STATUS OF FISH TAGGING AND TAGGING TECHNIQUES

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

BUREAU OF COMMERCIAL FISHERIES

WOODS HOLE, MASSACHUSETTS

FOR THE PERIOD . . . . . 1957 through 1961

Prepared at the request of the

American Fisheries Society, Northeast Section

January 30, 1961

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REPORT NO. 62-2

INTRODUCTION

During the five year period, 1957 through 1961, 66,849 fish and shellfish have been tagged, representing the following species: alewife, cod, dogfish, fluke, haddock, halibut, pollock, redfish, sea scallop, scup, whiting, winter flounder, and yellowtail.

Of this total, 11,186 have been tagged by the State Conservation Departments of Massachusetts, Rhode Island, New York, and New Jersey in a coordinated program with this laboratory representing the following species: alewife, fluke, scup, and winter flounder.

Five types of tag were used - Petersen Disc, Internal Anchor, Spaghetti, Atkins-Spaghetti, and Dart-Spaghetti.

These tagging programs were conducted to learn more about migration, age and growth, age method verification, identification of stocks, group identification, mortality determination, and efficiency of tags - as basic information for commercial fisheries research.

Contained in the following pages are:

1. A table of tagging showing-
   Species tagged
   Size range of species tagged
   Number tagged
   Method of attachment (type and color of tag)

2. A detailed description of each type of tag, manufacturer's specifications, method of attaching tag, and an evaluation of the tag as used.

3. General comments.

Evaluation of the tags is based on observations by biologists tagging fish, observations by port agents who examine fish returned with tags intact on the fish, tank observations of tagged fish at this Laboratory, and tag return records.

TAGGING

U.S. BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

Species	Size tagged	Number tagged	Method of attachment	Type of Tag 1 Petersen disc	2 Internal anchor	3 Spaghetti	4 Atkins spaghetti	5 Dart spaghetti
*Alewife	15-30 cm.	149	Thru dorsum att. w/flexible vinyl tubing trailing				Yellow tag & tubing	
Cod	22-133 cm.	3,244	Joined by pin or wire thru nape	2 yellow, or 1 ea. red, white				
			In abdominal cavity		Yellow tab & capsule			
			Thru dorsum tied in loop			Yellow (printed)		
Dogfish	45-110 cm.	872	Thru dorsum tied in loop			Yellow (printed)		
			Thru dorsum w/pin	1 ea. yellow, white				
			Thru tip of nose w/pin	2 yellow or 1 ea. red, white				

TAGGING

U.S. BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

(Cont.)

				Type of Tag				
				1	2	3	4	5
Species	Size tagged	Number tagged	Method of attachment	Petersen disc	Internal anchor	Spaghetti	Atkins spaghetti	Dart spaghetti
*Fluke	26-56 cm.	5,904	Joined by pin thru nape	2 yellow, or 2 bi-color, red white				
			Thru dorsum att. w/ flexible vinyl tubing, trailing				Yellow tag & tubing	
Haddock	13-75 cm.	12,508	On operculum w/pin	2 yellow, or 1 ea. red, white				
			Thru dorsum w/wire	2 yellow, or 1 ea. red, white				
			Thru dorsum w/ vinyl tube, trailing	1 white				
			In abdominal cavity		Yellow tab & capsule			
			Thru dorsum tied in loop			Yellow (printed)		

TAGGING

U. S. BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

(Cont.)

Species	Size tagged	Number tagged	Method of attachment	Type of Tag 1 Petersen disc	2 Internal anchor	3 Spaghetti	4 Atkins spaghetti	5 Dart spaghetti
Halibut	26-120 cm.	204	Thru dorsum w/pin	2 yellow, or 1 ea. red, white				
			In abdominal cavity		Yellow tab & capsule			
			Thru dorsum tied in loop			Yellow (printed)		
Pollock	26-64 cm.	50	On operculum w/pin	2 yellow				
			Thru dorsum			Yellow (printed)		
Redfish	13-36 cm.	6,503	On operculum w/pin	2 yellow, or 1 ea. red, white				
			Thru dorsum w/pin	2 yellow, or 1 ea. red, white				
			Thru dorsum tied in loop			Yellow (printed)		

TAGGING

U. S BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

(Cont.)

