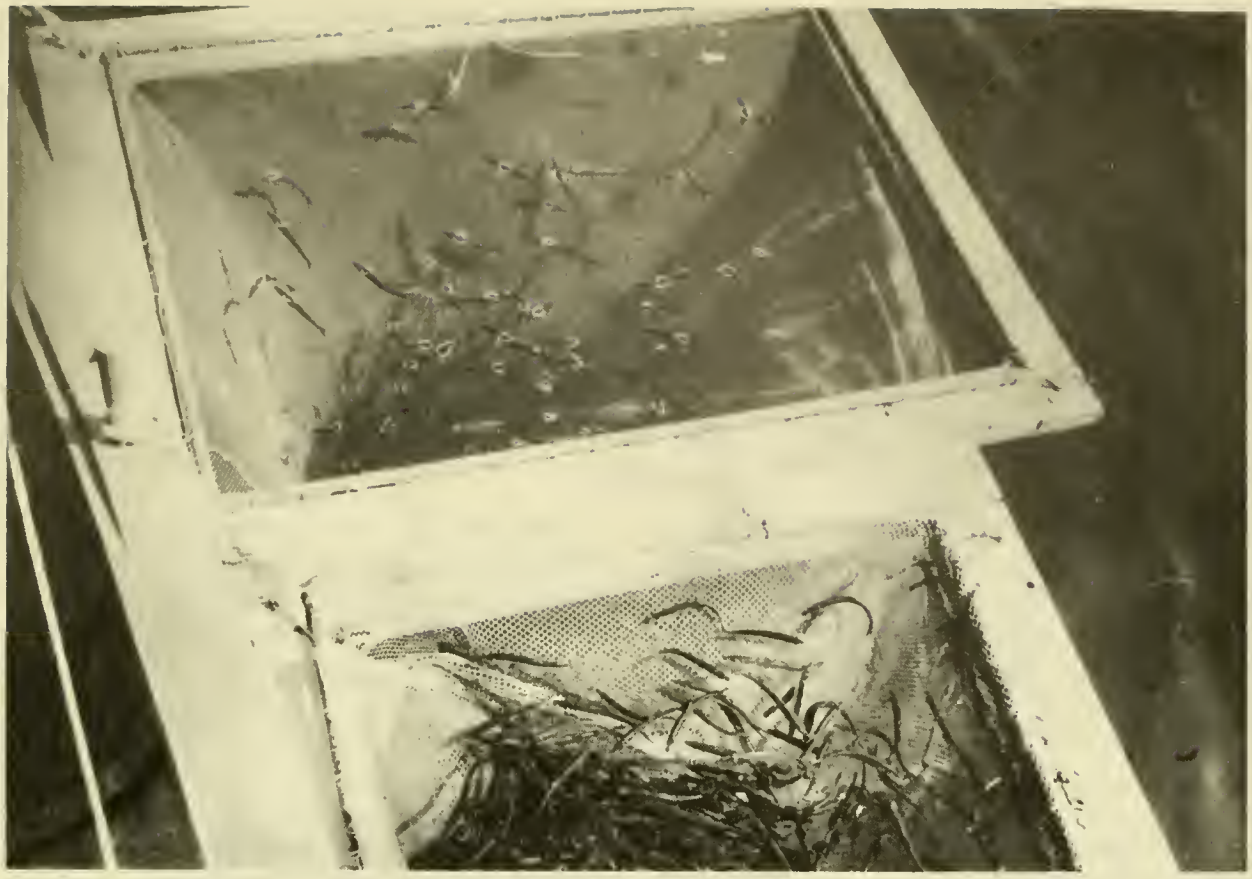

Figure 2.--Holding pockets used in testing the Maine sardine tag. The lower pocket contains untagged fish; the upper, tagged fish.

Herring selected for tagging were in the 5- to 6-inch total length group. Fish of that size group are especially sought by the sardine fishery and, when tagged in the late summer and autumn, offer an opportunity for overwintering and recovery the following year. The dorsal musculature of a 5- to 6-inch herring is well-formed and holds the tag well, whereas smaller fish of about 4 inches show distress and inability to sound when the tag is attached.

Herring that showed abrasion or considerable scale loss were discarded. Under average field conditions a three-man team could maintain records, load needles, and tag fish at a rate of about 100 per hour. It was impossible to apply the tag without removing some of the scales, and herring that appeared sluggish in the holding pocket were replaced.

To test tag retention 50 tagged herring were mixed with 50 unmarked fish in a small holding pocket and pumped through a descaling machine into the hold of a carrier vessel. To simulate the second pumping operation that the fish undergo when being unloaded for processing, the entire test lot was subjected to another pumping by the carrier vessel. None of the tags was detached by the descaling and pumping processes.

