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Temporal and regional patterns in seal-induced catch and gear damage in the coastal trap-net fishery in the northern Baltic Sea: effect of netting material on damage

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Abstract

Seal-induced damage in the traditional trap-net fishery increased dramatically during the 1990s in the northern Baltic Sea. Most damage is induced by a rapidly growing grey seal (*Halichoerus grypus*) population. We evaluated seal damage in the coastal trap-net fishery of the Gulf of Bothnia, where different gear constructions and netting materials are used. A total of 72 commercial fishermen with 136 trap-nets were involved in the study. Catch and gear-damage observations made by fishermen were consistent with our own. The largest catch losses of salmon (*Salmo salar*) were recorded in the Bothnian Sea, where seals damaged at least 37% of salmon catch (by number). In other regions, losses were notably smaller, at between 3 and 9%. The number of salmon caught in a trap on any one occasion correlated significantly with the number of damaged salmon. However, the more salmon were present in a trap, the smaller was the proportion damaged by seals. Observed catch losses in the whitefish (*Coregonus* sp.) fishery varied between regions from 5 to 7%. Gear damage was observed in 2–15% of trap-net emptyings, depending largely on region. The extent of gear damage followed the trend of catch damage in each region. Fish entanglement in trap-nets increased the amount of gear damage. The type of netting material significantly affected gear-damage frequencies and salmon entanglement. Seal-induced catch and gear damage could be reduced by gear modification and operational changes. The choice of suitable netting materials and the development of seal-safe fish-bags are essential in protecting the gear and catch from seals.

Keywords: Seal-induced damage; Trap-net; Netting materials; Gear damage; Salmon; Baltic Sea

1. Introduction

Expanding seal populations in the Baltic Sea have caused increasing conflicts between seals and fisheries (e.g. Baltscheffsky, 1997; Lunneryd and Westerberg, 1997; Lunneryd, 2001). Seals damage both fish and

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fishing gear (e.g. Westerberg et al., 2000; Kreivi et al., 2002; Lunneryd et al., 2003; Lehtonen and Suuronen, 2004), and in some areas have caused fishing to stop. Growing seal populations are also an increasing problem for fisheries in many other areas along the northern Atlantic coast (e.g. Haug and Nilssen, 1995; Morris, 1996; Cairns et al., 2000; Moore, 2003). In the Gulf of Bothnia, seal-induced damage in the trap-net fishery has increased dramatically since the mid-1990s (Kreivi et al., 2002; Westerberg et al., 2000).

Two seal species are regularly found in the Gulf of Bothnia: the grey seal (*Halichoerus grypus*) and the ringed seal (*Phoca hispida botnica*). Grey seals are found throughout the Baltic Sea but are mainly concentrated in the Gulf of Bothnia and the Åland Sea (Sjöberg, 1999). Due to favourable ice conditions in the winter, the main range of the Baltic ringed seal is within the northern Bothnian Bay. Grey seals cause most of the catch and gear damage in the Baltic Sea (Westerberg et al., 2000; Kreivi et al., 2002; Lunneryd et al., 2003), while ringed seals are smaller and cause less damage (Westerberg et al., 2000).

Seal populations in the Baltic Sea started to increase in the 1980s after their hunting was prohibited and environmental conditions improved (Helle, 1999). Overflight censuses in 2003 covering the entire Baltic Sea recorded 16 000 grey seals (Finnish Game and Fisheries Research Institute, FGFRI). However, as grey seals are highly mobile (Sjöberg, 1999) and diving seals cannot be seen, this estimate is only approximate (Helle, 1999). The ringed-seal population in the Baltic Sea has been estimated at around 6500 individuals. The estimated yearly growth rate for the grey seal population in the Baltic Sea is 10% and that of the ringed seal 6% (FGFRI).

The coastal commercial fishery has undergone significant changes in recent decades due to changes in the fish markets, environment and fish stocks (Hudd and Leskelä, 1998). Larger trap-nets have been introduced and coastal fishing activities have partly moved from near-shore regions to the open sea. In the 1960s and 1970s, when the extensive open-sea trap-net fishery for salmon was developing, seal populations were smaller and caused no noticeable damage.

This study explored the effects of growing seal populations on the coastal commercial trap-net fishery in the northern Baltic Sea (the Gulf of Bothnia), focusing on the temporal and regional patterns of damage. A further aim was to determine whether regional fishing strategies and different gear netting materials have affected the extent of seal-induced damage and whether it possible to reduce the damage by modifying fishing practices. We also compared the observations of seal-induced damage made by fishermen and scientists.

2. Materials and methods

The Gulf of Bothnia (60–65°N) is the northernmost and most isolated part of the Baltic Sea (Fig. 1). There is no tide in the gulf and salinity and temperature discontinuities are weak. The gulf is ice-covered in most winters, with freezing beginning in the north in November and the ice cover reaching its greatest extent in February. The ice thaws in April–May. The Gulf of Bothnia can be divided into five separate regions, which from south to north are the Bothnian Sea, the northern Bothnian Sea, and the southern, central and northern Bothnian Bay (Fig. 1).

Data were collected along the Finnish coast of the Gulf of Bothnia during the fishing season of 2002 (2 May–14 October) as part of a survival study on released salmon. A total of 72 commercial fishermen with 136 trap-nets of different types were involved (Table 1). The main target species were included in the analysis: Atlantic salmon (*Salmo salar*) ($n = 22\,467$), sea-running brown trout (*Salmo trutta* L.) ($n = 5943$) and whitefish (*Coregonus* sp.) ($n = 48\,239$). Gear damage was recorded by counting the number of seal-made holes in traps. All holes were repaired immediately to avoid double counting.

A trap-net is here considered to be any floating, bottom-anchored fishing gear (this concept includes trap- and pound-nets) (Fig. 2). Depending on the type and materials of a trap, fish may be guided into the fish-bag (by trapping) or they may become entangled in the netting of the ‘wings’ and ‘middle chambers’ (by gilling). Conventional monofilament traps are designed to catch mostly by gilling and entangling. Conventional traps made of twisted nylon with certain mesh sizes catch mostly by gilling, but also by trapping to some extent.

To ensure an adequate number of salmon for the survival study, 18 seal-safe fish-bags made of Dynema netting (see Lehtonen and Suuronen, 2004)