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Some techniques and procedures used to tag herring in ICNAF Subarea 4.

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Tagging studies have received relatively little emphasis in Northwest Atlantic herring *(Clupea harengus harengus* L.*)* investigations largely due to the long-standing opinions of many researchers that: 1) herring are too delicate and descale too easily to withstand the tagging operation; 2) their flesh is too soft to retain tags for an appreciable period; 3) the volume of catches makes prohibitive the number which must be tagged to ensure valid results; and 4) the methods of mass handling the catch make the detection of recaptured tagged fish difficult.

Although some of the reservations have some validity, European investigators have been successfully tagging *Clupea harengus harengus* with a variety of tags since the second world war (Parrish and McPherson 1963).

In North America, internal tags have been successfully used to follow movements of the Pacific herring *Clupea harengus pallasii* (Dahlgren 1936; Stevenson 1955) since the 1930's, and Beckett (MS 1971) and Winters (MS 1970, MS 1975) have successfully used the internal tag method on *Clupea harengus harengus* in the Gulf of St. Lawrence.

The identification and delimitation of stocks still remains as one of the most important problems in management of the Northwest Atlantic herring fisheries. In an attempt to resolve some stock interrelationships, tagging studies were conducted in 1973 and 1974 in the Bay of Fundy using external tags, rapidly applied by means of cartridge-fed tagging guns, as described by Dell (1968). The usefulness of these tags in discerning move-

ments and migrations of herring, and also mackerel, have been aptly documented (Moores et al., 1975; Stobo et al., 1975; Stobo, 1976 a, b). The purpose of this paper is to outline the techniques currently being employed to tag herring with these external tags by St. Andrews Biological Station personnel.

Catching and holding fish

The most inexpensive way that we use to tag fish is to purchase them from a herring weir (Fig. 1) or trap. Both these are inshore gears usually fixed in a single position for the fishing season. During the normal commercial hauling procedure, 2500-3500 fish are transferred by small dipnet into a free flooding barge (Fig. 2); the barge is subsequently towed offshore and the enclosed fish dip-netted in small numbers, tagged and released.

The use of commercial purse seine boats is necessary to tag fish in offshore locations. Normally we charter a purse seiner, which then searches for and catches fish in designated areas. Once 4-5 tons of fish are captured by the purse seine, the net is partially hauled (Fig. 3); the portion of the purse seine still in the water forms a large bag which holds the fish throughout the tagging operation. The tagging skiff is then attached to the float line of the purse seine and tagging commences. During the actual tagging operation, the purse seiner essentially drifts (the power skiff keeps the purse seiner from drifting over the purse seine) and periodically hauls in more of the purse seine in order to keep the fish remaining in the purse seine accessible to the dip nets used by the tagging crews. Fish have been held in the purse seine in this manner for periods of 6 hours; containment for periods longer than this would probably result in progressively higher mortalities related to the tagging operation.

Tags and applicator

The anchor tag consists basically of a molded nylon T-bar and shaft to which is glued a length of colored machine-labelled #20 vinyl tubing. Our tagging operations have used two varieties of this tag, the FD-67 and FD-68B Anchor tags[1] (Fig. 4). The FD-67 tag has a relatively short nylon shaft with a length of vinyl tubing slipped over, and glued to the terminal 5 mm of the shaft. The FD-68B has the nylon shaft running the full length of the vinyl tubing with a ball of nylon at the terminal end; the tubing is also glued to the shaft. The FD-68B tag is thus much less liable to lose the vinyl tubing, but it

[1] Tags and applicator tool were obtained from the Floy Tag Manufacturing Company, 2909 Northeast Blakey, Seattle, Washington, USA 98105.

is also much less flexible than the FD-67 tag.

The length of both the shaft and vinyl tubing can be specified when ordered from the manufacturer. The tags are available in several colors and are manufactured in cartridges of 25 tags (Fig. 5). In each cartridge, the tags are attached in a row on a nylon mounting strip which is part of the original molding.

