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# Pilot study of marine mammal bycatch by use of an Electronic Monitoring System



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## Introduction

Bycatches of harbour porpoises and other cetacean species occur in gillnet fisheries throughout the Northern Hemisphere (Trippel et al., 1996; Tregenza et al., 1997; Vinther, 1999; Vinther & Larsen, 2004). Due to the bycatch taken in commercial fisheries the Council adopted Council regulation No 812/2004 which lay down measures concerning monitoring of the fisheries and measures to reduce incidental catches of cetaceans in gillnet fisheries (EU, 2004). According to the Council Regulation 812/2004, Member States must annually report to the Commission on their monitoring schemes and the findings regarding bycatch of marine mammals. Monitoring of marine mammal bycatch is however very costly and the Council Regulation therefore provides the opportunity to carry out pilot projects which can contribute to knowledge upon new methods to monitor bycatch of marine mammals.

From September 2008 to July 2009, 6 Danish commercial fishing vessels (4 trawlers, 1 seiner, and 1 gillnetter) have had an Electronic Monitoring System installed onboard. The aim was to test a fisheries management paradigm shift where vessels, which carried out a fully documented fishery, got additional landing opportunities based on the fact that there was complete catch documentation and registrations of retained and discarded cod. The total catch registration was audited by use of a sensor system and 4 video cameras, each filming different angles of the catch handling as well as the discard chute. Since the system is recording all catch events it is expected that the Electronic Monitoring System can be used for bycatch registrations of marine mammals. If such a system can work onboard commercial fishing vessels it will be a more cost efficient method to monitor bycatch of marine mammals and higher observation coverage can be obtained compared to the use of at-sea observers onboard. This report gives an evaluation of the use of Electronic Monitoring System to monitor incidental bycatches of marine mammal by one Danish gillnetter.

## Method

### *The gillnet fishery*

The trial vessel was 14 m long and fishing exclusively fish with gillnets and trammelnets. The main target species were cod (*Gadus morhua*), plaice (*pleuronectes platessa*) and hake (*Merluccius merluccius*) depending on the season. The mesh sizes and gillnet types used are shown according to species in Table 1 below.

The fishery was conducted in the Skagerrak (ICES Division IIIaN) within ICES rectangle 43F8, 43F9, 44F9, 44G0 on a daily basis with both night and day net sets.

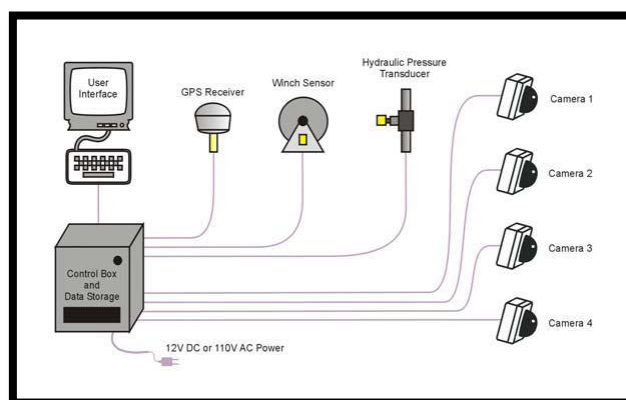
**Table 1:** Net specifications according to target species

	Mesh size (total mesh)	Net type
Cod	140-170 mm	Trammelnet and gillnet
Plaice	136 mm	Trammelnet and gillnet
Hake	120 mm	Gillnet

### *The system*

The electronic monitoring system is developed by Archipelago (Archipelago Marine Research Ltd., Canada). It contains 4 CCTV cameras, a GPS, a hydraulic pressure sensor, a winch/net-drum rotation sensor and a control box (computer) (Figure 1). All together the system provides data from every catch event, both regarding fishing effort, position and catch composition. More information on the system can be found in "Fully documented fishery" (Dalskov & Kindt-Larsen, 2009). All data were analyzed using the software

“Video Analyzer” developed by Archipelago. The software provides a view of all 4 cameras at the same time.



**Figure 1:** Overview of the electronic monitoring system

### Camera placement

The 4 cameras were each filming different views of the fishing gear handling and catch sorting in order to verify each catch event compared with the logbook. The images below show the 4 camera views on the Danish gillnetter (Figure 2). The upper right image provides a view of the net hauled from the surface to the net drum. This view is used to see if any marine mammals are caught as bycatch.

