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Winners and losers of a technical change: A case study of long-term management of the Northern European Hake

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ABSTRACT

Since 2004 management of the Northern Stock of European Hake has been focused on recovering the stock level up to a level consistent with the precautionary approach. After that, in 2007 and once this objective was on the track of being fulfilled a long term management plan was proposed. This plan has to be congruent with the maximum sustainable yield policy as well as producing stable yields and population levels. Thus, in that year, a bioeconomic impact assessment of long-term management plans for this stock was carried out. However the biological and economic assessments were not integrated and not fully congruent. On the basis of this assessment additional questions relating to the combination of harvest control rules with technical measures were raised by the managers and stakeholders.

Here, the model used in the biological assessment is extended in order to integrate the economic part and to shed light on the effect of technical measures at stock and fleet level. Two scenarios are presented: a 'base case', where the model is parameterized from historical observations; and an 'alternative case' where an increase in the mesh size of some trawlers is simulated.

In both scenarios the probability of falling below limit reference points is above 0, contrary to the result obtained in 2007. However, the relative trends of the median of population indicators are similar. While the biological performance of the base and alternative scenarios is also similar the trawlers are highly penalized when their mesh size is increased and the overall economic profit is lower. Furthermore, two fleets gain and the rest remain the same with the increase in the mesh size of trawlers.

1. Introduction

Technical measures such as mesh size regulations are commonly used to strengthen catch quotas and effort management as part of recovery and long-term management plans in order to reduce growth overfishing and the discarding of undersized fish.

This concept is based on the classical theory of fisheries management related to yield per recruit analysis (Armstrong et al., 1990; Quinn and Deriso, 1999; Scott and Sampson, 2011) or spawn at least once; policies (Myers and Mertz, 1998). In yield per recruit analysis an exploitation pattern is related to an optimum harvest rate which will maximize long-term yield and likewise a harvest rate is related to an optimum exploitation pattern. Within the context of Ecosystem Based Fisheries Management (EBFM) Froese et al. (2008) have recently defined the optimum size at first capture. Such approaches are based on stock dynamics and the overall exploitation and selection pattern, but they do not consider the dynamics of the fleets involved in the exploitation of the stock. When the stock is exploited by a single homogeneous fleet, in terms of the selection pattern of individual vessels, the problem of increasing the selectivity and the benefit of this increase revert to the fleet itself.

Usually stocks are exploited by several fleets operating with different fishing gears and mesh sizes. In general, each fleet is focused on a particular age range, even if there is some overlapping of ages between them. In some fleets like trawlers, when the mesh size is increased, the number of larger individuals retained increases and that of smaller ones decreases. Then, in a hypothetical situation where only the mesh size of the trawlers was increased, the level of exploitation of smaller individuals would decrease, increasing that of larger individuals. The result of this could be an increase in competition between fleets that catch larger individuals, if the future growth of smaller individuals, now underexploited, does not balance the exploitation increase of larger individuals. In the context of EBFM some authors have recently advocated a balanced exploitation of the individual stocks instead of selective fishing (Rochet et al., 2009; Zhou et al., 2010).

Due to the nonlinear and complex nature of fishery systems, it is not straightforward to derive the effect of technical changes within the individual fleets. Suuronen and Sarda (2007) have anal-

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ysed the role of technical measures such as mesh size restrictions in European waters. They concluded that their effect, in biological terms, could not be as significant as expected and recognize that measures that imply cost or lost of earnings for the industry could be unsuccessful. So they recommend carrying out cost-benefit of technical measures before their implementation. Several studies have analysed the cost and benefits of an increase in mesh sizes, at fleet level, in particular cases (Heikinheimo et al., 2006; Macher et al., 2008; Pascoe and Revill, 2004; Thunberg et al., 1998; Tschernij et al., 2004). In the short term, almost all the scenarios in which an increase in selectivity at age was simulated resulted in short term losses for the fleet compared with *status quo* scenarios. Two scenarios in Macher et al. (2008) gave similar results to those obtained in the *status quo* scenario due to the increase in selectivity only affecting ages that were previously fully discarded, the landings thereby unaffected and with similar profits. In general, the performance of the overall fleet and the stock was better when selectivity was increased. In the study of Kuikka et al. (1996) the escapement mortality they modelled was considered to be high, so the increase in mesh size did not produce significant benefits in the stock and the yield in the long term. When the change in selectivity was not applied to all the fleets, the fleets not affected by the change gained more than those affected by the change (Heikinheimo et al., 2006; Pascoe and Revill, 2004). The variety of results obtained in these studies highlights the necessity of analysing the effect of technical changes, case by case, as pointed out by Suuronen and Sarda (2007).

