

Use of pingers in the Danish North Sea wreck net fishery

by

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Abstract

Use of acoustic alarms (pingers) has been mandatory in the third quarter of the year in the Danish North Sea wreck gillnet fishery since August 2000. Data collected by independent observer programs since 1993 includes information from a total of 873 wreck sets without pinger use and 129 wreck sets with pinger use. Nineteen of the 873 wreck sets without pingers had by-catch of one or more harbour porpoise, while none of the 129 wreck sets where pingers were used had porpoise by-catch. This 100% reduction is statistically significant ($P = 0.045$, $d.f.=1$). We conclude that the use of pingers is the reason that the by-catch in the observed Danish North Sea wreck net fishery was eliminated in 2000 and 2001.

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Introduction

By-catches in Danish fisheries have been monitored using observer programmes since 1992. High by-catches of harbour porpoises (*Phocoena phocoena*) in the North Sea bottom set gillnet fisheries for turbot, cod, hake and plaice were documented by Vinther (1995; 1997; 1999), who estimated the average total annual by-catch in the period 1994-98 at 6,785 porpoises (Vinther, 1999). This by-catch was well above the level agreed by ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) in 1997 as acceptable (ASCOBANS, 1997), which led to the formulation of the Danish action plan to reduce by-catch of porpoises in the North Sea (Ministry of Environment and Energy, 1998).

The action plan recommends the use of acoustic alarms (pingers) as one of the primary mitigations measures and in 2000 a requirement to use pingers was included in the fisheries regulations. The regulation requires the use of pingers in all Danish bottom set gillnet fishing in the North Sea in the period August-October when net fleets up to 300m are used. In practice this will only apply to wreck gillnet fishing. The reason for selecting this fishery and period was that particularly high rates of by-catches were observed here (Vinther 1999).

An observer program was established in 2000 specifically to monitor by-catch of porpoises by vessels using pingers during wreck fishing. The primary objective of the program was to evaluate the efficiency of the pingers in mitigating the by-catch in this fishery. The program was continued in 2001, and the results from these first two years of mandatory pinger use are presented in this document.

To help ensure that pingers would be used where required, the Danish Fishermen's Association (DFA) acquired a large number of pingers, which were made freely available to the fishermen in return for information on their use. This voluntary reporting scheme included those vessels using pingers in the wreck net fishery, which were not covered by the observer program. In addition, a number of Danish vessels engaged in the flat bottom gillnet fishery, where pinger use is not mandatory, used pingers on a voluntary basis in 2001. These vessels were also covered by the reporting scheme established by the DFA. The data from the DFA scheme is presented in this document, but not included in the analyses of by-catch rates.

Materials and methods

Wreck net fishing

In the wreck net fishery nets are set on wrecks and other man-made objects on the seabed. These objects are often shipwrecks, but also include containers, boulders etc. The nets, normally two or three rows each including up to four net panels, are set across the wreck and normally very close together. The target species of this fishery is most often cod (*Gadus morhua*), but other gadoids are also caught in small numbers.

The mandatory use of pingers in the wreck net fishery requires that a pinger is attached at each end of a string of nets. Pingers are not required on additional strings of nets as long as each part of the additional string is within 200m distance of a pinger.

Observer effort, 1993-2000

Data from independent observer programs covering Danish bottom set gillnetting in the North Sea are available from the years 1993-2000, *i.e.* before the introduction of mandatory pinger use in the wreck fishery. These data, presented in Table 1, include observations of hauls from a total of 873 wreck sets where pingers were not used. The subset covering the months August–October includes 432 wreck sets observed of which 298 occurred north of 55°30'N. These 298 sets also include 12 wreck sets from September and October 2000 where pingers were not used, despite the requirement for use of pingers in this period. Eleven of these 12 sets occurred north of 55°30'N. Two porpoises were caught in these 11 sets.

Table 1. The number of wreck sets without pingers covered by the observer program, the number of wreck sets with by-catch of porpoise and the total number of porpoises caught, by area and season for the years 1993-2000.

1993-2000 (without pingers)	Number of wreck sets	Wreck sets with by- catch	Porpoises by-caught
North of 55°30'N	493	19	37
August-October	298	18	36
November-July	195	1	1
South of 55°30'N	380	0	0
August-October	134	0	0
November-July	246	0	0
Total	873	19	37

Observer effort, 2000-2001

Table 2 presents data from the pinger observer program in 2000-2001. The program covered a total of 129 wreck sets where pingers were used, of which 64 occurred north of 55°30'N.

Data analyses

The by-catch rate is here calculated as the number of observed wreck sets with by-catch divided by the total number of observed wreck sets. The by-catch process is considered to be a binomial process, and the difference in by-catch rate between sets without pingers and sets with pingers is analysed using statistical tests comparing proportion parameters for two samples (software package S-PLUS™).

Table 2. The number of wreck sets with pingers covered by the observer program, the number of wreck sets with by-catch of porpoise and the total number of porpoises caught, by area and season for the years 2000-2001.

2000-2001 (with pingers)	Number of wreck sets	Wreck sets with by-catch	Porpoises by-caught
North of 55°30'N	64	0	0
August-October	64	0	0
November-July	0	0	0
South of 55°30'N	65	0	0
August-October	65	0	0
November-July	0	0	0
Total	129	0	0

Voluntary reporting

Fishermen using pingers made available by the DFA were required to fill in a form for each trip where pingers were used and return the form to the DFA together with a copy of the logbook for the trip. The form asked for information on, *i.e.* vessel identification, dates of leaving and returning, number of wreck visited, number and type of nets used, number of pingers used, number of porpoises caught and number of porpoises observed (categories: 'none', 'few', 'some' and 'many'). The logbook includes, among other information, the geographical area where fishing was conducted during the trip.