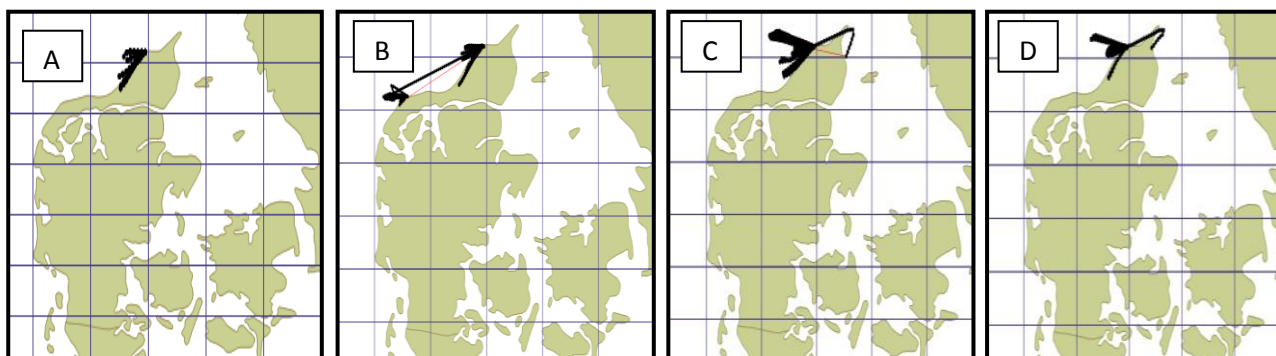


**Figure 2:** the 4 views of the camera installed.

## Results

### Gillnetter

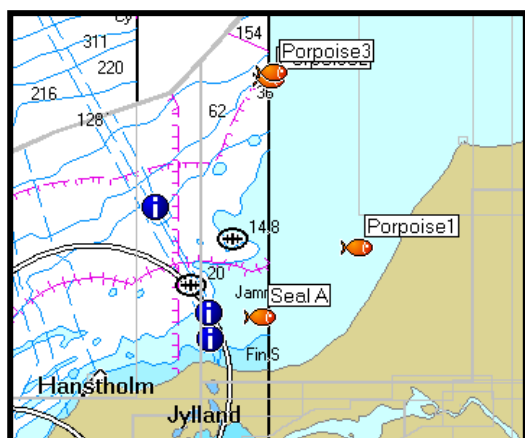
The data was collected from 1 September 2008 until 31 July 2009. The 4 figures below (Figure 3) are showing the areas where the vessel has been fishing within the 4 periods covering the whole experiment period. The gillnetter mainly had been fishing with in ICES square 43F8, 43F9, 44F9 and 44G0. A total of 119 fishing days was made with a total of 540 net sets, containing approximately 11-13km/net per day. The sensors (GPS, pressure sensor and rotation sensor) had been running for 1,718 hours with 98,6% data complete and 732 hours of video recording has been collected.



**Figure 3:** Maps of the fishing areas according to different seasons in the different ICES squares. A: 04/09/08-16/09/08, B: 17/09/08-08/01/09, C: 14/01/09-04/05/09, D: 06/05/09-23/07/09.

### Bycatch- video analysis

All 732 hours of video recording has been analyzed in order to record the number of incidental bycatch of marine mammals and sea birds. A total of 3 harbour porpoises (*Phocoena phocoena*), 1 harbor seal (*Phoca vitulina*), 2 cormorants (*Phalacrocorax carbo*) and 1 Sea gull (*Laridae*) were caught. A map visualizing the marine mammal bycatch positions are shown on figure 4 and all positions and net details can be viewed in table 2-4 below. All animals were found in good conditions indicating that all animals had drowned within the nets and not had been dead previously to their gillnet entanglement. It has not been possible to determine age or sex of the animals due to the image resolution.



