INTERNATIONAL COUNCIL FOR THE
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Pelagic Fish Committee

EXPERIMENTS ON THE DETECTION OF MAGNETIC WIRE TAGS IN HERRING CATHES AT SEA

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Introduction

At the 1978 ICES Statutoty Meeting a resolution was adopted which called for the planning of a major ICES herring tagging experiment in the northwestern North Sea and the waters west of Scotland (C.Res.1978/2:15). Following this resolution a planning group was established which considered various methods for tagging herring, and which finally came up with a proposal for the use of magnetic codend wire tags (Convenor's report of the ICES planning group on a herring tagging experiment, undated). These tags are several orders of magnitude smaller than the conventional internal tags that have been used previously on North Sea herring, and the presence of the tag itself is very unlikely to affect the survival of the fish.

At the Statutory Meeting in 1979, however, most delegates felt that not enough was known about the new tagging method, and it was decided that first some experiments should be conducted to test the feasibility of this method, before further plans could be made for a full-scale experiment. Two main areas of doubt were the reliability of the detection equipment when used on board vessels at sea, and the maximum screening capacity of the detector. If the equipment was to be used on board commercial fishing vessels (as was envisaged in the Convenor's report), then the screening of fish should not present too much of a bottleneck for the normal fishing and processing operations on board.

In view of these questions, the IJmuiden Laboratory decided to conduct some preliminary experiments with the detection equipment on board a vessel at sea during the summer of 1980.
Contact was sought with one of the main producers of magnetic codend wire tags at this moment, and the company was invited to demonstrate their equipment on board RV "Tridens" during a cruise in the North Sea in July 1980.

Material and methods

Tagging equipment and a prototype detector were supplied by Northwestern Marine Technology (Shaw Island, Washington 98286, U.S.A.).

The tags used were 0.25 mm in diameter and 1.07 mm long. They each carried a binary code, which was etched in four longitudial rows along their sides. Figure 1 gives an impression of the dimensions and appearance of the tags. The tags were injected into the fish by the NMT-standard tag injector. After implantation, the tags were magnetised by holding a strong magnet for one second against the skin of the fish.

Since the experiment was designed primarily to test the detection equipment, little attention was paid to the tagging procedure itself. Dead herrings were taken from a trawl catch, and the tags were injected into the geniohyoideus muscle in the lower jaw (figure 2). This position was chosen because it had been used in earlier experiments with Alaskan herring (Convenor's report). In fact, the geniohyoideus muscle may not be the best possible position to tag life herring. As is shown in figure 2, the muscle is normally covered by the gill covers, and it can only be exposed by bending the gill covers outward; a procedure which may not be completely harmless to the fish. A better position would probably be the dorsal musculature just behind the skull. For reliable tagging in this position, the tag injector should be slightly modified to enable tags to be inserted approximately in the longitudinal direction of the fish.

As the experiment was carried out during the acoustic survey for herring in the North Sea, freshly caught herrings were readily available from experimental fishing hauls. The herrings used were caught approximately 20 miles southeast of Shetland, and the fish had a length range of 28-33 cm.

NMT also supplied a prototype detection tube of 140 cm length, 15 cm inner diameter, and 19 cm outer diameter. This tube contained a number of passive electrical coils, shielded against magnetic disturbances from outside. Inside the coils a minute voltage was generated by the passage of the magnetic tag. This voltage (in the order of 1 micro-volt) was detected and converted into an audible signal.

The detector was positioned at an angle of approximately 30 degrees with the horizontal level, in order to allow fish to pass through it at a reasonable speed (at least 30 cm/sec).

In the first trials, herrings were fed into the detector tube by means of a small conveyor belt, which received the fish from the main conveyor line on board. After it appeared that the conveyor line was in fact the limiting factor as regards throughput of fish, the maximum screening capacity was estimated by emptying baskets of fish directly into the detector tube. A plastic funnel was attached to the entrance of the tube, and a jet of water was directed continuously at this funnel in order to faciliate the passage of fish through the tube.

Results

a. Reliability of the detector

19 Tagged fish were slipped in among a catch of several hunderd kilograms of herring, and the fish were fed into the detector tube by means of the small conveyor belt.