The tagging gun (Fig. 5) is constructed of plastic, steel and aluminum parts. When the lever handle is squeezed, a piston is forced through the hollow slotted needle. With a cartridge of tags inserted into the top of the tagging gun, the action of the piston will shear a tag from the cartridge strip and propel the T-bar portion into and through the needle. The shaft of the tag slides through the slot in the needle. When the handle is released, it returns to its original position, thereby withdrawing the piston and advancing the cartridge so that the applicator is ready to insert the next tag. Although the needle occasionally becomes clogged with debris, it can be replaced without the use of tools.

Tagging procedure

The optimal size of a tagging team was four persons - one using the tagging gun, two holding fish, and one to dip-net the fish (see Fig. 2) - and a team this size could tag approximately 500 fish per hour. No anaesthetic or disinfectant was used and no special procedures employed to minimize scale loss. As many as 8 fish were dip-netted at a time and held out of the water while individual fish were grabbed, tagged and tossed overboard. All of the fish lost some scales in the process, but those which were seriously descaled were discarded.

The tagging procedure is shown in Fig. 6. Each fish was held firmly with one hand being anterior and the other posterior to the dorsal fin. The fish remained completely immobile only when held this way; experience showed that this handling method minimized the size of the tagging wound and scale loss.

The tags were inserted near the base of the dorsal fin with the intent to introduce the tag diagonally between the interneural bones. This procedure should ensure good retention with the T-bar anchoring on the interneurals, and cause minimal additional water resistance since the external portion of the tag extends posteriorly. The rapidity of tagging, however, resulted in many tags being inserted only into the dorsal musculature.

Potential effect of tags

The tags did cause wounds to develop around the point of insertion in many of the fish. These wounds were apparent within ten days of tagging (Fig. 7), but there were no signs of

infection and it appeared that healing had commenced in some cases. Similar wounds were also present on fish recaptured 9-19 months later (Fig. 8); in some cases the size of the wounds were slightly larger than observed shortly after tagging, in others almost completely healed. The apparent condition of none of the fish, however, appeared to have suffered from the presence of the tags.

The development of tagging wounds, therefore, is not necessarily time related since fish recaptured 9-19 months after tagging did not have significantly larger wounds than those recaptured within 10 days of tagging. Furthermore, the presence and apparent persistence of such wounds over this period, coupled with an absence of any indication of infection, suggests that there was no substantial mortality directly due to the wounds. It is also worth noting that this development and persistence of tagging wounds is not restricted to relatively soft-bodied fish such as herring. Stobo (1972) reported essentially similar results for yellow perch, *Perca flavescens*, and Carlson (personal communication) has observed such wounds during homing studies of yellowtail rockfish, *Sebastes flavidus*,

There appeared to be no particular method of inserting the tag to prevent wound formation. In some cases in which the T-bar was held only in the dorsal musculature, or had partially emerged through the skin, only a small wound resulted. In other cases in which the angle and placement would appear to be correct, both small and relatively large wounds occurred.

Removal of the flesh overlying the T-bar anchor revealed no obvious reason for the size of the wound. Some anchors rested against the interneurals, others down on the side of the fish against the ribs, and still others encased in the dorsal musculature. No hemorrhaging was apparent in any of the dissected fish. In a few cases, a small cavity was apparent in the musculature around the T-bar and these tags were associated with larger more ragged wounds, although the difference was marginal. It would thus appear that the logistics of applying the tag are not of critical importance since the specimens recaptured after more than 9 months at liberty showed no obvious relationship between large wounds and anchor location.

