# A note on improving the mechanism of pinger attachment for the Danish North Sea gillnet fishery

FINN LARSEN

*Department of Marine Fisheries, Danish Institute for Fisheries Research, Charlottenlund Castle, DK-2920 Charlottenlund, Denmark*

*Contact e-mail: fl@dfu.min.dk*

ABSTRACT

This paper describes development of a better mechanism for the attachment of pingers to fishing gear, aimed particularly at the Danish bottom-set gillnet fishery. In a cooperative effort involving gillnet fishermen, the fishermen's organisations and researchers, modifications to the physical shape of a pinger and its attachment to the gear were developed, taking into consideration the acoustic functioning of the pinger, battery life, robustness to operational rigours, weight, volume, buoyancy, environmental effects, cost and handling. The suggested attachment (THOR-1) has a number of important advantages in this fishery compared to the more common head rope attachment. THOR-1 was tested for ease of handling on board a gillnet vessel and found to perform very well, with minimal interference with normal fishing operations. The main disadvantage of THOR-1 is the need for an effective range of around 200m.

KEYWORDS: GILLNETS; INCIDENTAL CATCHES; EUROPE; FISHERIES; SMALL CETACEANS; HARBOUR PORPOISE

## INTRODUCTION

Bycatch of small cetaceans is a major problem in a number of gillnet fisheries around the world (see e.g. review in Perrin *et al*., 1994). For the North Sea it was estimated that more than 8,000 harbour porpoises (*Phocoena phocoena*) were bycaught annually in the mid-1990s (Vinther, 1999; Northridge and Hammond, 1999); the need to mitigate this bycatch has been identified by both ASCOBANS and the IWC (IWC, 1996; ASCOBANS, 1997). An experiment conducted in the Gulf of Maine sink gillnet fishery demonstrated that bycatch of harbour porpoises could be reduced significantly by using acoustic alarms (pingers) attached to the nets (Kraus and Brault, 1997; Kraus *et al*., 1997) and it was recommended that pinger experiments should be conducted in other fisheries to further test this mitigation measure (IWC, 1996).

In 1997, a trial was conducted by the Danish Institute for Fisheries Research (DIFRES) in cooperation with a number of Danish fishermen to investigate whether pingers could reduce bycatch of harbour porpoises in the commercial bottom-set gillnet fishery for cod in the North Sea (Larsen, 1999). The results showed that the pingers almost eliminated the incidental catch, but it was also clear from the experience that the mechanism used for attaching the pingers to the fishing gear would present problems during normal fishing operations in the Danish bottom-set gillnet fisheries. This was not unexpected as the pinger attachment mechanism had been designed based on the special requirements of the trial, including the requirement for each vessel to switch between active and control pingers on a daily basis. For this reason, pingers used during the trial were attached to the head rope of the nets with a snap hook on a short strap and a 50mm wide Velcro-strap glued to the mid-part of the pinger and strapped around the head rope. The pingers were attached to the tail-ends, i.e. the bridles used to tie the nets together into strings. The report of the study (Larsen, 1999) recommended that if pingers were to be used in commercial fisheries, pinger housing and attachment to the fishing gear should be designed so that they would interfere as little as possible with the fishing operations.

To ensure a wide acceptance among fishermen it is important that pingers are not seen as an impediment to the efficient conduct of fishing operations. If pingers interfere with the practical operations of the fishing gear, fishermen will be inclined to use them as little as possible. Another important consideration for the fishermen is the cost of using the pingers, which is affected by such factors as battery life and the ability of the pinger to stand up to operational rigours. The IWC Scientific Committee, having agreed that pingers can be an effective mitigation means for harbour porpoise bycatch, recommended that field trials be carried out to address such practical operational issues as mentioned above (IWC, 2000). This point was also made by Northridge *et al*. (1999) in the report of their sea trial of pingers in the Celtic Shelf gillnet fishery.

