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Questioning the effectiveness of technical measures implemented by the Basque bottom otter trawl fleet: Implications under the EU landing obligation

Nekane Alzorriz[a,b,*], Luis Arregi[b], Bent Herrmann[c], Manu Sistiaga[d], John Casey[a], Jan Jaap Poos[e]

[a] European Commission, Joint Research Centre (JRC), Institute for the Protection and Security of the Citizen (IPSC), Maritime Affairs Unit, Via Enrico Fermi 2749, 21027, Ispra, VA, Italy
[b] AZTI-Tecnalia, Marine Research Division, Txatxarramendi ugartea w/n, 48395, Sukarrieta, Spain
[c] SINTEF Fisheries and Aquaculture, Fishing Gear Technology, Willemoesvej 2, 9850, Hirtshals, Denmark
[d] SINTEF Fisheries and Aquaculture, Fishing Gear Technology, Brattørkaia 17C, 7010 Trondheim, Norway
[e] Wageningen IMARES, Institute for Marine Resources and Ecosystem Studies, P.O. Box 68, 1970 AB IJmuiden, The Netherlands

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ABSTRACT

The selective properties of a bottom trawl fitted with a 70 mm diamond mesh codend and a 100 mm top square mesh panel (SMP) for hake (*Merluccius merluccius*), pouting (*Trisopterus luscus* and *Trisopterus minutus*) and red mullet (*Mullus surmuletus*) were investigated over the period 2011–2013. The experiments were carried out over three separate cruises aboard two commercial Basque bottom otter trawlers in the Bay of Biscay area. "Fall-through" experiments were also undertaken to estimate the potential size selection of 100 mm square mesh for the same species. Results from the "Fall-through" experiments and the at-sea selectivity cruises demonstrated that a 100 mm SMP has the potential to enable undersized and immature individuals to escape through the meshes. However, the selectivity cruises demonstrated that in practice, the SMP was largely ineffective at releasing undersized individuals as only a small fraction of the fish entering the trawl attempted to escape through the SMP during their drift towards the codend. The fraction attempting to escape was quantified by the "SMP contact probability" and was less than 4% for hake and red mullet and less than 15% for pouting. Furthermore, for each species, the release potential for the diamond mesh codend was found to be significantly lower than the length-at-maturity and the legal minimum conservation reference size. On average, the proportions of the total catch of undersized individuals of each species retained by the gear, were 52%, 17% and 45% for hake, pouting and red mullet respectively. Based on our findings, we conclude that the gear currently deployed by the Basque bottom otter trawl fleet operating in the Bay of Biscay is largely ineffective at releasing undersized hake, pouting and red mullet. The introduction of the obligation to land all catches, under the 2013 reform of the EU Common Fisheries policy will create new challenges for the Basque bottom otter trawl fleet and thereby an incentive to improve selectivity to avoid unwanted catches of undersized individuals.

1. Introduction

Over the past 30 years, numerous technical regulations and associated amendments have been introduced in almost all developed fisheries worldwide in an attempt to improve fishing gear selectivity, reduce discards and enhance the status of fish stocks (Madsen, 2007; McClanahan, 2010; Feekings et al., 2012; Santurtún et al., 2014). Despite such measures, discarding in some European fisheries remains high (Uhlmann et al., 2013). The capture and discarding of small immature fish reduces the potential biomass of the exploitable stock and affects subsequent recruitment (Graham et al., 2003). While discarding is a widely recognized problem in many fisheries, it is particularly acute in multi-species trawl fisheries (Daan, 1997). The Basque bottom otter trawl fishery in the Bay of Biscay (ICES Divisions, VIII a, b, d) is one such fishery. Currently, the fleet comprises 7 vessels, ranging from 37 to 42 m overall length. The fleet deploys trawls that have a low headline, typically below 2 m vertical opening, wingspreads between 22 m and 26 m, and

* Corresponding author. Fax: +39 0332 789658.
E-mail address: nekane.alzorriz@jrc.ec.europa.eu (N. Alzorriz).

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footropes between 80–100 m in length. Trawling is carried out at a towing speed of 4 knots at depths ranging from 30 m to 200 m. Trip duration varies from 5 to 7 days. The main target species are megrim (*Lepidorhombus whiffiagonis*), anglerfish (*Lophius* spp.), hake (*Merluccius merluccius*) although squids (*Loligo* spp.), red mullet (*Mullus surmulletus*), pouting (*Trisopterus minutus* and *T. luscus*), sole (*Solea solea*), horse mackerel (*Trachurus trachurus*) and mackerel (*Scomber scombrus*) also comprise target species depending on the fishing ground, season and quota availability (Iriondo et al., 2008, 2010). Discarding of both target and bycatch species in the fishery can be substantial. In 2013, on average, estimated discards represented about 52–65% by weight of the total estimated catch (8532 t) of the fleet (Rochet et al., 2014). Discarding occurs for a variety of reasons including capture of individuals below minimum legal landing size, lack of quota, the absence of a market, damaged or degraded individuals in the catch, and high-grading.

In 2002, a recovery plan was introduced for the northern stock of European hake, in an attempt to allow the stock to recover from its then depleted state (EC, 2002). The recovery plan prescribed inter alia, an increase in the minimum codend mesh size for trawls from 70 mm to 100 mm in the Bay of Biscay (EC, 2002). However, since 2006 the provisions of Annex III, Appendix 3 of EC, 2006 were introduced to provide an optional alternative to the mandatory use of bottom otter trawls with a 100 mm codend mesh size. Such provisions permit the deployment of otter trawls with a minimum codend mesh size of 70 mm provided that a 100 mm square mesh panel (SMP) is inserted into the middle of the top panel of the rear tapered section of the trawl just in front of the untapered section constituted by the extension piece and the codend; a configuration intended to improve the selectivity for undersized hake.