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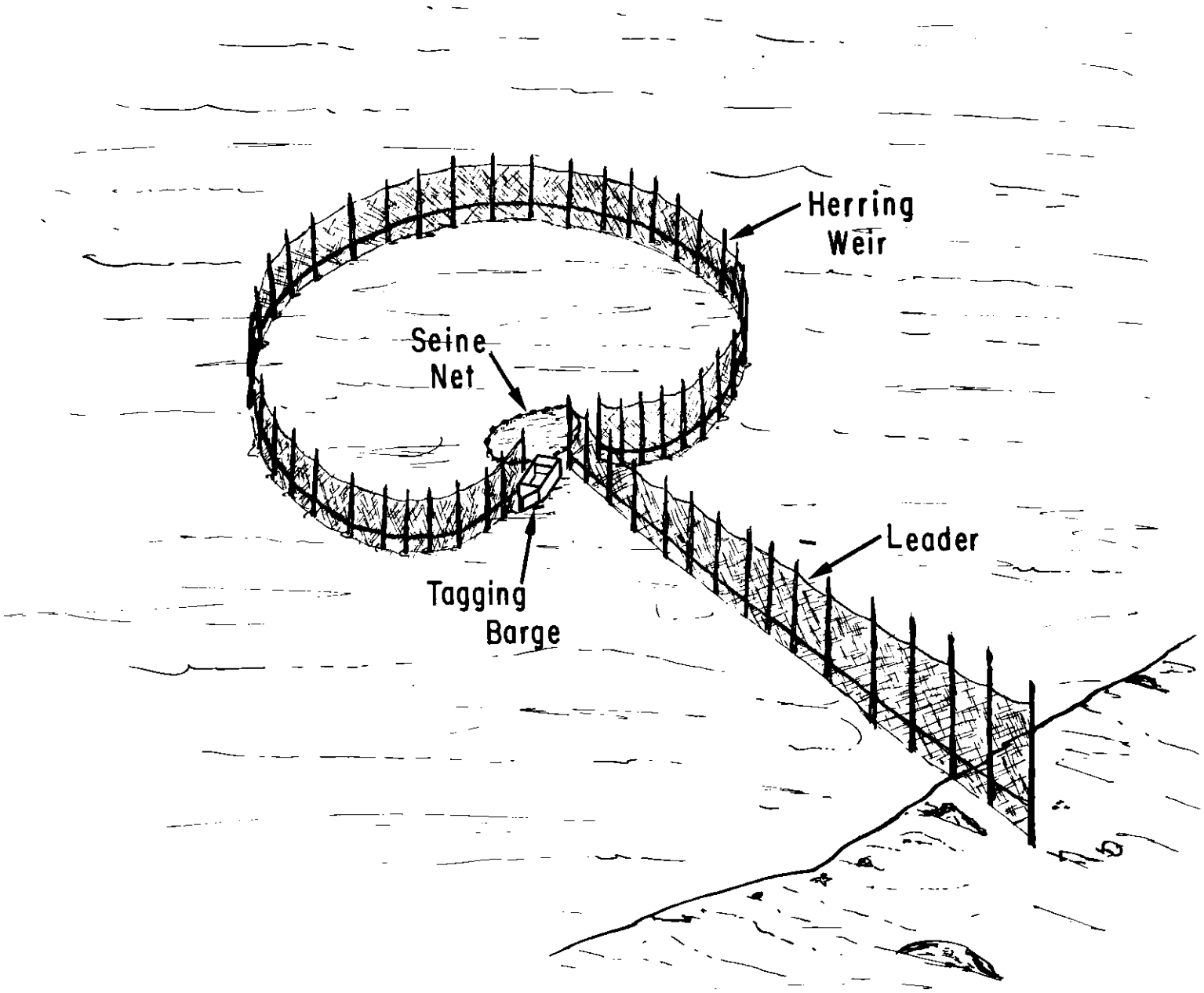
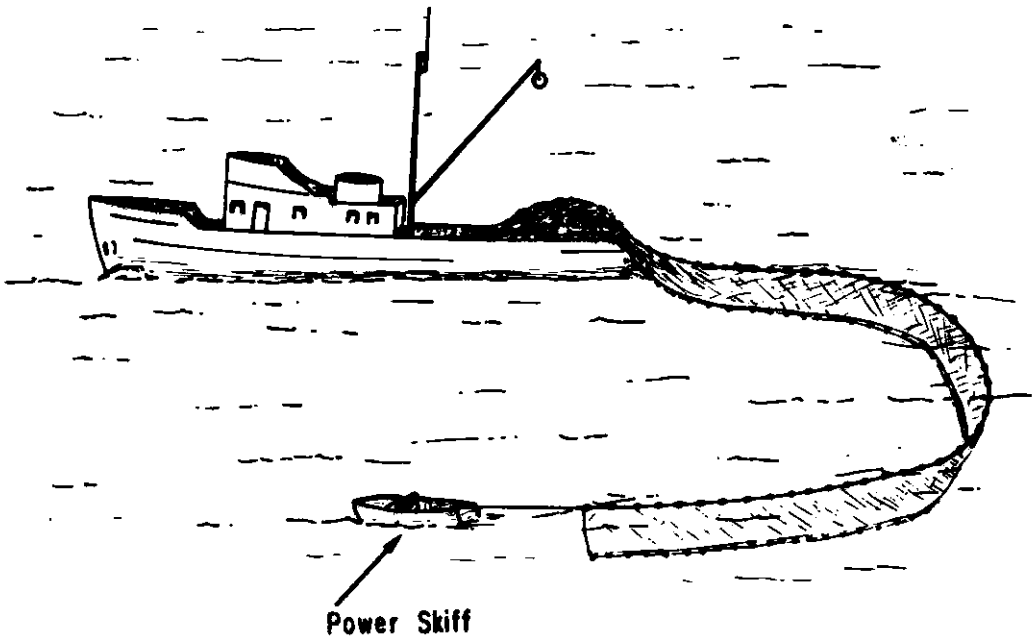