Species	Size tagged	Number tagged	Method of attachment	Type of Tag 1 Petersen disc	2 Internal anchor	3 Spaghetti	4 Atkins spaghetti	5 Dart spaghetti
Sea Scallop	9-12 cm.	14,989	Thru upper valve in area of byssal notch w/pin	1 yellow, or 1 red				
*Scup	14-34 cm.	7,465	Thru dorsum w/pin	2 yellow				
			Thru dorsum att. w/ flexible vinyl tubing trailing				Yellow, or red w/yellow tubing	
			Same secured by double knot				Yellow, or red w/yellow tubing	
			Same tied in loop				Yellow, or red w/yellow tubing	
			In dorsum					Yellow (printed)

TAGGING

U.S. BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

(Cont.)

				Type of Tag				
				1	2	3	4	5
Species	Size tagged	Number tagged	Method of attachment	Peterson disc	Internal anchor	Spaghetti	Atkins spaghetti	Dart spaghetti
Whiting	18-50 cm.	7,260	Thru dorsum w/pin	1 ea. red, white				
			Thru dorsum att. w/ flexible vinyl tubing				Red w/ yellow tubing	
			Thru dorsum att. w/nylon monofilament loop				Red w/ clear mono-filament attachment instead of spaghetti	
			Thru dorsum, tied in loop			Yellow (printed)		
*Winter Flounder	19-41 cm.	3,082	Thru nape w/pin	1 ea. red, white				

TAGGING

U. S. BUREAU OF COMMERCIAL FISHERIES
Woods Hole, Mass.
1956 thru 1961

				Type of Tag				
Species	Size tagged	Number tagged	Method of attachment	Petersen disc	Internal anchor	Spaghetti	Atkins spaghetti	Dart spaghetti
Yellow-tail	18-48 cm.	4,619	Joined by pin thru nape	1 ea. red, white, or 2 yellow, or 2 bi-color, red, white				

TOTAL TAGGED -----
66,849

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* A portion of the species designated with asterisks (totaling 11,186 fish) were tagged by the Conservation Departments of Massachusetts, Rhode Island, New York, and New Jersey, in programs coordinated with this laboratory. The State Conservation Departments have conducted the tagging operations, assisted with public relations, and processed the tag return data, making it available to this laboratory. The Woods Hole Laboratory of the U.S. Bureau of Commercial Fisheries has supplied the tags, acknowledged the tag returns, paid the rewards, and assisted with public relations and with the facilities of the Port Agent System of the Office of Statistical Services, Gloucester, Massachusetts.

PETERSEN DISC TAG

The Petersen Disc tag has been widely used for a long period of time by laboratories of all countries which engage in fish tagging. It has become not only a standard tag, but a tag used as a standard by which other newly developed tags are evaluated in controlled tagging experiments. This Laboratory has used them on nearly all species.

Specifications

Used in pairs, one showing message "Fish and Wildlife Service, Woods Hole, Mass. Return both discs. Reward"; the other showing serial number designation and "USFWS".

Size specifications:

Diameter of disc	-	1/2 inch
Thickness	-	25/1000 inches
Center Hole	-	.039 inches diameter
also		
Diameter of disc	-	11/16 inches
Thickness	-	30/1000 inches
Center Hole	-	.039 inches diameter

Material specifications: These discs have been successively made of cellulose acetate, vinylite plastic, and polyvinyl chloride plastic. Those made of the first two materials were processed with a transparent layer laminated on the face of the disc to protect the printing. The polyvinyl chloride plastic tag (a later development) does not require lamination as the printing is impressed deeply in the material by a combination of heat, pressure and a penetrating ink.