Most commercially available pingers have been developed with head rope attachment in mind. However, this attachment places considerable constraint on the size and shape of the pinger, which in turn limits the amount of energy that can be included with the pinger. This requires batteries to be changed more often, or limits the pinger's lifetime if batteries cannot be changed. In some fisheries, like the Danish cod gillnet fishery, head rope attachment also puts considerable physical stress on the pinger, e.g. when the pinger hits the railing or steel post (see below) during shooting of the nets and when it goes through the net hauler during retrieval of the nets.

To help resolve these problems, DIFRES initiated a study in 1999 to develop a better mechanism for attachment of pingers to fishing gear, aimed particularly at the Danish bottom-set gillnet fishery. The project was conducted in cooperation with the Danish Fishermen's Association (DFA) and with active fishermen. The results of the study are presented here in the hope that they will be useful for other fisheries as well.

## METHODS

A working group was established including active bottom-set gillnetting fishermen, members of the DFA Gillnet Fishermen's Committee, a representative of the DFA and researchers from DIFRES. The working group was given

the task of developing modifications to the physical shape of the pinger and its attachment to the gear, taking into consideration the acoustic functioning of the pinger, battery life, robustness to operational rigours, weight, volume, buoyancy, environmental effects, cost and handling.

Practical handling trials with models of the suggested designs were subsequently conducted on board a commercial gillnetting vessel. These handling trials were intended to identify immediate problems related to shooting, hauling and storing nets with pinger models attached. Longer term trials with actual prototype pingers are considered the next step in the development process, but are outside the scope of the present project.

## GEAR TYPES AND FISHING PRACTICE

Gillnets in the Danish North Sea cod fishery are normally 1,000 meshes long, typically 21.5-26.5 meshes high and stretched mesh size is 150-170mm. The head rope is 8 or 10mm and 60-70m long giving hanging ratios of around 0.5. In the fishery on wrecks a string is 2-4 nets long and typically 2-4 strings are placed on each wreck, with an anchor at each end of each string. In the fishery on flat bottom/stony grounds, nets are typically tied together into strings of 5 (sometimes 10) nets in length. These strings are equipped with strong snap hooks at the ends to facilitate fast and easy coupling of these small strings into strings 20-60 nets long, depending on whether they are set in parallel rows or, less common, as a single meandering string. When set in parallel rows, the distance between neighbouring rows can be as little as 10m. The strings are kept in place by anchors attached at the end of the strings, and at regular intervals (normally for every 10 nets) along the strings. Buoys mark the end of each string as well as the anchors in between. Fishing depths are typically 20-80m. In the most recent years there has been a tendency towards setting the nets in long meandering lines or circles and using fewer anchors.

Nets are stored on board in large sacks or in small wooden compartments called pounds. The nets are most often shot over the side of the vessel around a steel post on the railing, and at speeds up to 6 knots. The nets are hauled using hydraulic net haulers, of which a variety of different designs are in use. After the catch has been removed, the nets are often run through a machine, which stretches and cleans the nets from seaweed and other items, before placing them back into the pound or sack. Nets can be moved between pounds using small portable net haulers, in some cases through metal tubes from one end of the vessel to the other.

Because of the very short strings used in the Danish wreck fishery, pinger handling is much less of a problem than in the flat bottom fishery. In the wreck fishery, pingers can be attached at each end of a string and still ensonify the whole string as a string is rarely more than 200m long.

In other Danish bottom-set gillnet fisheries (e.g. for hake, plaice and turbot) the mesh size, hanging ratios, height of nets, buoyancy of head ropes and fishing depths vary, but the nets are handled in ways similar to the handling in the cod fishery.

## RESULTS

The pinger development working group considered low interference with net handling, low cost and long lifetime to be the most important criteria for the acceptance of pingers among fishermen. The last two factors are to some degree linked and inversely related, so an acceptable compromise has to be found between them.