Fig. 1. Typical herring weir in which the trapped herring have been seined prepatory to pumping into a commercial carrier. The tagging barge is positioned in the mouth of the weir. After 2500-3500 fish are dip-netted into the barge, it will be towed offshore for the actual tagging.

Fig. 2. A 4-man team tagging herring in a free-flooding barge. The depth of water in the barge is about 50 cm. Note the herring swimming in the barge.



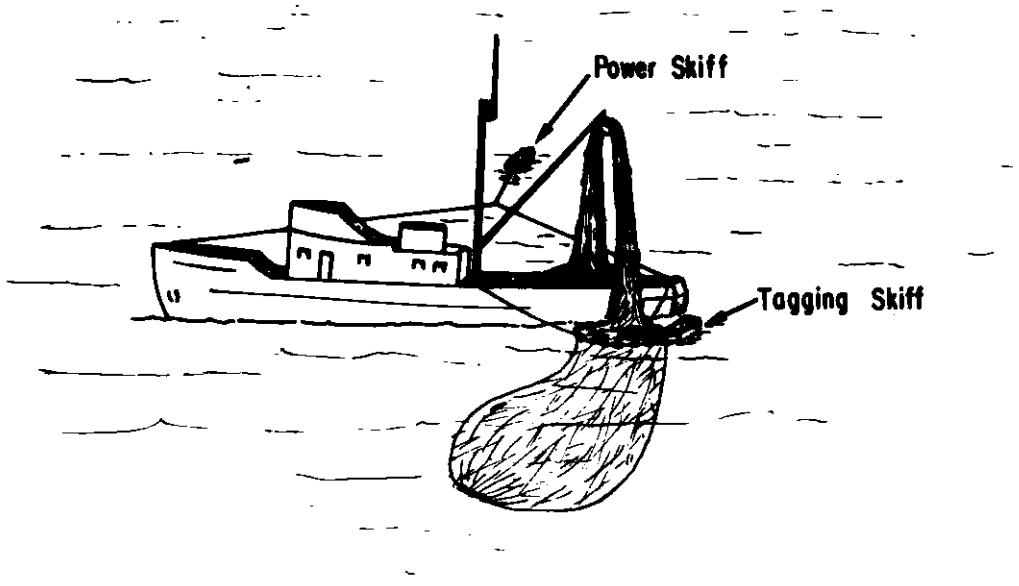


Fig. 3. Purse seine boat setting its seine in the normal manner and subsequently when the tagging operation is underway. The power skiff hauls the seiner off the partially deployed seine if necessary.

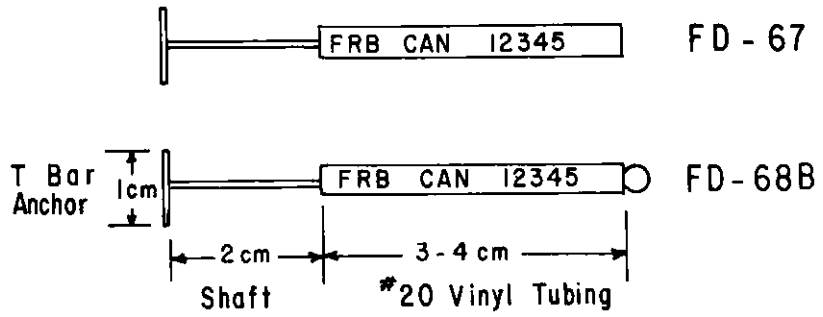


Fig. 4. Two types of anchor tags currently being used to tag herring.