The tendency of tags to cause mortality was tested under aquarium conditions by releasing 20 tagged fish and 20 untagged fish in a 1,500-gallon tank of circulating sea water. It is apparent that the tag did affect the mortality of the test fish, particularly in the early weeks of the experiment, although the gap between the mortalities of tagged fish and controls lessened with time (table 1). The

Table 1.--Mortalities of juvenile herring tagged with Maine sardine tags and held in aquarium tank in Bureau of Commercial Fisheries Biological Laboratory, Boothbay Harbor, Maine

Days after tagging	20	40	60	80	100	120	140
Tagged fish (20):							
Cumulative deaths	2	3	3	3	5	8	9
Percent mortality	10	15	15	15	25	40	45
Untagged fish (20):							
Cumulative deaths	0	1	2	2	3	6	8
Percent mortality	0	5	10	10	15	30	40

experiment was concluded after 140 days because of heavy algal growth in the acquarium; at that time the control and tagged fish mortalities were 40 percent and 45 percent respectively. The tagging wounds had healed cleanly, but the tags acquired the algal growth that invaded the aquarium.

Field releases of 8,303 tagged herring were begun in May and completed in September. To disperse the tags along the Maine coast, three tagging areas were established (fig. 3):

Area I - West Quoddy Head to Schoodic Peninsula, with Cutler, Maine as a tagging location.

Area II - Schoodic Peninsula to Pemaquid Neck, with Isle au Haut and Marshall Island as locations for tagging.

Area III - Pemaquid Neck to Kittery Point, with Cape Porpoise as a tagging location.

RESULTS

Between May and October 1960, 8,303 tagged herring were released along the Maine coast. By September 1962 there were 116 recoveries as follows:

Tagging location	Number of tags released	Recoveries	Percent recovered
Area I	4529	58	1.3
Area II	2009	57	2.8
Area III	1765	1	0.1

Recoveries for the entire coast totaled 114 in December 1960. The overall recovery rate was 1.4 percent during the first fishing season. To date the best recovery rate for any single lot released was 4.9 percent.

Herring tagged in Areas I and II were available in the 5- to 6-inch size group, but the only herring available in Area III were large fish, 9- to 10-inches long. It was known that fishing effort for the larger fish as sardines would be relatively light because they are less desirable for canning; nevertheless 1,765 of them were tagged in the hope that direct recoveries by fishermen, rather than recoveries by persons packing fish in cans, would provide information regarding older fish. Only one tag from the Area III group was recovered, and further recoveries appear unlikely because of the bias of the fishery toward smaller fish.

Two tags were recovered during the second season, 1961, when relatively few small herring were caught, and the chances of recovering any extant tags were considerably narrowed. The longest time between release and recovery was 391 days with an average of 18 days from release to recovery. The 1960 tagging experiments have been summarized in table 2. Distances from release to recovery have been measured along the shortest water route. Recoveries made at the site of release have been recorded as zero miles regardless of how many days elapsed between release and recovery. All of the recovered tags had remained tightly sealed. The code letters of the