Results

Of the 873 wreck sets without pingers covered by the observer programs in 1993-2000, 19 had by-catch of one or more porpoises resulting in a total by-catch of 37 porpoises, all of which occurred north of 55°30'N. Of these 19 wreck sets with by-catch, 18 (36 porpoises) occurred in the months August-October.

Thus the overall by-catch rate for wreck sets without pingers is 0.022, the by-catch rate for the area north of 55°30'N is 0.039, and the by-catch rate for the area north of 55°30'N in August-October is 0.06. No by-catch of porpoises was observed on the 129 wreck sets with pingers covered by the observer program in 2000-2001.

Figure 1 presents the geographical distribution of wreck sets covered by the observer program in 2000-2001, including the distribution of the two by-caught porpoises.

Since the primary objective is to evaluate the effect of pingers on the by-catch of porpoises in the wreck net fishery, the appropriate comparison of by-catch rates is between wreck sets with and without pingers only for the months August-October and north of 55°30'N. A statistical test of the null-hypothesis that the by-catch rate north of 55°30'N in August-October 2000-2001 is equal to the by-catch rate in the same area and months in the years 1993-2000

results in a P-value of 0.045 (d.f.=1), *i.e.* the null-hypothesis is rejected in favour of the one-sided alternative that the by-catch rate north of 55°30'N in August-October in 2000-2001 is lower than the by-catch rate north of 55°30'N in August-October in the years 1993-2000.

Voluntary reporting

Table 3 presents a summary of the data collected by the DFA voluntary reporting scheme in Danish gillnet fisheries. The reporting includes 132 trips with a total of 606 days at sea, of which 91 trips and 423 days at sea took place in the North Sea and 25 trips with 94 days at sea took place in the Skagerrak-Kattegat area. Four porpoises were by-caught in the North Sea during these trips. Two of the porpoises were caught in nets without pingers and a third was caught in a net where the closest pinger was non-functional. One of the porpoises was released alive. One porpoise was caught in the Skagerrak-Kattegat area in a net without pingers.

Table 3. Summary of data from the DFA reporting scheme by area.

Area	Number of trips	Total days at sea	Percentage of trips with observations of				Number of porpoises by-caught
			Many***	Some	Few	None	
North Sea	91	423	10	9	7	74	4*
Skagerrak -Kattegat	25	94	8	8	16	68	1**
not given	16	89	-	-	-	-	0

* Two of these porpoises were caught in nets without pingers and one of these two was released alive.

** Caught in nets without pingers.

*** "Many" refers to many porpoises seen, etc.

Discussion

The results presented here show that for the Danish wreck net fishery in the North Sea the by-catch rate north of 55°30'N in August-October 2000-2001 was reduced by 100% compared to the by-catch rate in the same area and months in the years 1993-2000. The explanation for this reduction could be one or both of the following:

- *There were considerably fewer porpoises in the area covered by the observer program in the period after August 2000 than in the period before August 2000.*
- *Pingers were used on the wreck nets from August 2000.*

The first explanation is difficult to evaluate, since systematic data on porpoise abundance were not collected during the years in question, except for 1994. However, other data indicates that porpoises were abundant in the area north of 55°30'N also after August 2000. These include:

1. Two porpoises were by-caught in 11 wreck sets without pingers in September-October 2000.
2. The observers noted that many porpoises were seen during one of the trips in October 2000.

3. Eight porpoises were by-caught during an experiment with high density gillnets in October 2000 in the same general area covered by the observer program (Larsen *et al.*, 2002).
4. Of the 32 ICES-rectangles visited by one or more of the vessels involved in the DFA voluntary reporting scheme, 8 were included in the category 'many porpoises observed' and 15 were included in the category 'some or a few porpoises observed'.

In light of this, we consider the second explanation to be the most likely. This is also supported by the small "controlled experiment" conducted by two of the vessels covered by the observer program in 2000. As mentioned above, they made 12 wreck sets without using pingers, resulting in a by-catch of 2 porpoises. In comparison they made 87 sets with pingers, resulting in no porpoise by-catch.

We can therefore conclude that the use of pingers in the Danish North Sea wreck net fishery has eliminated by-catch of harbour porpoises. It should be recalled, however, that in several of the controlled pinger trials reported (*e.g.* Kraus *et al.* 1997; Larsen, 1997) a few porpoises were caught in nets with active pingers. It is probably to be expected that a small number of porpoises will be by-caught in the future wreck net fishery, also in nets equipped with functional pingers.

Habituation of the porpoises to the acoustic signals of the pingers is often mentioned as a reason for concern regarding the widespread use of pingers to reduce by-catch. The results from the use of pingers in the Danish North Sea wreck net fishery in 2000 and 2001 do not suggest that habituation has occurred. On the other hand, the results do not allow us to conclude that habituation will not occur in the future. If habituation takes place to an extent where it results in a significant reduction in the efficiency of the pingers, it should manifest itself as an increased by-catch rate in the fishery using pingers. It is therefore important to continue monitoring the wreck net fishery at a level, which will allow detection of increased by-catch rates. It is also important to ensure that the pingers are kept functional and used appropriately, as malfunctioning pingers and inappropriate use will lead to increased by-catch rates. This increased by-catch rate could be interpreted as the result of habituation, if it cannot be shown that the cause is malfunctioning pingers or inappropriate use.

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