The working group evaluated a number of different pinger designs, including two commercially available products, the Dukane Netmark1000 and the Aquatec AQUAmark100, in the light of these criteria. All are designed to be attached to the head rope. The working group did not find head rope attachment an optimal solution; the reasons for this include:

(1) concern over crew safety when nets with pingers attached to the head rope are moved around the vessel using net haulers and when nets are shot over the side at high speed;
(2) concern over pingers button-holing the mesh while the nets are kept in pounds or sacks;
(3) concern over pingers not being able to withstand the repeated hits on the steel post during net shooting;
(4) the need to keep pingers as small as possible, thereby reducing the amount of energy that can be included (and thus lifetime) and reducing the possibilities for protecting the pinger against damage due to physical impacts;
(5) head rope attachment normally requires permanent or semi-permanent attachment, which results in excessive pinger use and waste of pinger energy in fisheries where nets are set close to each other.

There are technical solutions to some of these problems, but these solutions can lead to other problems.

The working group considered alternative ways of attaching the pingers, and suggested one in particular for practical handling tests on board a commercial fishing vessel. This solution, named THOR-1 (see Figs 1 and 2) after the port Thorsminde, where the working group met, takes advantage of the anchors that, in the Danish gillnet fisheries in the North Sea, are placed for every 10 nets along a string, and of the vessel having to slow down to set these anchors. A pinger can be attached to the anchor spring line (the line between the tail-end and the anchor) at the same time as the anchor is set, without delaying the shooting of the nets. The pinger needs to be positively buoyant and attached with a line of 1.5-2m to keep the pinger off the seabed. A snap hook on the pinger line will facilitate fast attachment to the anchor spring line. If the pinger is not positively buoyant on its own, a float can be attached to the pinger line.

### Handling trials

The handling trials were carried out on board a commercial gillnet vessel in the North Sea in October 1999. The vessel was typical for a Danish North Sea gillnet vessel: 19.85GRT, a crew of four, and equipped with a hydraulic net hauler. Weather conditions during the trials were fine with almost clear skies, winds around 8ms$^{-1}$ and waves of 1.5-2m. Two strings of five gillnets each were used, with dimensions as described above for cod fishing.

Dummy pingers machined in solid polyethylene cylinders with rounded edges were used (see Fig. 2). The dimensions of the dummy pingers were: length=180mm; diameter=80mm; rounding=10mm. A 15mm diameter hole was drilled through one end and a 2m length of 10mm polypropylene line was fed through this hole and the ends tied together to form a double string. A heavy snap hook of the same type used by the fishermen to connect strings of nets was tied to the other end of the double string for attachment to the gear. The dummy pingers were positively

