

First steps towards providing management advice for the Bay of Biscay squid (*Loligo vulgaris*)

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Summary

In the Bay of Biscay, cephalopod catches were in the past by-catches of demersal trawl fisheries that targeted hake, anglerfish, megrim or sole among others. However, in the last years cephalopods obtained in multispecies fisheries are becoming more important in terms of the share of the catch that they represent or the income for fishers. They have even become target species for some trips in certain seasons of the year. Due to this increase in catches and economic importance, there has been an increasing effort within ICES to compile all the information available on cephalopods in the North East Atlantic with the objective of providing management advice in the short term. One of these species is the common squid (*Loligo vulgaris*) in the Bay of Biscay (ICES divisions VIIIa,b,d). This work represents the first attempts for providing management advice for this stock. After compiling and reviewing the available data, two alternative methods in which to base the management advice are tested: the ICES approach for data-limited stocks and a biomass dynamic assessment model. Trends in abundance indices are compared to model outputs. Although the results are promising, the short-lived nature and the high fluctuations of the stock motivate further method developments.

Introduction

Squid (*Loligo vulgaris*) in the Bay of Biscay (ICES divisions VIIIa,b,d) is one of the cephalopods species obtained in multispecies fisheries which has become more important in the last years in terms of the share of the catch that they represent and the income for fishers. However it lacks a scientific assessment and it is exploited while its abundance, productivity and sustainability are undetermined or highly uncertain. With the objective of providing management advice for this and other cephalopod species in the short term, ICES has launched several initiatives in 2013 and 2014 (e.g. data call, CRC report, several workshops, etc.) that will be culminated in a theme session of the ICES Annual Science Conference. In this paper we present the first attempts for providing management advice for squid in the Bay of Biscay.

Material and Methods

The squid is a short lived species (living a maximum of 15 months), characterized by its high natural mortality. It is distributed in the North East Atlantic and currently there is no study that could help on the definition of the stock, but ICES considers all the information in VIIIa,b,d as a unit (ICES 2013). Information on this stock consists on a fishery-independent abundance index from the French groundfish survey called EVHOE from 1992 to 2012 (except 1993 and 1996), and landings by country and ICES area since 1996. The fraction between the total yearly abundances of *L. vulgaris* and the total yearly abundance of *Loligo spp.* in the survey hauls were used to disaggregate the survey indices and the landings by species.

Two alternative methods in which to base the management advice were tested. On the one hand, the ICES approach for data-limited stocks (ICES 2012). On the other hand, a Schaeffer biomass dynamic assessment model (Schaeffer 1954) which is implemented both in a maximum likelihood framework

including only observation errors and in a Bayesian state-space model framework incorporating observation and process errors (Millar and Meyer 2000, Polacheck *et al.* 1993).

Results and Discussion

Currently ICES does not provide advice for Bay of Biscay squid. However, according to the ICES approach for data-limited stocks, this stock could be classified as Category 3 (stocks for which survey-based assessments indicate trends). Then, the recommended catch would be based on the last catch adjusted by the ratio between the two most recent index values with the three preceding ones. This would result in an increase in the catches due to the sharp population increase suggested by the survey in the last years.

The second approach consisted on a Schaeffer biomass dynamic model fitted to data from 1997 to 2012. Given that there was exploitation before 1997 the initial biomass was considered different from the carrying capacity. Assuming only observation errors the logarithm of the likelihood function was evaluated depending on the value of the intrinsic growth rate r , the carrying capacity k and the initial state. The grid search method allowed identifying the combination of suitable parameters (leading to biomass levels large enough to support the restrictions imposed by the catches) and the areas where approximately the maximum will be located. Afterwards, a Bayesian state-space version of the Schaeffer model that incorporated both observation and process error was applied. The fitted values were within the range of the observations but the model was not able to reproduce the large fluctuations observed in the last three years. In addition convergence could still be improved.

This work is considered yet preliminary, but it allows to outline the main lines for future work:

- In the last years there have been efforts to improve the knowledge on cephalopod biology and fisheries. However, there are many data issues not fully resolved yet like species identification that deserve further work.
- High fluctuations of short-lived species might require development of data limited approaches that are less sensible to drastic inter-annual changes.
- The surplus production model fit could be improved. Having additional biological information incorporated through the prior distribution could be useful.
- Additional data (effort, recruitment indices, etc.) could be used to improve the biomass dynamic fit or to try alternative population dynamics models.

References

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