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Technical note

Live-capture of grey seals in a modified salmon trap

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ABSTRACT

Seal-induced catch damages have increased dramatically in the coastal trap-net fishery in the Baltic Sea. Most damage is caused by the rapidly growing grey seal (*Halichoerus grypus*) population. These seal–fishery interactions require practical and sustainable solutions. A potential measure is capture of live seals using fishers' commercial trap-nets. The benefit of this approach to fishers would be to catch "nuisance" seals that have learned to use commercial fishing gear for finding their food sources and to remove them in an ethical way while endangered species could be released. We developed a capture system that can easily be installed into a modern salmon trap-net, commonly referred to as the pontoon trap. The aim was to develop a technique that enables undisturbed fishing while allowing live-capture of seals. Development work involved the testing of various structures and recording the behaviour of seals and fish on video. This paper demonstrates the criteria for a successful trap design and presents some observations of seal behaviour. The technique developed provides a unique method for scientific studies where seals have to be captured alive.

1. Introduction

The grey seal (*Halichoerus grypus*) population in the northern Baltic Sea started to increase in the 1980s after hunting was prohibited and environmental contaminant load of seals reduced (Harding et al., 2007). In 2008, the Baltic grey seal population recorded by aerial censuses was estimated as 22,300 individuals (Finnish Game and Fisheries Research Institute). The annual rate of increase of the grey seal population in the northern Baltic Sea has been about 7.5% since 1990 (Harding et al., 2007).

In concert with growing seal numbers, seal-induced catch damage has increased dramatically in the coastal trap-net fishery for salmon (*Salmo salar*) and whitefish (*Coregonus lavaretus*) in the northern Baltic Sea (Baltscheffsky, 1997; Fjälling, 2005; Kauppinen et al., 2005). The grey seal causes most damage although the ringed seal (*Phoca hispida botnica*) are also believed to cause marked damage in the northernmost areas of the Gulf of Bothnia. In the most affected areas, more than 50% of yearly trap-net catches is also damaged by seals (e.g. Kauppinen et al., 2005; Jounela et al., 2006). The damage is of such a magnitude as to seriously threaten the survival and sustainability of the small-scale coastal Baltic fisheries and many fishermen now consider seals to be the most serious threat to their livelihoods. Expanding seal populations are an increasing problem also for fisheries in many other areas outside the Baltic Sea (e.g. Cairns et al., 2000; Moore, 2003).

There have been various attempts to mitigate seal-induced damage in the coastal Baltic fishery. Seal-safe trap-net modifications have shown to be one potential way to reduce the damage (Lunneryd et al., 2003; Lehtonen and Suuronen, 2004; Suuronen et al., 2006; Hemmingsson et al., 2008). In addition, promising results have been obtained by acoustic harassment devices (Fjälling et al., 2006). However, no single gear modification or scaring device has been shown to provide complete protection from seal-induced damages.

Due to increasing damage in the coastal Baltic fishery, grey seal hunting resumed at the end of 1990s. According to fishermen, hunting of seals in the vicinity of fishing gears reduces the number of seal individuals attacking the trap-nets. Although there is no scientific evidence that such action would markedly reduce catch losses and gear damage, selective removal of the "nuisance" seals may be necessary if the coastal fishery is going to survive in the northern Baltic Sea. Hunting grey seal by traditional methods, however, is difficult; especially during the open-water season. Nowadays along the Finnish coast (including Åland) only half of the yearly quota of nearly a thousand individuals is taken (Anon., 2007).

The objective of this study was to develop a grey seal capture technique that can be installed in a modern salmon trap. The aim was to come up with a design that enables as undisturbed fishing as possible while allowing seals visiting the traps to be caught alive. This method would enable the capture of those individuals that have specialized to find their food in the traps. The technique would allow a quick and ethical slaughtering of grey seal post har-

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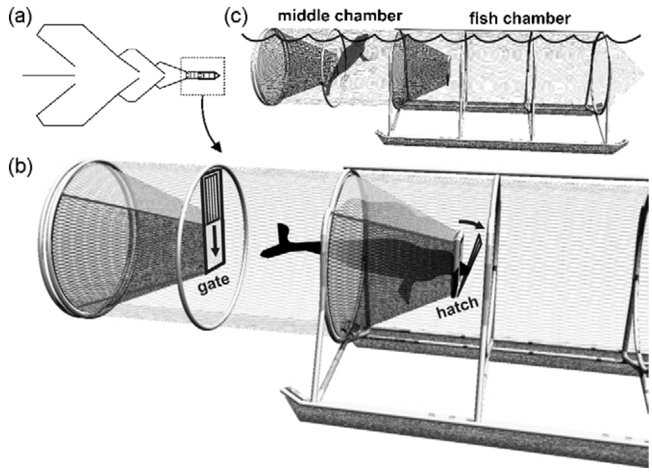