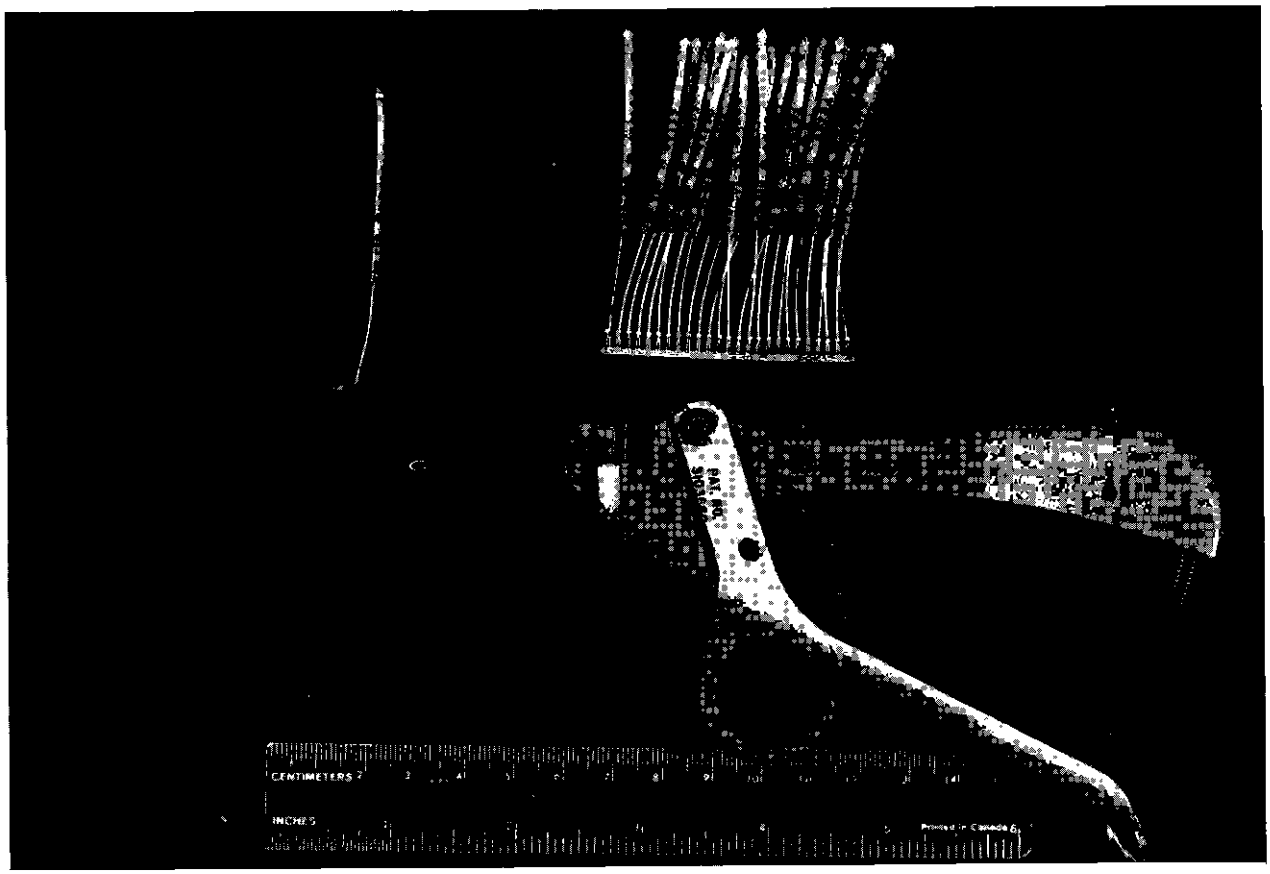


Fig. 5. Tagging gun and cartridge of FD-68B tags. A single tag is also shown. The cartridge fits into the gun just posterior to the hollow slotted needle (see Fig. 6).