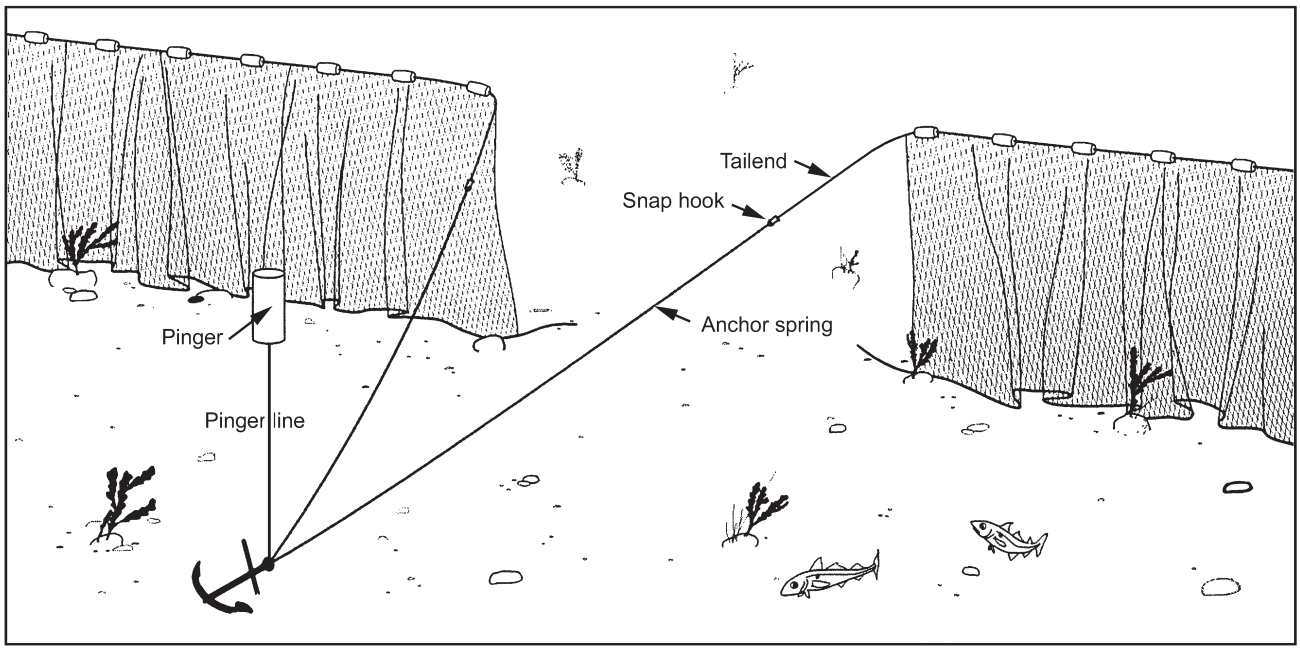


Fig. 1. The attachment of THOR-1 to the anchor spring line on a bottom-set gillnet.

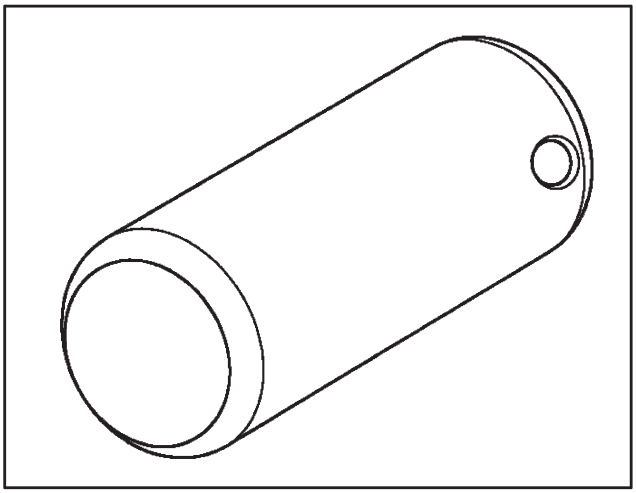

Fig. 2. Diagram of the dummy pingers used during the handling trials (not to scale).

buoyant. The dimensions of the dummy pinger were chosen to make it considerably larger than pingers designed for head rope attachment, and large enough to carry three D-cell batteries, to determine if this size would present a problem in handling.

The nets were shot and hauled twice, with dummy pingers attached at both ends as well as to the snap hook between the two five-net strings. The dummy pingers were attached by the crewmember also attaching the nets to the anchor lines. There were no problems in attaching the dummy pingers to the anchor spring lines without interfering with the normal handling of the nets. Similarly, a dummy pinger was attached to the snap hook between the two five-net strings without interference or delay. At the first haul of the nets, the dummy pingers were removed before the nets entered the net hauler. This requires the attention of one of the crewmembers, who are normally all busy removing the catch from the nets during hauling. At the second haul, the dummy pingers were removed at the table where the catch is also removed, thus demanding less attention from the crew, but requiring the dummy pinger to pass through the net hauler. The fishermen noted that when the pingers are removed at the table, it would facilitate removal if the ends of the pingers were more rounded, this would make them easier to take through the mesh in cases where they have ended up underneath the net.

The pinger development working group discussed the results of the handling trials and concluded that this way of attaching pingers to the nets did not interfere with the normal handling of the nets. The working group also discussed various ways of making the pingers easily available for fast attachment during shooting of the nets. However, the working group agreed that, given the variability in net handling practices among vessels, this problem would be best solved by individual solutions for each vessel.