Operculum attachment

Serially numbered and message discs (one inside, and one outside the operculum) are attached with stainless steel pin inserted through a soft membranous section of the operculum. The excess pin length is then cut off, and with long-nosed pliers a small loop is formed in the terminal end of the pin and bent over to lay flush against the face of the outside disc.

Dorsum attachment

Serially numbered and message discs (one on each side of the fish) are attached by inserting the stainless steel pin or wire through the dorsal musculature and securing the terminal end as described with the operculum attachment.

The wire is used on large fish. It is cut in two lengths, 3 inches, and 5 inches, for handy use, each having one end formed into a bent-over-loop. A stainless steel hypodermic needle is inserted through the dorsum or the nape, and the terminal end of the wire is then inserted in the hollow needle, and so through the fish.

Nape attachment

Same method as dorsal attachment.

Byssal notch attachment (Sea Scallop)

There is a deep byssal notch in one ear of the lower valve which is not present in the upper valve. A touch causes the scallop to withdraw the mantle and a fine hole is drilled in the ear of the upper valve just over the byssal notch. A stainless steel pin is inserted through a serially numbered Petersen disc then through the folded over end of an 8-inch length of yellow vinyl tape (to aid visibility), pushed through the hole and bent over inside the shell to hold it in place.

A modified drill press with a jig to hold the scallop is used in this method of tagging.

Due to an intensive public relations program, and the fact that scallop tagging is not done by any other laboratory, no message disc was required.

Evaluation of Petersen Disc Tag

Effect on fish

With care, the fish is not mutilated in attaching the tag to the fish. There is a tendency for irritation leading to infection to occur under the discs if the tag is attached to tightly to the fish, or when the fish grows considerably after the tag is attached. Irritation will also develop if the tag is too loosely attached, due to movement and vibration of the tag.

Visibility

The tag is quite easily seen when handling the fish, especially with dorsum or nape attachment.

Durability

The tags and attachments are completely durable in sea water.

Permanence

The tag has reasonable permanence (especially with dorsum or nape attachment). Petersen discs (with operculum attachment) on fish which may grow considerably can become embedded and overgrown with tissue to the point that they may not be seen at all. When the discs are attached too tightly, this has been observed to take place in tank experiments in a surprisingly short period. Comparing the operculum and dorsum or nape placement of these tags it may be seen that the latter two methods are preferable. The dorsum and nape attachment adapt to growth. The pin or wire will bend to accommodate the increase in girth, the discs on each side of the fish gradually turning upward, reducing the tendency to develop irritation under the discs due to restricting growth.

Speed

Since five separate and rather slow manual operations are involved, this tag cannot be attached as rapidly as the other types.

Internal Anchor Tag

The capsule component of this combination tag was obtained from Norway, where it was developed as the Lea hydrostatic tag and used extensively with a dorsum attachment consisting of a stainless steel wire bridle secured to a stainless steel pin, with the hydrostatic tag trailing just above the fish.

In a double message tag developed at Woods Hole, the hydrostatic capsule served as the external portion and was fastened with a fine monel chain to an internal anchor consisting of a plastic strip bearing a duplicate number and a short message. According to tank observations, the flexibility of the connecting chain allowed the incision for the internal tag to heal within 3 to 5 weeks after tagging.

More of these tags would have been used, but the laboratory in Norway which produced them could no longer supply them for export, and the hand crafting involved discouraged production in this country.

A manufacturer is presently developing for this laboratory two simplified hydrostatic long message tags with a variety of attachments.