The Northern European Hake stock management is at the point of moving from a recovery plan to a long-term management plan (LTMP). In 2007, a bioeconomic impact assessment of LTMPs for this stock was carried out (SEC, 2007a,b). However, the biological and economic assessments were not integrated and not fully congruent.[2] Based on the conclusions of these analyses the European Commission (EC) launched a consultation with the stakeholders about the LTMP. The consultation dealt with different aspects of the management of the stock. In particular, it considered the increment in mesh size on some fleets, such that the overall selection pattern improves and discards decrease. Thus, the need for an approach that could facilitate the assessment of such changes, within the framework of the long-term management of the stock, was identified. In May 2008, both North and South Western Water Regional Advisory Councils (NSWWRACs) stated a specific question in relation to what would be the effect in Northern Hake induced by the harmonisation of a unique mesh size of 100 or 120 mm for gillnetters and trawlers operating in Subarea VII and Divisions VIIIabd (Fig. 1). The modelling tool was developed and parameterized and various changes in mesh sizes were simulated under NSWWRACs premises. In this study, the results of the most data rich scenario are presented.

This contribution aims to calculate the costs and benefits of a mesh size increase, within the framework of the LTMP of the Northern stock of Hake, analysing them at stock and fleet level. On the basis that the fleets involved in the Hake fishery used different gears and mesh sizes, the exploitation is divided into several fleets according to their technical characteristics. Furthermore, as discards are expected to be affected by the LTMP and mesh size increase, they have been included in the simulation. In 2007, the exploitation was simulated using a single fleet and discards were not included. Hence, to begin, the paper compares which are the differences between the impact assessment performed in 2007 (SEC, 2007b) with those undertaken here.

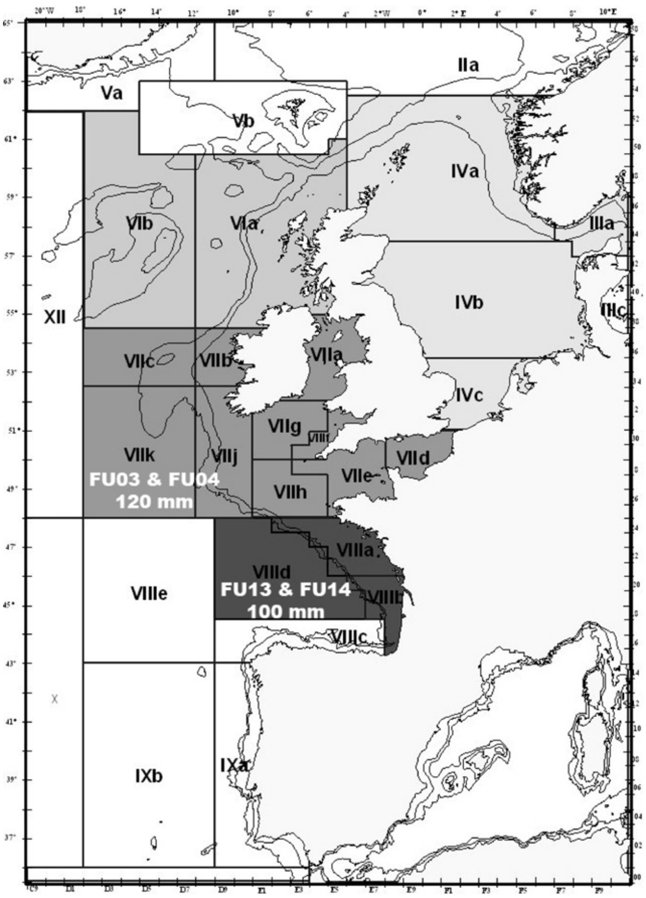

Fig. 1. Northern European Hake distribution along ICES divisions and location of Fishing Units considered in the article and their mesh size.

The objective of this study is to perform an integrated bioeconomic analysis of the LTMP for Northern Hake stock in order to determine the robustness of the evaluations performed in 2007 (SEC, 2007a,b). The robustness is analysed in relation to the sustainability of the stock and to the fleets' performance with and without the implementation of technical measures. First, the case study is presented including descriptions of the fishery and its management. Then the simulation model, data used and parameterization of simulations are described. Finally, the results and their discussion are presented within the framework of the management of this stock, together with (an analysis of) the usefulness of this approach.

2. The case study

The Northern stock of Hake is considered to be a subpopulation of the European Hake (*Merluccius merluccius*), which is a demersal species distributed widely from Mauritania to Norway and the Mediterranean Sea (Casey and Pereiro, 1995). For management purposes, three different stocks are considered: the Mediterranean stock; and two stocks in the Northern East Atlantic, divided by the parallel 44.3°, the so called Northern and Southern stocks of Hake. The northern stock of European Hake, the only stock considered herein and referred to as Hake, is exploited principally by Spain and France, with 60% and 30% of the total international catch, respectively. The International Council for the Exploration of the Sea (ICES) divides the fishing activity of this stock into 15 different Fishery Units (FUs), characterised by the gear used and the fishing area (see Table 1). Five of these FUs account for 70% of the total international catch, FU01, FU03, FU04, FU13 and FU14. For a full review on Hake biology and of European Hake see Murua (2010).

[2] In the economic evaluation age structure was not considered and the production model used to generate the catch was not the same one used in the biological evaluation. Only the medians were considered and from 2015 onwards it was assumed that the system was stable.