All tagged fish were registrered by the system, whereas no false alarm was produced during this test.

Next, 100 kgs of herring were divided among 6 baskets, and one tagged herring was added to one of the baskets. The baskets were then emptied as fast as possible into the detector tube. This experiment was repeated several times. Each time, the tagged fish was registrered by the system without failure, whereas no false alarm was produced on the passage of the other fish.

Of course the present detector could not separate the tagged fish from the flow of fish that passed through the tube. When an audible signal was produced, this meant that there had been a tagged fish among the ones that had just passed through the detector. The tagged fish could then be singled out by taking the last batch of fish which had been screened, and dropping these one by one through the detector.

The only occasion when the detector produced a false alarm (not during the course of an experiment) was when a strong magnetic object was brought in the near vicinity (less than 20 cm) of the detector tube.

According to the manufacturer, the tag has to pass through the detector approximately lengthwise. If the tag has an inclination of more than 45° in relation to the longitudinal axis of the tube, the detection is suspected to become less reliable. In practice, the orientation of the tag appeared to present no problems. The tags used in the above experiments were implanted at an angle of approximately 30°, and they were all registrered satisfactorily. No detailed tests were conducted to determine the critical angle of the tags, but it should be mentioned that even a tag which was implanted deliberately at an angle of 90° was still registrered by the system.

b. Maximum screening rate of the detector

When the small conveyor belt was used to feed herring into the detector, the average throughput of fish was 70 kgs/minute (4 tonnes/hour). It was obvious, however, that the conveyor line system was the limiting factor as regards the throughput of fish, and that the detector itself would be able to screen herring at a much higher rate. Therefore, the detector was detached from the conveyor line, and the fish were poored into the detector directly from plastic baskets. This increased the screening rate to approximately 200 kgs/minute (12 tonnes/hour).

The above experiments were conducted with freshly caught herring, and it was suspected that the maximum throughput of fish would decrease after the fish had been on board for a few hours, due to the development of rigor mortis. The experiment with the baskets was therefore repeated 4 hours after the fish had been caught and all fish had stiffened, sometimes in a twisted position. It appeared that the average screening rate under these conditions was reduced to 140 kgs/minute (8 tonnes/hour).

It should be noted that the above screening rates are still minimum estimates because some time was lost in putting down empty baskets and taking up full ones. If a special system would be designed to feed the herring continuously into the detector, the screening rate could probably be increased.

Conclusions

The experiments on board RV "Tridens" have shown that the detection of magnetic codend wire tags in herring is very well possible during fishing operations at sea, at least on trawlers which process their catch through some kind of conveyor line system. Although further experiments will be required with specially equipped commercial boats, it is unlikely that major problems will arise concerning the reliability of the detection system.
The maximum throughput of fish with the present detector tube is already approaching the processing capacity of many commercial freezer trawlers. Higher screening rates -if necessary- could be obtained by two detector tubes working parallel to each other.