Specifications

This combination internal and hydrostatic tag is composed on an internal tab 1-3/4 inches x 7/16 inches, rounded at the ends, with a center hole 1/8 inches in diameter, made of cellulose acetate, and connected to it by a short chain a capsule (or hydrostatic tag) of the following description: The capsule is cylindrical in form of hard case plastic, hollow, transparent, 1-3/16 inches long x 1/8 inches in diameter, flattened slightly and drilled with a 1/8 inch hole for attachment at the leading end and tapered to a round point at the trailing end. It contains a tightly rolled paper message of 50 to 70 words, showing through the transparent capsule wall (when rolled and inserted) the serial number and instruction to "Cut open and read". This capsule, or hydrostatic tag is approximately of neutral buoyancy, and pressure-proof to 1,000 ft. of depth. The internal tab and the hydrostatic tag are connected by a 1-1/4 inch length of monel metal chain to monel metal jump rings in the holes of each unit.

Attachment

A vertical incision in the wall of the abdominal cavity the width of the internal tag is made with a surgical scalpel having a blade curved in a hook shape. One end of the internal tag (or tab) is inserted in the incision parallel with the length of the fish, the other end bent and similarly inserted so that the tab lies inside the abdominal wall, the chain and hydrostatic capsule hanging outside, trailing.

Evaluation of Internal Anchor Tag

Effect on fish

The species tagged are not adversely affected by this incision method of attaching the tag, based on tank observations over a period of nine months, and on the percentage of tags returned.

Visibility

The external capsule is fairly easy to see, and the internal tab may eventually be seen, should the external part become separated.

Durability

The materials which make up this combination tag are in themselves durable in salt water, as well as within the body cavity.

Permanence

The effect of friction on the chain causes the links nearest to the outside wall of the fish to wear thin and part in about three and one half years. While the permanence of the external part of this tag is limited to the life of the chain, the internal part, although less likely to be discovered, is permanent in terms of the life of the fish.

Speed

The incision can be made and the tab inserted very rapidly. With only two simple manual operations involved, three fish can be tagged with the internal anchor tag in the time required to tag one fish with Petersen Disc Tags.

Spaghetti Tag

This tag was first used on the west coast, especially in the tagging of tuna. It can be stored and handled easily in spools of 1,000 units, and does not require a separate attachment.

Specifications

Vinyl plastic tubing, soft, flexible - - it has an over-all diameter of .098 inches and the units measure 14 inches in length. The inside diameter is .066 inches, and the wall thickness is .016 inches. The tags are delivered on spools of 1,000 units printed on one continuous length of tubing scored for cutting in 14 inch units, each unit showing the letter designation, serial number, and the message "Reward - - return to U.S. Fisheries, Woods Hole, Mass." The serial number and message are impressed into the material by a combination of heat, pressure and a chemically penetrating ink, after which the printing is coated with a silicone spray.

Also

Same in 12 inch lengths (over-all diameter of .074 inches, inside deameter .042 inches, wall thickness, .016 inches).

Attachment

The tags are passed through the dorsum with a stainless steel needle of the following description: For the 14 inch tag --stainless steel needle, 6-5/8 inches in overall length, the fore part .100 inches in diameter and tapered to a sharp point, the after part (2-7/8 inches long) being reduced in diameter to make an easy fit when inserted in the tubing. The after part or shank of the needle, is inserted in the tubing as far as the shoulder, the point of the needle is then pushed through the dorsum, drawing the tag through. The two ends of the tag (evenly distributed on each side of the fish) are brought over the back and tied in a loop with an overhand knot.

For the 12-inch tag of small diameter, the attachment is made in the same manner with a similar needle of smaller size.

Evaluation of Spaghetti Tag

Effect on fish

The passage made by the needle begins to develop a covering tissue similar to the skin of the fish, soon after the tagging operation. This area is nearly always found in a healthy condition when returned tagged fish are examined. Irritation has been found in less than 5% of fish returned with tags intact, and no infection has been found.

Visibility

This tag has a higher degree of visibility than the other types used by this lab.

Durability

The tag has proven durable in sea water with one minor limitation. The portion of the tag which passes through the body of the fish occasionally becomes blackened, or stained due to exposure to body acids. Relocating the printed message and serial number on the tag (when the units are spaced for cutting from the spool) can overcome this disadvantage by positioning the printed part outside the body of the fish.