**Figure 4:** Positions of bycaught porpoises and seals.

**Table 2:** Net and position details of all bycaught harbour porpoises.

Porpoise	Date	Position	Set	Fishing depth	Net type	Mesh size	Net amount	Water temp
1	11/09/08	57.23.159 00934.690	Day	8-14m	Gillnet	130 mm	240 net 55m each	17 C <sup>0</sup>
2	06/02/09	57.43.202 00915.057	-	38-60m	Gillnet	120 mm	-	6,5 C <sup>0</sup>
3	09/02/09	57.44.097 00915.635	-	-	-	-	-	4.6 C <sup>0</sup>

**Table 3:** Net and position details of all bycaught harbor seals.

Seal	Date	Position	Set	Net depth	Net type	Mesh size	Net amount	Water temp
A	15/09/08	57.14.866 00931.233	Night	6-12m	Gillnet	130mm	180 nets 55m each	-

**Table 4:** Net and position details of all bycaught birds.

Sea birds	Date	Position	Set	Net depth	Net type	Mesh size	Net amount	Water temp
I Cormorant	18/09/08	57.14.007 00931.307	Night	4-10m	Gillnet	130mm	-	15,4C <sup>o</sup>
II Cormorant	18/10/08	5713.887 00930.514	-	-	-	-	-	-
III Sea gull	04/01/09	5736.399 00941.605	Day	-	Gillnet	-	-	6,5C <sup>o</sup>

#### *View time*

All 731.8 hours of video recording from the gillnet vessel were processed. The videos were viewed at highest possible speed (16\*real time) and sections where no gillnet hauls took place were skipped. The total view time spend analysing data were 220 hours. If an observer could have monitored the same amount of net hauls a total of 1094 hours is needed (hours for observers transport to and from the vessel are not included).

## **Discussion and conclusion**

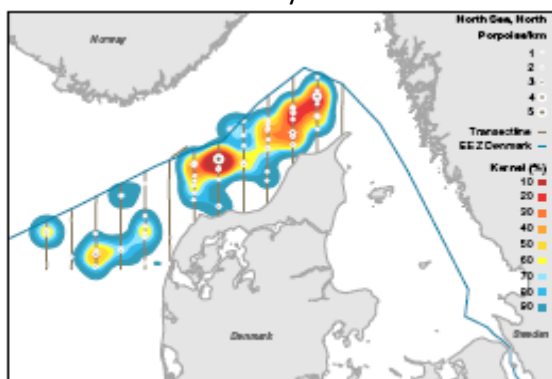
Monitoring programs of marine mammal bycatch has previous been conducted by use of observers onboard Danish commercial fishing vessels (Kindt-Larsen et al., 2008; Vinther, 1999). Observer monitoring programs are although very expensive as high coverage percentages are needed to estimate proper bycatch rates. High observer coverage is needed since fisheries with no bycatch registration and low observer coverage can lead to false bycatch conclusions (Barlow, 1989).

The main goal of this pilot project was to test if the Electronic Monitoring System could provide reliable information needed for marine mammal bycatch registrations and the results have shown that the system has proven to be a reliable alternative to the use of at sea observers. The system had been up running 98,6% of the maximum time period indicating a very low data loss. Bycatch of marine mammals could easily be verified on the images and images could be processed at the highest possible speed. These findings are very important for future studies of marine mammal bycatch registrations since the EM system is much more cost efficient compared with having observers onboard (Dalskov & Kindt-Larsen, 2009) and much higher coverage percentages can be obtain.

Within this pilot only data from one vessel is obtained and therefore extrapolations to a total bycatch rate for the whole fleet is not possible, since the vessel only cover a small area and few types of fisheries. However if the system is used within larger monitoring schemes it will be possible to provide better estimates of the total bycatch rates. Registrations of mesh size, height, twine size and number of nets used is although needed, if these data are to be extrapolated to a larger fleet as done by Vinther (1999).

In 2008 the National Environmental Research Institute published a report on "High density areas for harbour porpoises in Danish waters" based on aerial surveys (Teilmann, et al. 2008). A total of 3 surveys were conducted from 2006-2007 (Figure 5). If the density map (Figure 5) is compared to the fishing areas

(Figure 3) very little of the fishery overlap with the high density areas. However hauls in period C and D does overlaps with medium density areas and here two porpoises are bycaught. Due to the high position resolution of the EM system it will therefore be possible to make direct mapping between bycatches and density maps, which could be a very useful tool when pointing out areas with high risk of marine mammal bycatch.



**Figure 5:** Kernel density map of harbour porpoises based on 3 aerial surveys conducted in Skagerrak/northern North Sea in 2006-2007 (Teilmann, et al. 2008).

In short it can be concluded that the EM system can be used as a very efficient monitoring method to register marine mammal bycatch and coverage percentages up to 100% can be obtained.

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