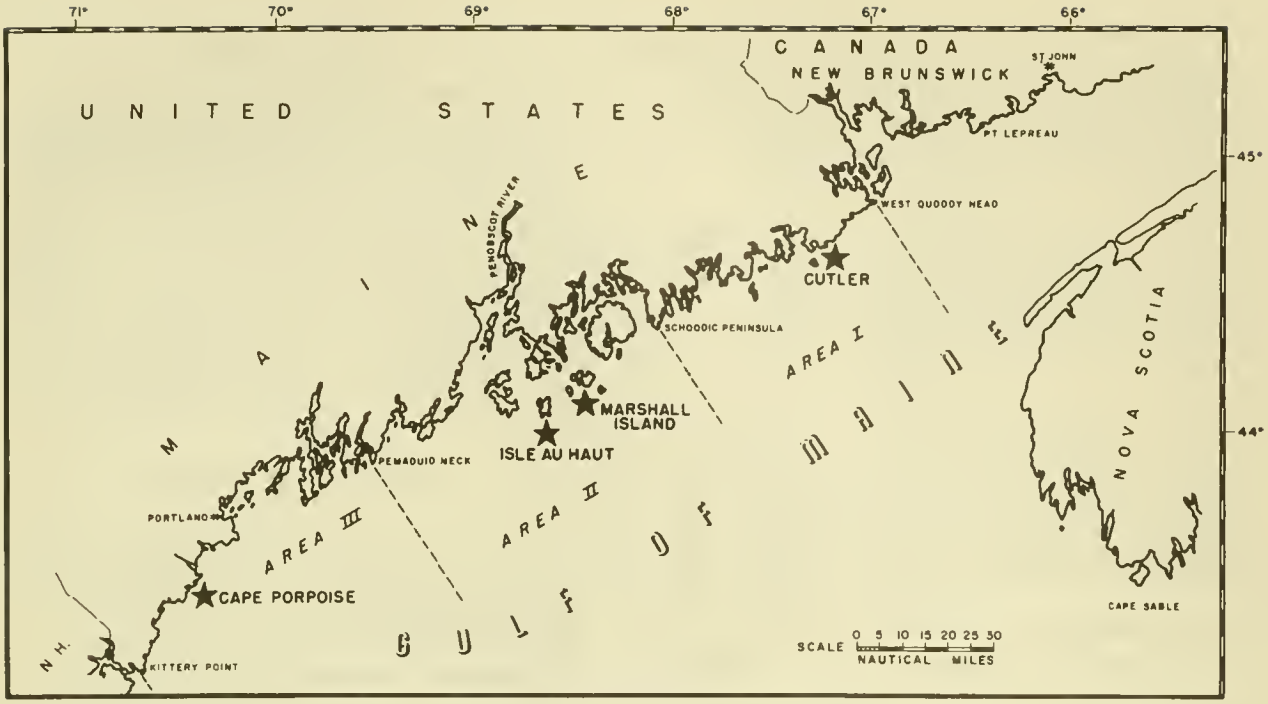

Figure 3.--Tagging areas established for 1960 field tests along the Maine coast. Stars indicate tagging sites.

tag recovered after 391 days at sea were clearly legible, and there was no perceptible change in the tag.

DISCUSSION

Immature or "sardine" herring were first tagged in the eastern Maine-New Brunswick area by McKenzie and Skud (1958), who used a maroon celluloid opercular tag described by McKenzie (1950). The tag was subsequently used by McKenzie and Tibbo (1961) who reported a maximum time to recovery of 165 days. Graham (1929) concluded from aquarium studies that a dorsal or caudal tag location was superior to the operculum, and for the insertion of the polyvinyl loop described in this paper the dorsal position on the herring was chosen as offering thicker musculature for attachment than the caudal area.

Bright yellow was chosen for the color of the tag because recoveries were expected from persons working in the canneries. Wood, Parrish, and McPherson (1955) have shown that Scottish herring tags of bright yellow, red and bright yellow, and blue and bright yellow give significantly higher recoveries than red or amber tags. They note from shipboard experiments that although bright yellow and amber have very similar absorption spectra, the bright yellow tag was much more conspicuous in a mass of herring.

The effect of color upon recoveries of the polyvinyl chloride tag at Maine canneries was tested in August 1962 at Isle au Haut (Area II). A total of 1,200 tagged fish was released composed of 400 each of the colors scarlet, green, and yellow. During the first 2 months after release, recoveries at sardine canneries were 24 yellow tags, 14 green, and 2 scarlet.

The number of recoveries in Areas I and II were directly related to quantities of fish caught in those areas. In Area I, 200,000 bushels of herring were caught in 1960 following tag releases and 1.7 percent of the tags were returned. Area II with a catch of 400,000 bushels gave a recovery rate of 2.7 percent, even though only half as many tags were released.

Table 2.--Herring tag experimenta, 1960. All locations are in Maine with the exception of seven recoveries from New Brunswick, Canada (identified by the initials N.B.)