Permanence

This tag is completely permanent from the point of view of remaining intact on the fish, as well as allowing for maximum growth of the fish -- due to the flexibility of the material and the length allowed for the loop.

Speed

The tag can be attached quite rapidly, three manual operations being involved. This tag can be attached to the fish at a rate of somewhat better than two to one, as compared to the Petersen Disc Tags.

Atkins-Spaghetti Tag

The Atkins tag has been in use for a long time in various sizes, where a single trailing tag was required. Vinyl plastic tubing as an attachment is firm enough to restrict motion of the tag, and to hold the tag away from the body of the fish.

Specifications

Used singly, an oblong tab with rounded ends, it is marked on both sides, and produced in two colors -- red, and yellow. Length is 7/8 inches, width 5/16 inches, finished thickness 25/1000 inches, with a hole 1/16 inches in diameter punched 1/8 inch from one end. A transparent layer of plastic is laminated to each side to protect the printing. The tag shows on one side "Reward" and letter and serial number--and on the other side "Mail at once to USFWS, Woods Hole, Mass."

Attachment

Vinyl tubing (spaghetti) .066 outside diameter is cut and tied through the hole at the end of the Atkins tag in varying lengths, according to the species being tagged, and the method of attachment. A stainless steel needle is used, 4-1/2 inches in length, and of the same type described for Spaghetti tags. This vinyl tubing attachment is drawn through the dorsum with the needle, as described with the Spaghetti tag.

Three methods of securing the attachment were used:

1. The terminal end was tied in a single figure eight knot on one side of the dorsum, the remainder of the attachment and the tag trailing from the other side of the dorsum.

2. The same attachment as #1 was made except that the terminal end was tied in a double figure eight knot.

3. Using a longer length of tubing, the attachment was tied in a loop over the fish, with the tag trailing above.

Evaluation of Atkins-Spaghetti Tag

Effect on fish

While the species tagged showed a somewhat slower rate of healing where the needle passed through the dorsum (three to four weeks) than haddock tagged with the spaghetti tag (two weeks), the tag is considered satisfactory in its effect on the fish.

Visibility

The tag is quite easily seen. Like other dorsum and nape attachments, some part is visible on each side of the fish in comparison with the operculum Petersen disc attachment.

Durability

The tag is completely durable in sea water.

Permanence

Tag return percentages and tank observations have shown a single figure 8 knot has some tendency to pull through the flesh. A double figure eight knot, and more particularly, a loop, will overcome this disadvantage.

Speed

This tag can be attached to the fish fairly rapidly. Three manual operations being required as described for the spaghetti tag.

Dart-Spaghetti Tag

This tag is essentially a spaghetti tag fixed to a barb as an attachment. This type of tag (in larger dimension) has been used on tuna and other species requiring a tag which can be quickly attached.

Specifications

Vinyl plastic tubing, soft, flexible--it has an over-all diameter of .074 inches, inside diameter of .042 inches, wall thickness of .016, and a length of 3-1/2 inches. The letter designation, serial number, and message--"Rwd. USFWS Woods Hole, Mass." --are impressed into the material by a combination of heat, pressure, and penetrating ink. The printing is then coated with silicone spray. A semi-flexible nylon double-barbed dart, overall length 1-1/8 inches, shank length 1 inch, and width between tips of barbs 5/16 inches -- is inserted in the end of the tubing.

Attachment

Two methods of attachment are used, as follows:

1. Perforation Method. A stainless steel needle (as described for use with the Atkins-spaghetti tag) is used as an instrument for perforating the scales and skin of the dorsal area just below the dorsal fin. The dart is inserted in this perforation and forced inward until the barbs of the dart are secured in flesh or skeletal structure, the spaghetti component trailing.