Fig. 1. (a) A trap-net is equipped with a leader, wings and chambers. In a pontoon trap the chambers are made of strong double-layer netting held under tension by rigid hoops; (b) the principle of the capture unit: the non-return gate system installed in the entrance of the middle chamber allows the seal to swim into the middle chamber and towards the entrance of the fish chamber where it pushes the hatch and thereby releases the gate that falls down behind the seal. Attached in the hatch is a release wire that triggers the gate (wire not shown); and (c) the seal is trapped in the chamber where it is still able to reach the surface for air.

vest thereby utilizing its valuable resources (meat, oil, hide and bones). In the northern Baltic coastal areas there is a long tradition of households exploiting seals. Ringed seal (currently not a hunted species in the Baltic Sea) incidentally caught in the trap-nets could be released alive.

2. Development of capture technique

Development of the capture technique and sea trials were carried out in May–October 2007 in the northern Baltic Sea, in the Bothnian Sea, near the towns of Pori and Merikarvia, in close cooperation with local professional fishermen. Two salmon pontoon traps (Fig. 1, see also Hemmingsson et al., 2008) were modified for the purpose of this study; one trap was used in Pori and the other in Merikarvia.

A simple and practical capture unit that could easily be attached on a pontoon trap was sought. A captured seal should be able to reach the water surface, either through a breathing cylinder or by lifting the netting at the roof of the capture unit. Care was taken to ensure the design prevented the seal from drowning when in the capture unit. An automated non-return gate should allow the seal to enter the capture unit but prevent it from escaping.

Testing of the capture unit involved periodical underwater video recording of behaviour of seals and fish in the trap. Video-monitoring was carried using two underwater camera systems; one where the image was in real time transmitted wirelessly to a computer at the harbour (used in Merikarvia); the other with a system in which the image material from three different video cameras was stored on a digital recorder attached to the trap (used in Pori). On the latter, the data were later extracted and analysed at the harbour.

The first gate-device tested was a simple one-way 'cat door' design that was constructed of a hinged frame with a thin vertical wire in the middle. Fish could swim undisturbed through the door into the final chamber of the trap (fish chamber). It was assumed that a seal could lift the door and swim towards the fish chamber where it would be trapped. However, this did not happen. Seals did not open the door; instead, they tried to swim through it and thereby became stuck between the wire and frame. A second 'door' version had a lowered frame. Seals quickly learned to open it and take a fish in the fish chamber but they also learned to open the gate from inside, and were able to escape with the fish. After testing various door designs throughout the summer, the attempts to catch grey seal in the fish chamber by using a cat door principle were abandoned.

Fig. 2. An adult grey seal is approaching through the open non-return gate into the middle chamber; from here the seal swims towards the entrance of the fish chamber.

A successful technique with a relatively simple principle was developed at the end of the fishing season. Instead of capturing seals in the fish chamber they were caught in the middle chamber, that is in front of the fish chamber (Fig. 1c), using a special “non-return” gate system. From the open gate installed in the entrance of the middle chamber the seal freely swims into the middle chamber and towards the fish chamber (Fig. 2). When the seal comes to the entrance of fish chamber, it pushes the hatch installed at the entrance and thereby releases the “non-return” gate that falls down behind it (Fig. 1b). After that, the seal captured in the chamber cannot escape through the closed gate or enter through the hatch into the fish chamber.

When the gate falls down, the fisherman automatically receives a text message on his cellular phone sent by the GSM-alarm unit. This enables the quick and ethical removal of the seal from the trap. This is important also because once there is a living seal captured in the middle chamber, fishing is seriously disturbed.

During the last 2 months of sea trials (September–October 2007), altogether 13 grey seals were caught alive in the middle chamber of the two experimental traps. These seals were killed in order to collect tissue samples for age determination and health monitoring, and to explore utilization possibilities of the animals using trained hunters. This was done by a single lethal shot to the head when the seal came up to breathe. The average weight of captured grey seals was 103 kg (range 40–135 kg). Their average age was 8 years (range 0–17 years). All were males, which may indicate that males visit trap-nets more regularly than females. No ringed seals were caught.