Square mesh panels are known to have great potential for improving selectivity in trawls (e.g., Broadhurst, 2000; Fonteyne and Polet, 2002; Madsen et al., 2002; Tschernij and Suuronen, 2002) by increasing the probability to release both undersized individuals and non-target species entering the trawl (Catchpole and Revill, 2008). However, their effectiveness varies for different species and several studies have shown that they are largely ineffective at releasing certain demersal species (Briggs, 1992; Frandsen et al., 2009; Rosen et al., 2012). The efficiency of such selective devices depends not only on the gear characteristics such as the dimensions of the panel itself, the size of the meshes and the position of the panel in the trawl (Herrmann et al., 2015), but also on the reactions of the fish in the trawl during the fishing operation. Such factors determine whether fish are able to come into contact with the panel and escape through the meshes (Glass and Wardle, 1995; Zuur, 2001; Herrmann et al., 2015).

Despite the adoption of the 70 mm + SMP provisions by the majority of the vessels that comprise the Basque trawl fleet, to date, the effectiveness of the 100 mm SMP has not been investigated and quantified. Furthermore, the average discards of hake over the period 2011–2013 are estimated to be approximately 50% of the total catch in weight of hake, 97% or which comprised individuals less than the minimum conservation reference size (MCRS) (Rochet et al., 2014).

Today, most policy frameworks for the marine environment aim to progressively implement an ecosystem approach (Garcia and Cochrane, 2005; Hering et al., 2010; Article 2(3) of EU, 2013). In an ecosystem approach to fisheries management, one of the basic tenets is that harvesting should be conducted with minimal impact on juvenile fish and that discards should be reduced (Graham et al., 2007; Bellido et al., 2011 Article 2(5a) of EU, 2013). Under the provisions of Article 15 of the 2013 reform of the CFP (the landing obligation; EU, 2013), by 2019, discards of most species will no longer be permitted and fishers from EU Member States will be required to land all catches of quota species from the northeast Atlantic and all species subject to a MCRS from the Mediterranean and Black Seas. The rationale for the landing obligation is that it should create economic incentives for the industry to develop measures to improve selectivity to reduce or avoid the capture of juvenile fish, unwanted catches of bycatch species and any potential over-quota catches.

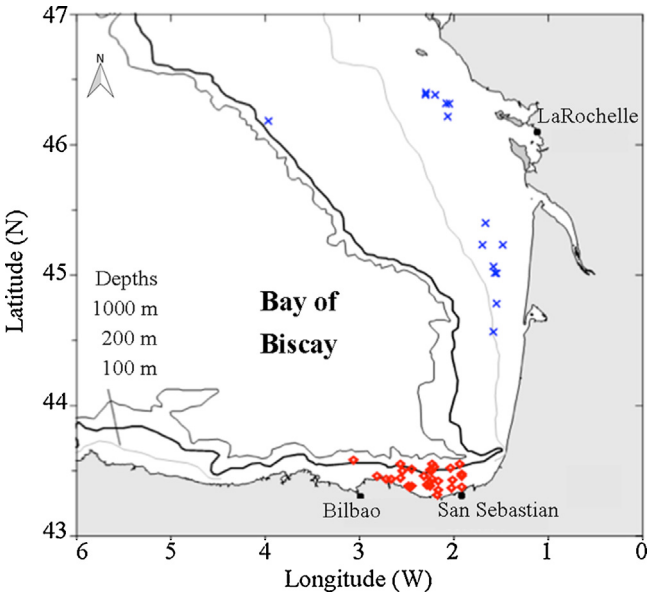

Fig. 1. The Bay of Biscay, showing 100 m, 200 m and 1000 m depth isobaths and fishing position for all hauls during the three cruises between November 2011 and July 2013. Key: X (total selectivity estimation; SMP + C) and ◊ (selection properties of the SMP alone; SMP + CL).

Hence, the question remains whether the provisions of Annex III, Appendix 3 of EC, 2006 are sufficient to meet the objective of releasing undersized hake, whether they allow the Basque fleet to avoid undersized catches of hake and mitigate the potential impacts of the obligation to land all catches. The aim of the present study is therefore to evaluate the selective properties of bottom otter trawl gear deployed by the majority of the Basque fleet and especially the effectiveness of the 100 mm SMP at releasing immature and undersized fish.

2. Material and methods

2.1. Sea trials and data collection

Selectivity cruises were performed at sea on board two Basque commercial trawlers "Gure Gaskuña" (39 m overall length (LOA), 590 hp) and "J. Kalamendi" (40 m LOA, 1190 hp). Three cruises were performed between November 2011 and July 2013 (Table 1). The cruises were conducted in the Bay of Biscay on fishing grounds with depths that varied between 26 m and 267 m (Fig. 1).

All three cruises were conducted using trawls with codends of 70 mm diamond netting attached to an extension of 90 mm diamond mesh constructed using 2.5 mm single polyamide (PA) -twine. The wings and the top panel were PA with a nominal mesh size of 100 mm, 2.5 mm single-twine. In each cruise, the SMP was made from 100 mm (nominal, knot to knot) meshes extended into the middle of the upper section of the extension, positioned 12 meshes in front of the codend. The SMP was one-fourth of the full width of the extension section, where the mean internal vertical opening of the gear was around 1.5 m (240 meshes round). The specifications for the gears used on each cruise varied with respect to length of headline and footrope, codend length and panel position in relation to the codline and are summarised in Table 2.