Tagging				Recoveries			
Location	Date	Tags released	Code	Location	Approximate distance	Tags recovered	Time at large
		Number			*Nautical miles*	*Number*	*Days*
Cutler	May 24	435	XK	Cross Island	6	1	85
	"	111	-XK	Beaver Harbour, N.B.	35	1	3
	May 26	425	XH	Beaver Harbour, N.B.	35	1	26
				" " "	35	1	30
				Jonesport	23	1	48
	May 26	271	XM	Beaver Harbour, N.B.	35	1	26
				Bois Bubert Island	33	1	32
	May 27	117	-XM			No recoveries	
	May 27	502	XHI	Lepreau Harbour, N.B.	45	1	5
				Deadman Head, N.B.	33	1	222
	May 27	115	-XH	Bois Bubert Island	33	1	26
	June 2	444	XN			No recoveries	
	June 7	437	XO	Cutler	0	2	1
				"	0	1	2
	June 7	400	XP	Cutler	0	4	1
				"	0	5	2
				Baileys Mistake	9	1	17
				Holmes Bay	13	1	20
	June 8	450	XKI	Cutler	0	6	1
	"	404	XNI	"	0	9	1
	"	301	XMI	"	0	19	1
	"	117	-XP	Bliss Island, N.B.	25	1	9
Cape Porpoise	June 22	410	XPI			No recoveries	
	"	455	XOI			No recoveries	
	June 24	500	XVI	Old Orchard Beach	12	1	6
	"	400	XS			No recoveries	
Isle au Haut (Moore Harbor)	Aug. 23	513	XSI	Isle au Haut (Moore Harbor)	1	2	1
				Isle au Haut (Duck Harbor)	2	1	1
				Moose Island	7	1	7
				Moose Island	7	2	8
				Isle au Haut Thorofare	3	1	9
				Merchant Island	5	1	10
				Isle au Haut (Point Lookout)	4	1	17
				Cape Rosier	18	1	23
				Bear Island	14	1	24
				Marshall Island (Sand Cove)	14	1	25
				Merchant Island (Sand Cove)	5	1	32
				Isle au Haut (Moore Harbor)	1	1	34
				Deer Isle (Sunshine)	12	1	35
				Metinic Island	25	1	35
				Matinicus Island	16	1	35
				Marshall Island (Sand Cove)	14	1	35
				Deer Isle (Sunshine)	12	2	36
				Cape Rosier	18	1	36
				Deer Isle (Conary Cove)	12	2	36
				Merchant Island	5	1	37
				Damariscove Island	50	1	391
Marshall Island (Sand Cove)	Aug. 30	531	XXI	Marshall Island (Popplestone Cove)	1	1	16
				Marshall Island (Sand Cove)	0	1	20
				Isle au Haut (Head Harbor)	10	1	22
				Swans Island (Toothacher Cove)	4	2	28
				Marshall Island (Sand Cove)	0	1	28
				Deer Isle (Sunshine)	9	1	28
				Deer Isle (Sunshine)	9	3	29
				Deer Isle (Conary Cove)	7	3	29
	Aug. 31	120	X2I			No recoveries	
	Sept. 20	396	X2	Deer Isle (Sunshine)	9	1	7
				Deer Isle (Conary Cove)	7	2	8
				Merchant Island	7	1	9
				Isle au Haut (Head Harbor)	10	1	27
				Swans Island (Buckle Harbor)	6	1	31
	Sept. 21	449	XX	Long Island (House Point)	6	1	6
				Matinicus Island	24	1	6
				Cape Rosier	22	1	7
				Deer Isle (Sunshine)	9	1	7
				Deer Isle (Conary Cove)	7	1	7
				Merchant Island	7	1	8
				Deer Isle (Sunshine)	9	1	8
				Deer Isle (Conary Cove)	7	1	8
				Isle au Haut (Head Harbor)	10	1	26
				Blue Hill Bay (Allen Cove)	16	1	28
				Marshall Island (Sand Cove)	0	1	30
				Swans Island (Buckle Harbor)	6	1	30

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CONCLUSIONS

Immature herring were tagged experimentally with loops of polyvinyl chloride tubing during the 1960 Maine fishing season. A total of 8,300 tagged herring released in units of 100 to 500 gave a recovery rate varying from 0 to 5 percent. The greatest known distance to recovery was 50 miles; greatest speed of travel was 10 miles per day; and the longest time to recovery was 391 days with an average recovery time of 18 days.

LITERATURE CITED

GRAHAM, MICHAEL.
1928. On methods of marking round fish with an account of tests in aquaria. Ministry of Agriculture and Fisheries (Great Britain), Fishery Investigations, series 2, vol. 11, no. 4, 25 p.

HODGSON, W. C.
1957. The herring and its fishery. Routledge & Kegan Paul, London, England, 197 p.

McKENZIE, R. A.
1950. A new celluloid opercular tag. Transactions of the American Fisheries Society, vol. 78, for the year 1948, p. 114-116.

McKENZIE, R. A., and B. E. SKUD.
1958. Herring migrations in the Passamaquoddy region. Journal of the Fisheries Research Board of Canada, vol. 15, no. 6, p. 1329-1343.

McKENZIE, R. A., and S. N. TIBBO.
1961. Herring movements in the Bay of Fundy and Gulf of Maine, 1957 and 1958. Journal of the Fisheries Research Board of Canada, vol. 18, no. 2, p. 221-252.

WOOD, H., B. B. PARRISH, and G. McPHERSON.
1955. Review of Scottish herring tagging experiments, 1948-1953. Conseil Permanent International pour l'Exploration de la Mer, Rapports et Procés-Verbaux des Réunions, vol. 140, part 2, p. 35-44.

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