3. Behaviour, diurnal activity and identification of seal

Underwater video observation showed that grey seals caught and confined in the middle chamber were usually calm and could easily surface for air (shown schematically in Fig. 1c). Seals were not found to chew on the netting but some of them ripped the gate-grid. Seals were often seen to continue feeding after being caught. Observations also revealed that a seal entering the middle chamber did not always release the gate; instead, they often escaped the trap (through the open gate) with or without a prey item, and usually no signs of seal visit were visible in the trap.

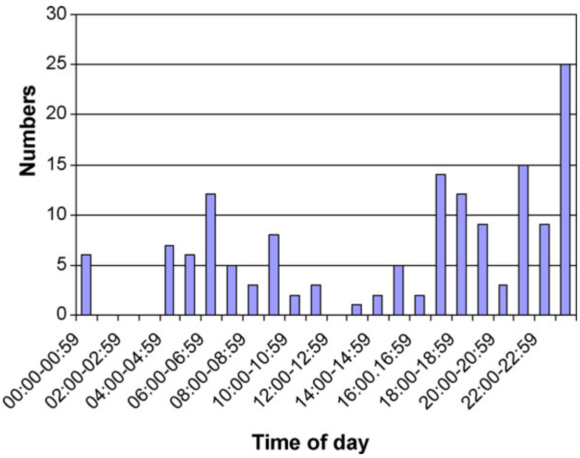

Fig. 3. Visits of grey seals at the experimental trap during various hours of the day in the Pori trials (all observations from May to October pooled).

Video-monitoring showed that for effective live-capture of seal with a trap-net there has to be fish in the fish chamber. An empty trap do not attract seals. Salmon appeared to be the most preferred prey for seal (in the trap). Whitefish also attracted seals but other coastal species seemed to elicit substantially less attraction. It is noteworthy that the gate-devices in our experimental traps where not found to interfere with fish swimming towards the fish chamber.

In the experiments conducted in Pori, a total of 149 observations of grey seal visiting the experimental trap were made during those 105 days when the underwater camera was in operation in May–October. Those visits took place on 30 different days. Seals visited the trap mostly in the early morning and in the evening (Fig. 3). During the darkest night hours in September and October, however, some seals may have visited the trap without being observed by our camera system. Moreover, during some days the water was very turbid causing problems in the observation of seals. No diurnal patterns were observed in fish swimming into the trap; salmon and whitefish were seen to enter during all hours. In the experiments in Merikarvia, the underwater camera system was fully operational only for nine days. In total, 42 observations of seal visits were made during those days.

Identification of individual grey seals on the basis of video-image was difficult. Nevertheless, in the video recordings made in Pori, three individuals could with reasonable confidence be identified due to their distinctive colour patterns. These three individuals were recorded 45, 27 and 24 times, respectively, during the 105 days observation period. That is, 96 out of 149 seal observations (64.4%) were from these three individuals. These observations provide some evidence that the visits in trap-nets can, to a relatively large extent, be by certain specialist individuals, and not simply by seals just randomly passing by.

4. Conclusions

The technique developed for capturing grey seal alive with a pontoon trap offers a practical method for selective removal of "nuisance" grey seals, but it also provides a unique and effective method for scientific studies where seals have to be captured alive (e.g. seal-tagging studies). When a commercial fisherman is using this technique, his fishing is disturbed only when a seal is caught. Once caught, the seal has to be removed quickly in order the fishing can continue without disturbance.

We were not able to demonstrate that only certain specialist seal individuals cause damage in trap-nets but relatively strong indications of that being the case were obtained. Establishing this would require research where a sufficient amount of seals caught in the vicinity of trap-nets were to be marked with satellite-linked transmitters. Nevertheless, capturing those individuals that regularly enter the trap-nets is likely to have a positive effect in reducing damage. At least it would allow fishermen to create temporary "seal-free" fishing periods.

With the grey seal population expanding, there may soon be no coastal areas in the Baltic where static fishing gears are safe from seal attacks. If effective mitigation measures for seal-induced damage are not found, the seal–fishery conflict in coastal fishery becomes serious. In the worst case, illegal hunting and deliberate drowning of seals in the gear may become a common practice. The problem requires rapid, practical and sustainable solutions, and selective capture of seals by trap-nets may be a part of the solution. Reducing seal-induced damages by extensive seal hunting is not likely effective or acceptable.

Supplementary material

A 14 minutes DVD that describes the live-capture technique developed and major underwater findings of this study can be ordered from the authors.

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