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Fig. 6. Tagging procedure for herring: A. The needle is positioned diagonally below dorsal fin. B. Needle is inserted through flesh and interneurals and tag is pushed through the needle into the fish. C. Needle is withdrawn leaving the positioned tag.

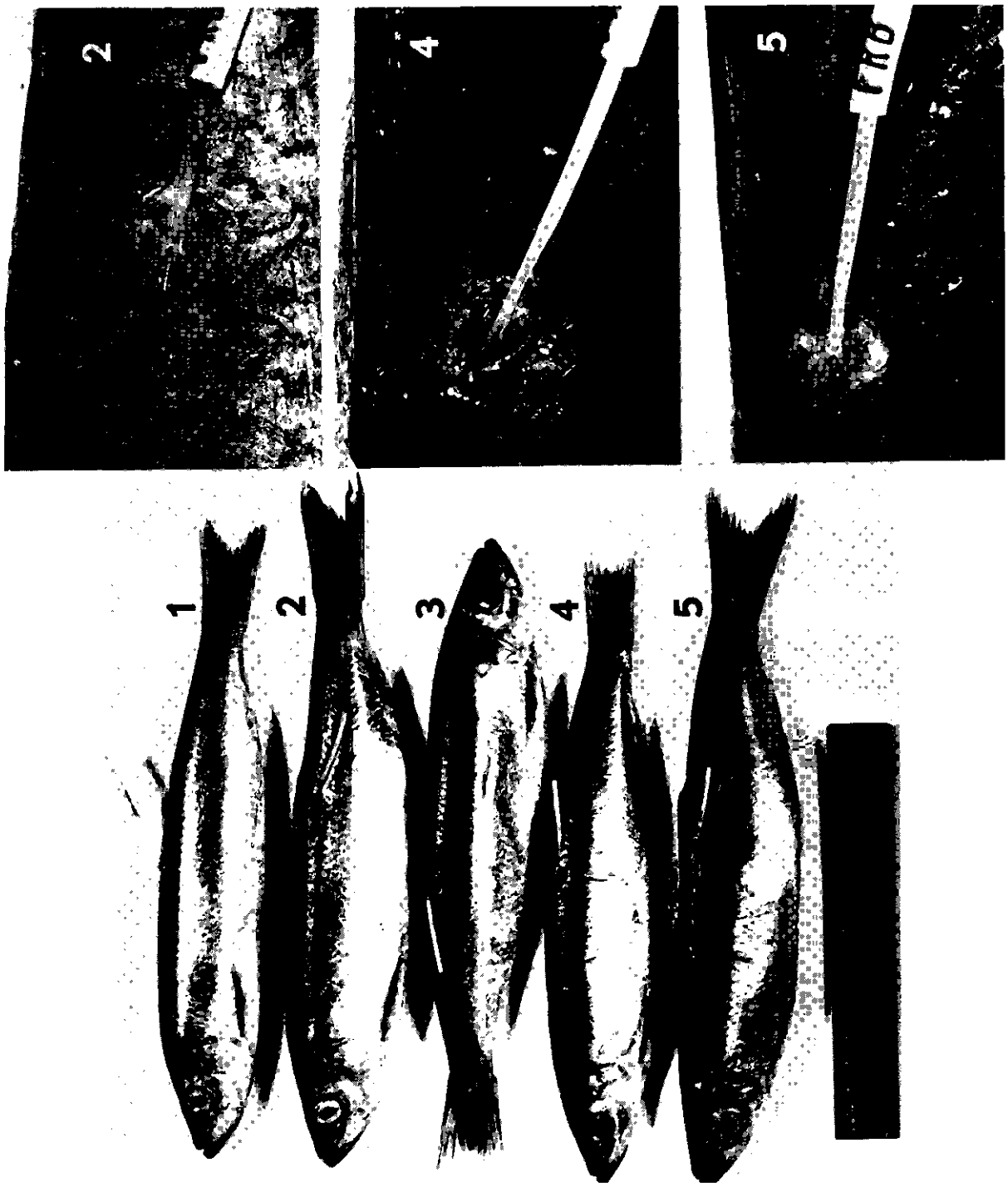

Fig. 7. Herring (length 24.3-26.8 cm TL) tagged on June 24, 1974 and recaptured on July 3, 1974 with close-ups of fish nos. 2, 4 and 5. Each fish exhibited a small tagging wound, the largest being 0.9 cm long.