2. Notched Tool Method. A stainless steel tube of an inside diameter large enough to contain the vinyl tubing (spaghetti) of the tag is made into a tagging tool in the following manner: A length of four inches of the stainless steel tubing, open at each end, is bisected at the forward end with a notch 3/16 of an inch deep. Each side of the notch is then shaped into a point and made as sharp as possible. The tag is inserted in the notched end of the tool until the barbs of the dart are lodged in the notch, the point of the dart being flush with the tips of the tool. The tag is attached to the fish just below the dorsal fin by inserting the tool (with the tag in place as described) until the projecting ends of the barbs are secured in the fish. The tool is then withdrawn, leaving the tag attached.

Evaluation of Dart-Spaghetti Tag

Effect on fish

The dart-spaghetti tag was unsuccessful when attached to scup by the Notched Tool Method. After a tagging program yielded very few returns, the reason for the failure was disclosed in the results of a tank experiment. Due to the mutilating effect of the tool when penetrating the large thick scales of the scup, infection occurred almost invariably resulting in the tag eventually separating from the fish.

This tag was used successfully on redfish employing the Perforation Method of attachment. The fish appeared to be unaffected by the presence of the tag, and there was no evidence that growth rate was influenced. In earlier taggings, the growth rate of redfish had been greatly diminished when Petersen discs were pinned through the opercle.

Visibility

The tag has a fair degree of visibility. Although the tag is attached on one side of the dorsum, it extends above the back of the fish.

Durability

The tag (both nylon dart and spaghetti component) have proven durable in sea water.

Permanence

When attached by the PERFORATION METHOD, the tag has proven permanent in its attachment to the fish, as well as in allowing for growth of the fish.

Attachment Materials

For Petersen Disc

Pins (nails), stainless steel, Formula 18-8, flat head, 1-1/2 inches in length x .035 inches in diameter, shipped in bulk.

Wire, of stainless steel, Formula 18-8, .035 inches in diameter, delivered on spools.

For Atkins

Monofilament nylon, translucent, .0093 inches in diameter, delivered on spools.

Note:

A substantial number of whiting were tagged through the dorsum with Atkins tags using this fine gauge attachment, and as results were very disappointing, it was not used again. It was assumed that the fine gauge of nylon monofilament attachment cut through the dorsum. Also, the material was almost transparent, lacking visibility.

Vinyl plastic tubing, .066 inches outside diameter, delivered on spools-used in various lengths according to the method of attaching to the fish.

General Comments

Aboard the commercial fishing vessels, certain groundfish species are ripped and gutted (cleaned) before being washed and stored in the hold. The fishermen carrying out this operation, reach into the piles of fish and grasp the fish by the head and hold them upside-down in a horizontal position for the cutting and cleaning operation. This position of the fish makes it difficult for the fisherman to see tags attached to either the operculum or the dorsal area.

During the period covered by this questionnaire, experience of this tagging unit has pointed out that the use of vinyl tubing, either as a tag or an attachment has increased visibility considerably, based on the comparative percentages of returned tags, as well as comments from those who found the tags.

The potential effectiveness and efficiency of dart type tags warrant further development of methods of attachment and general use of this type of tag. Experience of other laboratories making use of this type of tag indicates that a single barb dart is more effective than the double barb, as it tends to curve in direction as it makes an entrance in the flesh, and becomes seated in a position at right angles to the surface it has penetrated, making a more secure attachment.

A long message tag (capable of carrying fifty or more words) while being a practical tag in all respects, and small enough to avoid encumbering the fish--could be a valuable contribution to successful tagging operations--where technical information may be required with the return, or to secure more complete information with the returned tag by including detailed instruction in the tag itself.

Marine growths (bryozoans, polyps, barnacles, tubeworms) have been seen occasionally on all types of tags returned to this laboratory. The extent to which this growth occurs is not known, as those who discover tags usually clean them well before returning them.

Redfish tagged with Petersen disc and dart-spaghetti tags in an area of the harbor at Eastport, Maine, show marine growth in varying degrees on approximately twenty percent of the fish recaptured by our own biologists.