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Codend selectivity in a commercial Danish anchor seine

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ABSTRACT

Danish seining (or anchor seining) is a fishing technique that is gaining increasing attention because it is considered to be a fuel-efficient fishing method with low environmental impact. However, scientific documentation of the selectivity characteristics of Danish seines is lacking, and the gear generally is grouped with bottom trawls and Scottish seines in fisheries management legislation. In this study, we developed a codend cover to estimate the selectivity of a standard commercial Danish seine codend for four fish species. The data for the dominant species, dab (*Limanda limanda*) and plaice (*Pleuronectes platessa*), was best described by models that combine two or three logistic models, which indicated that more than one selection process was at work. Selectivity of cod (*Gadus morhua*) was best described by a Richard curve and selectivity of red gurnard (*Chelidonichthys lucernus*) by a logistic curve. The estimated selectivity curve of dab indicated, contrary to cod and plaice, low retention of individuals below MLS. Confidence limits for larger length classes of cod and red gurnard were relatively wide. For plaice, the estimated selection factor, which is the length with 50% retention divided by mesh size, was comparable to literature values from trawl studies. The average value for cod was similar for Danish and Scottish seines, but lower for trawls. The results are discussed in the context of fisheries management with focus on the landing obligation of the new Common Fisheries Policy.

1. Introduction

Although a decline in the number of seiners in Denmark is evident (1990: 252; 2000: 118; 2015: 32; EuroStat, 2016), Danish seining is still an important fishing technique. In recent years, interest in Danish seining has increased because it is viewed as a fuel-efficient fishing method (Thrane, 2004) and because its environmental impacts are said to be less than those of other active demersal fishing gears such as beam trawls or bottom trawls (ICES, 2006, 2010; Suuronen et al., 2012; Eigaard et al., 2015). The main target species of Danish seiners in Skagerrak and the North Sea are flatfish, primarily plaice (*Pleuronectes platessa*), which has been within safe biological limits for the last three years (ICES, 2015). Nevertheless, there is a general lack of scientific documentation of the selectivity of Danish seines. The sparse existing data (e.g., ICES, 2010; Suuronen et al., 2012) are often based on assumptions or older studies, where other regulations existed, different gears or vessels were used or where data were not analysed following the standards described in Wileman et al. (1996).

A new Common Fisheries Policy that includes a landing obligation (discard ban) system was introduced in most European Union (EU) waters, including Skagerrak and the North Sea, by 1 January 2016 (EEC, 2011, 2012; Condie et al., 2014a,b; Eliasen, 2014; Uhlmann et al., 2014; Sardà et al., 2015). The specific challenge for the industry, and the major difference from the earlier landing quota system is that the catch of all sizes of listed species is counted against the quota. A minimum conservation reference size (MCRS, generally equal to current minimum landing size, MLS) will be introduced for several commercial species and individuals below this size are prohibited from being sold for direct human consumption. Consequently, information about the selective properties of fishing gears is of great importance for the economy and fisheries management as selectivity parameters like L50 (length at which 50% of the fish are retained) and SR (selection range; L75–L25) give an indication of which sizes of fish can be expected by the fishery. This information is important to estimate the probability that the fisheries will adhere the objectives of the landing obligation. Furthermore, if the expectations of the landing obligation are too high (e.g. due to high bycatches of fish below MCRS), the data may allow for recommendations to be made on how to adjust the fisheries to the new system.

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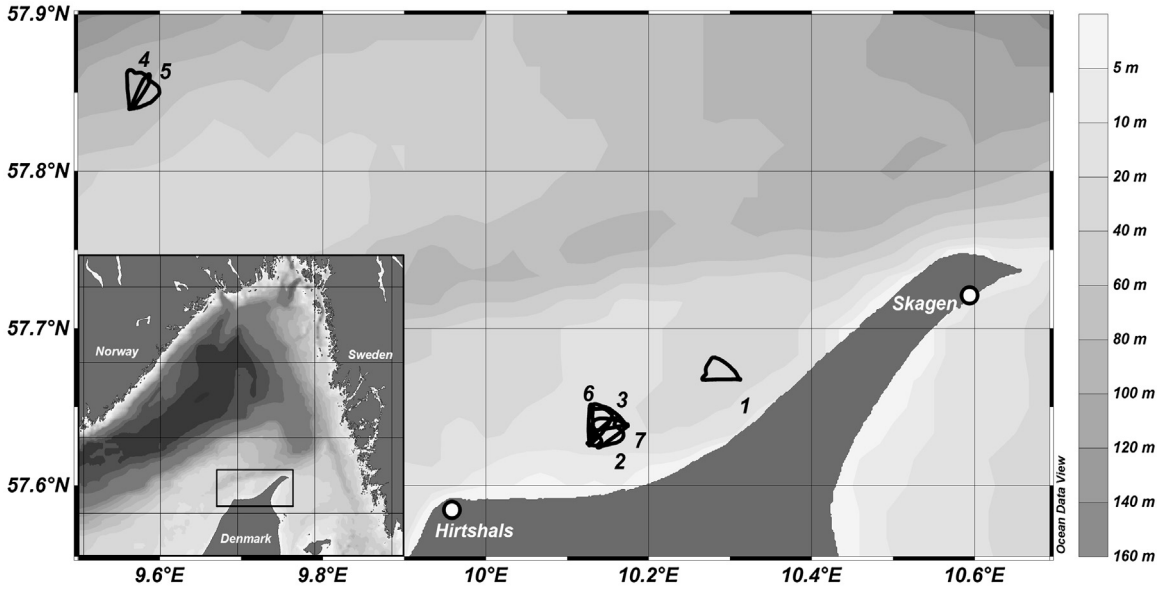