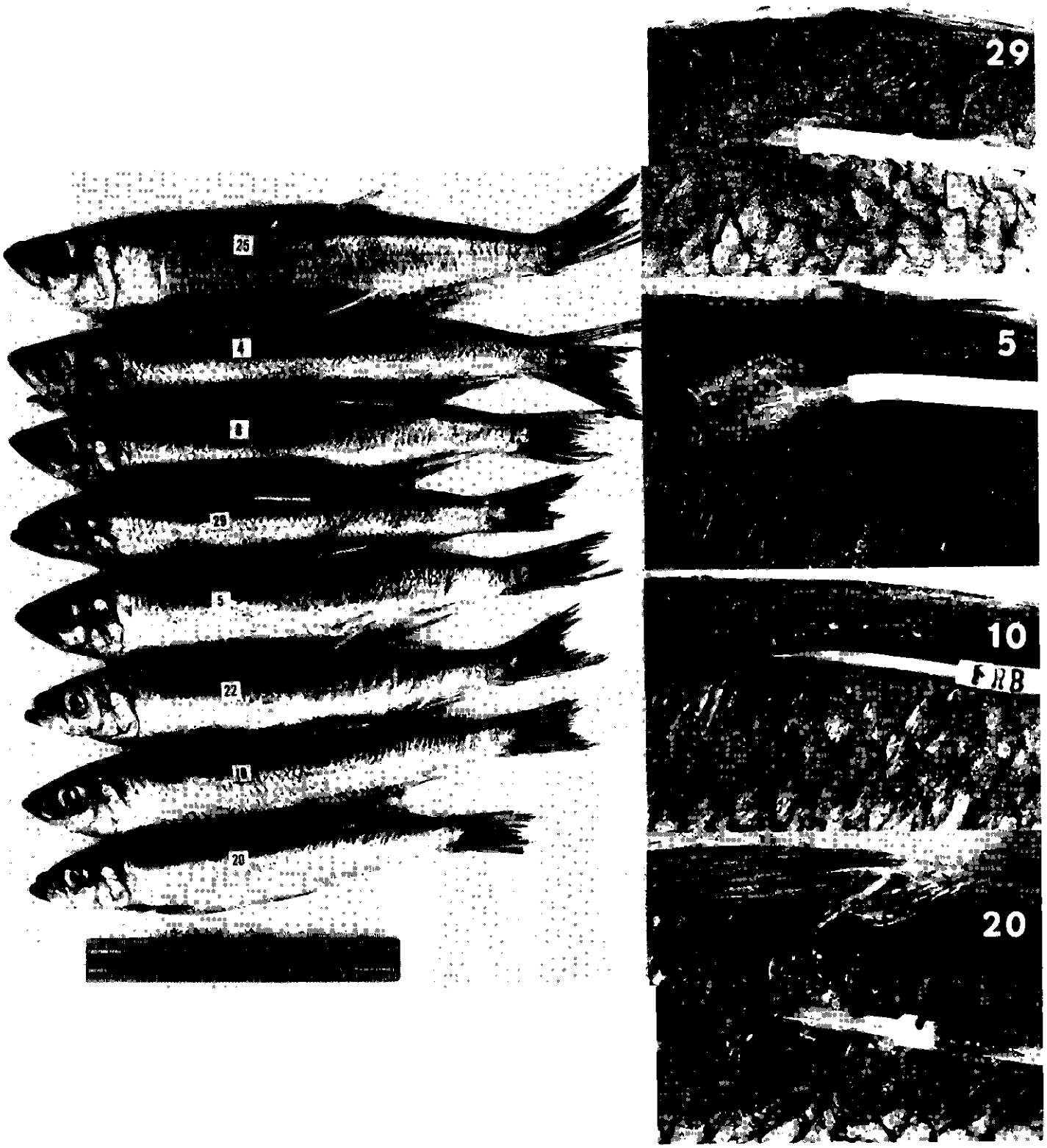

Fig. 8. Tagged herring (length 25.3-32.6 cm TL) which had been at liberty for over 9 mo with close-ups of fish nos. 5, 10, 20 and 29. The largest wounds were about 1.0 cm in length.