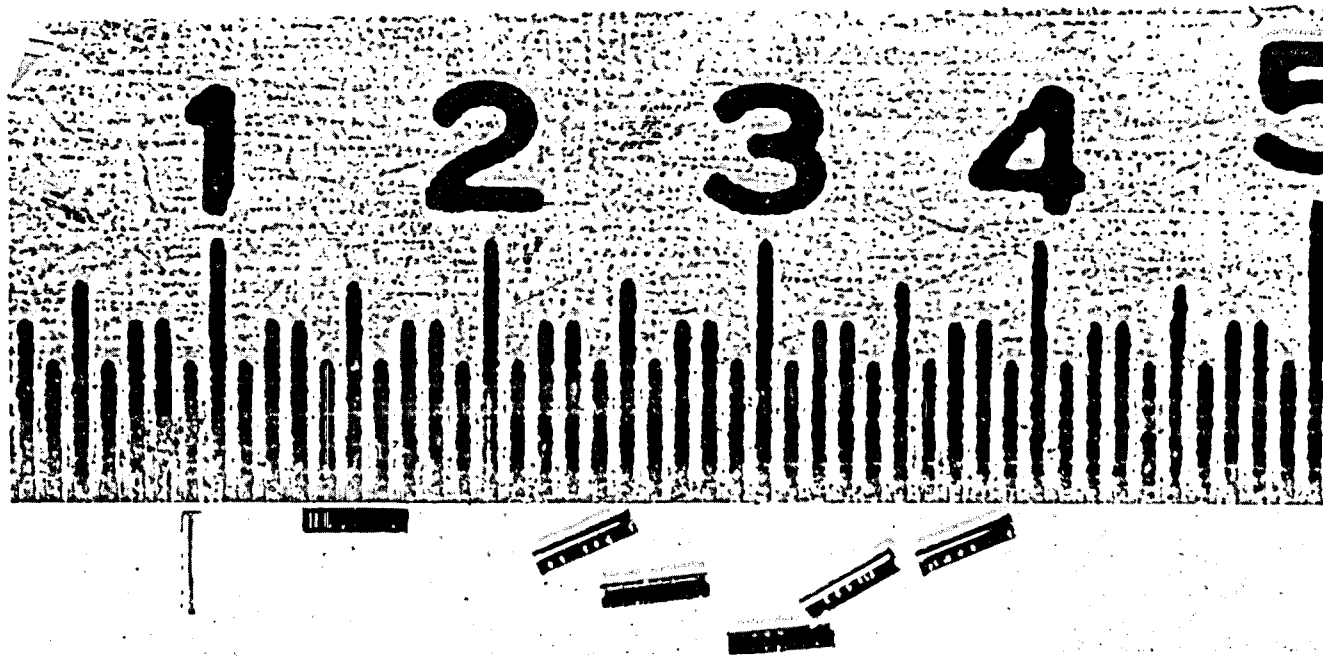

Figure 1. Coded wire tags with binary code etched in longitudinal rows along the side. Scale of the ruler is in 100ths inches.

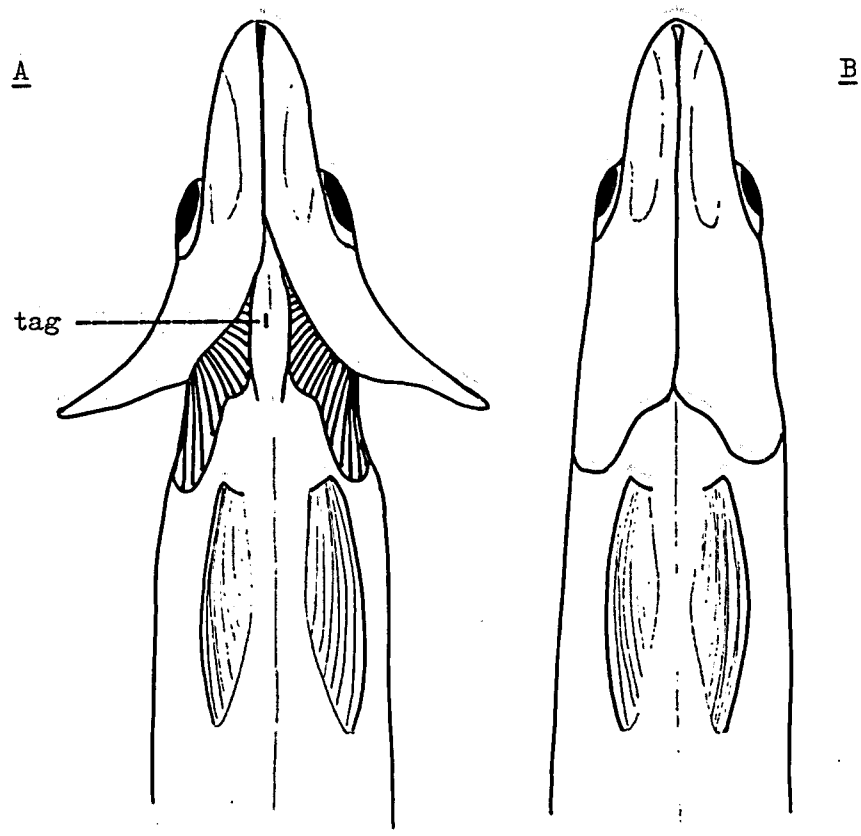

Figure 2. Ventral view of herring with gill covers bended outward, showing position of tag (A) and gill covers in normal position (B). Tag shown is about 2x actual size.