Fig. 1. Area and vessel tracks for the seven hauls conducted for the codend selectivity trials aboard the HG 35 *Vendelbo* in 2014.

By EU law, Danish seines belong to the same legislative category of fishing gears as Scottish seines and bottom trawls. All three gears follow the same technical regulations such as mesh size and selective devices. Several older studies regarding selectivity of Scottish seines exist (Reeves et al., 1992; Isaksen and Lokkeborg, 1993), but the overall state of knowledge is low. A recent theoretical study by Herrmann et al. (2015) estimated the selectivity of Scottish seines on the basis of one of those earlier studies using suitable statistical methods. Nevertheless, they concluded that further studies have to be conducted using currently used demersal seines. The understanding of selectivity in bottom trawls is much greater as the majority of selectivity studies for gears from this legislative category focused on trawls (e.g., Reeves et al., 1992; Graham et al., 2004; Frandsen et al., 2010b; Madsen et al., 2012).

Although the netting materials and codend constructions used in Danish seines, Scottish seines, and bottom trawls are similar, the gears have pronounced differences in construction and in the way they are operated. Bottom trawls use trawl doors to spread the net (von Brandt, 2005), and the towing speed is relatively constant throughout the fishing process. Seiners do not use any doors or other spreading devices, and the speed at which the net is dragged is slower than that in trawling, but it continuously increases during the fishing process. Scottish seiners move forward during the retrieval process, whereas Danish seiners do not as they are anchored (von Brandt, 2005). With such pronounced differences in towing speed and net geometry during the fishing process, it is likely that the selection processes differ among the three types of gears.

Due to the lack of consistent forward motion in Danish seines, it is important to develop a cover based on the principles of the conventional codend cover (Wileman et al., 1996) to study the selectivity of this type of gear. Such a device must cope with the different stages of the fishing process and always keep the cover a sufficient distance away from the codend to avoid a potential masking effect that can occur when the cover comes in contact with the meshes of the codend (Madsen and Holst, 2002).

The main objective of this study was to estimate the selectivity parameters for species caught with Danish seines using the codend design currently used in the commercial fishery. These selectivity parameters were compared to those of bottom trawls and Scottish seines, and the results should prove useful in terms of technical regulations and management policies. The data will also be used to evaluate the gear in terms of the landing obligation and to estimate the potential consequences for the Danish seine and bottom trawl sector now, and in the future, should other species be added to the landing obligation list.

2. Materials and methods

2.1. Study site and experimental setup

The experiments were carried out aboard the commercial Danish seiner HG 35 *Vendelbo* (length overall: 15.47 m, engine power: 91 kW) off the coast of Denmark in Skagerrak (ICES area IIIa; Fig. 1) in August and September 2014. The fishing took place in sandy shallow areas close to the coast (~13 m deep, Hauls 1, 2, 3, 6, 7) that are known to be good grounds for flatfish such as plaice and in deeper grounds (~68 m deep, Hauls 4 and 5) that are known to be good for roundfish such as haddock (*Melanogrammus aeglefinus*).

The vessel's commercial gear was used, which was representative for the Danish seining fleet that operates in Skagerrak and the North Sea. The seine had 380 meshes (nominal mesh size: 120 mm) around the fishing circle, and it consisted of a wing section with a weighted 43.6 m long ground rope, a belly section, and an extension section. The 7 m long non-tapered codend was made of Nymflex 4 mm double twine polyethlyene (PE) netting (mesh size: 124.4 ± 3.0 mm, N = 200, measured with an OMEGA gauge (Fonteyne et al., 2007)) with 97 open meshes around the circumference. The codend was constructed with one selvedge that included three meshes, following commercial practice. Although scientific selectivity studies are normally carried out with newly produced codends without additional devices (e.g., round straps, protecting bags, or flappers) that could affect selectivity, the codend in this study was equipped with two round straps (Fig. 2; Herrmann et al., 2006). These two round straps were 1.9 m in circumference and mounted 0.5 m ahead of the codline and 2.9 m in circumference and mounted 1.0 m ahead of the codline. Round straps are widely used by commercial vessels to limit a codend's circumference just in front of the codline to facilitate fast and more controlled emptying of the codend aboard the vessel, which is thought to improve safety for fishermen handling the gear. However, small variations of the specific mounting of these round straps may occur between