HARVESTING AND POPULATION DYNAMICS OF EUROPEAN HAKE IN THE GULF OF LIONS (NORTHWESTERN MEDITERRANEAN)

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Abstract
The European hake (*Merluccius merluccius*) is one of the main resources of the demersal fishery in the Gulf of Lions. This stock is considered as a shared stock, exploited by both Spanish and French fleets. The objective of this work was to analyze its population dynamics and to assess its current state of exploitation. Data were obtained from both commercial monitoring and scientific surveys. Two different stock assessment models were considered, which showed similar results, with the recruitment and spawning stock biomass displaying a decreasing trend along the data series. This trend was also found in the average length in catches. The current fishing mortality estimates were higher than the reference points and the stock is considered to be overexploited. Adequate management measures are needed to improve the status of the stock.

Keywords: Stock assessment, Demersal, Fisheries, Population Dynamics, Gulf of Lyon

The European hake (*Merluccius merluccius*) is one of the main resources of the demersal fisheries in the Gulf of Lions, where it is considered as a shared stock since it is exploited by both French and Spanish fleets. Its annual catch has oscillated between 1100-2800 t between 1998-2014 (Figure 1), with the French trawl as the most important gear in catches (72%) followed by French gillnetters (14%), Spanish trawlers (9%) and Spanish longliners (5%). Catches of trawlers are mostly composed by small individuals, mainly recruits, whereas gillnetters and longliners catches are mostly constituted of larger individuals, mainly mature females. The analysis of data from 1988-1991 determined that the level of exploitation at that moment was far above the optimal sustainable level, and the stock was found to be overexploited [1]. The management measures applied in the last years included the substitution of the traditional diamond 40 mm mesh size in the codend for the square 40 mm or diamond 50 mm in 2010 for trawlers, temporal bans of 1 month for both French and Spanish trawlers and the frozen of the fishing effort at 2008 levels since 2009, in a High Sea Fishery Restricted area in the eastern part of the Gulf. However, since 2009, due to the large decline of small pelagic fish species in the area, trawlers fishing small pelagic species diverted their effort on demersal species, including hake.

The objective of the present work is to analyze the population dynamics of the European hake in the area and assess its current state of exploitation. Data were obtained from different sources, 1998-2014: (i) official catches by fleet; (ii) monthly or quarterly on-board and on-port sampling for the different gears, (iii) annual bottom-trawl surveys and (iv) individual biological samplings. Interannual trends of the annual average length by gear have been analyzed by linear regression. Growth parameters used were obtained from tagging experiments in the study area [2]. Maturity ogive was calculated using biological data collected over 2004-2014 and natural mortality was calculated as a vector. The stock assessment considered ages 0-5+, with the survey index as tuning fleet (ages 0-2). The models applied were Extended Survivor Analysis and a4a, with suitable parameters selected after running different sensitivity analysis and the robustness of the results tested by retrospective analysis. The yield per recruit analysis was used to estimate the reference points for the stock.

The investigation of catch data showed that annual average length has significantly decreased for both French gillnetters (from around 39 to 35 cm, $p<0.001$) and Spanish longliners (from around 59 to 43 cm, $p<0.001$, Figure 2) during the period analyzed. Average length for Spanish trawlers did not show any trend (around 24 cm, $p>0.05$) and for French trawlers a slightly increasing trend was detected (from 19 to 21 cm, $p<0.05$). The best a4a model showed similar results than XSA in terms of fishing mortality and spawning stock biomass (SSB), but gave higher estimates of recruitment, especially for the last year (Figure 1). Both recruitment and SSB show fluctuations along the data series, with a general decreasing trend and currently at low levels, with certain stabilization in 2014. Fishing mortality (F) has reached the highest levels of the time series. For XSA, the current F (1.75 as the average of ages 0-2 for years 2012-2014) showed values nearly 12 times higher than the reference point $F_{0.1}$ (as a proxy of F_{MSY}= 0.15). The stock is in an overexploitation status. The improvement of the stock would only be possible with an adequate observation of the management regulations already in force as well as the reduction of the current fishing mortality, which could also include adequate spatio-temporal closures for the protection of nursery and spawning areas.

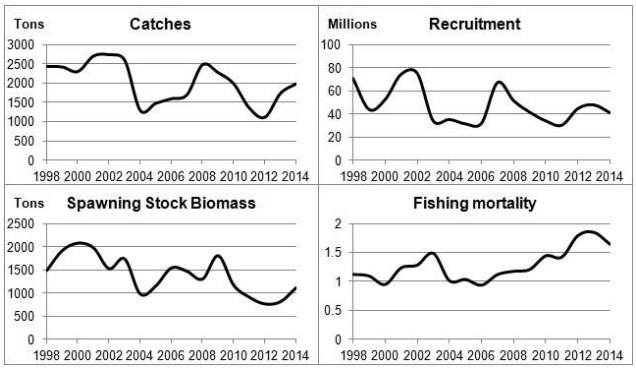

Fig. 1. Catches of European hake in the Gulf of Lions and results of the stock assessment model.

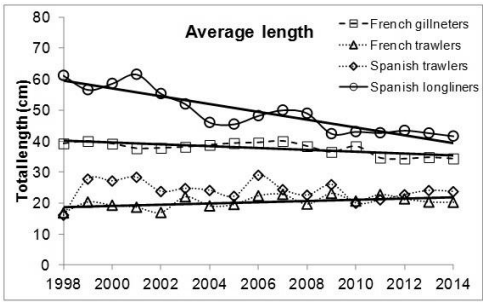

Fig. 2. Average length of catches of European hake by gear for the period analyzed. Black lines represent significant trends.

References
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