## DISCUSSION

In June 2000, use of pingers became mandatory in the months August-October in the Danish North Sea wreck net fishery. This fishery was selected primarily because of the particularly high harbour porpoise bycatch rate observed but also because problems regarding pinger attachment were expected to be minor in this fishery as a result of the way nets are handled. However, the wreck net fishery has now almost completely disappeared because of the severely reduced quotas for the North Sea cod stock, and the fishing effort has moved into other types of gillnetting or into hook fishing. If pinger use becomes mandatory in some or all of these other types of gillnetting, as suggested by a recent proposal from the EU-Commission, the importance of developing solutions to the problems related to attaching pingers to fishing gear becomes apparent.

The mechanism and procedure for attaching pingers to bottom-set gillnets suggested by the Danish working group is one way of solving the attachment problems. It has a number of important technical advantages over head rope attachment, some of which are particular to the Danish gillnet fisheries, while others are of a more general nature.

The main advantages of the suggested attachment compared to head rope attachment are:

(1) it avoids the safety problems related to shooting nets with pingers over the side of the vessel at high speed;
(2) the pingers are easily removed and do not have to go through the net cleaning machinery, which reduces handling problems;
(3) because the pingers are not permanently attached to the nets, physical stress on the pingers is minimised;
(4) size and shape constraints on the pinger are reduced, thus it can carry more energy and can also be better protected against physical damage;
(5) because the pingers are not permanently attached to the nets, they can easily be used in different fisheries over the year;
(6) fishermen can optimise pinger use and avoid wasting pinger energy because just the required number of pingers necessary to ensonify all nets can be attached;
(7) it will be easier to design a housing for changing the batteries in this kind of pinger;
(8) replacement of failed pingers is considerably easier.

In other field trials of pingers, head rope attachment has been the precedent. Gearin *et al*. (2000) tied the pingers to the head rope using nylon tie wraps, but made no comments on their experience with this attachment. Kraus *et al*. (1997) put the pingers in bait bags tied to the head rope, but also did not comment on whether any problems were experienced with this attachment. Northridge *et al*. (1999) also used bait bags, but noted that this attachment would not necessarily be a long term solution. Use of bait bags avoids the problem of 'button-holing' and probably also to some extent protects the pinger against hard impacts. Otherwise, this method has the same problems as tying the pinger directly to the head rope, but how severe these problems are will vary with vessels, net types and hauling techniques.

The major disadvantage of THOR-1 is that it requires a pinger that is able to ensonify more than half the distance between two adjacent anchors, i.e. more than 300m. Although this is not a technical problem, it means that the porpoise free zone around the nets will be larger than may be necessary to avoid incidental catch. A solution to this problem would be to attach pingers for every five nets, where many Danish fishermen already have a snap hook, which the pinger could be attached to. This would reduce the required efficient pinger range to maybe around 200m, depending on how large an overlap is necessary between adjacent pingers. This will clearly lead to larger habitat exclusion for the porpoises than using pingers with a smaller effective range. However, the results presented by Larsen and Rye Hansen (2000) suggest that even with an effective pinger range of 400m, only a very small fraction of the North Sea would be unavailable to the porpoises at any given time if all gillnets in Danish fisheries that have incidental catch of porpoises were equipped with pingers.

A further advantage of the suggested solution is that it has been developed with the active participation of the fishermen who will be affected, if pingers are made mandatory in Danish bottom-set gillnet fisheries other than the wreck fishing. Active involvement of the affected fishermen has two main advantages. One is that the solution will be based on the collective body of experience among the fishermen regarding the practical possibilities. The other is that active involvement in the decision process will help both to legitimise the regulations as well as increase compliance with the regulations.

The handling trials suggest that this way of attaching pingers would be a workable solution for fisheries like the Danish bottom-set gillnet fisheries, but only after intensive use will it be possible to conclude that there are no other significant disadvantages than the ones identified here.

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