Catch curve analysis for the red seabream (*Pagellus bogaraveo*) stock from the Azores (ICES Xa2).

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Summary

Validate assessments are not available for red seabream from the Azores (ICES area Xa2) and so, current fishing mortality (F) is not known from modelling. Total mortality (Z) was estimated using the catch curve analysis. Annual fishery length composition from 1995 to 2013 was used and converted to catch at age using annual survey age length keys (ALK). Adopting a constant value of natural mortality (M) for the species the annual fishing mortality was estimated. Total mean annual biomass of the exploited stock was then estimated from the catch equation. Results suggested an increase trend on the annual fishing mortality along time but with very high fluctuations. High values of fishing mortality (F=0.6-0.7) are estimated during the first (1995-1998) and last three years (2011-2013), although high uncertainty are observed. Only for the period 2000-2002 fishing mortality is equal or lower than natural mortality (M=0.2). The correlation between survey relative abundance indices and biomass values estimated from the catch curve suggests that mortality is dependent of fish availability. Changes on the catchability along time is suggested as an explanation for the high variability on fishing mortality.

Introduction

Red seabream (*Pagellus bogaraveo*) is the main commercial species of the mix demersal hook and line fishery from the Azores (Pinho et al, 2014). This stock has no management objectives defined because the uncertainty on the assessment, being precautionary managed based on trends of abundance indices and landings (ICES, 2014). Structured models and yield per recruit analysis have been explored for the stock assessment of this resource. Catch curve is one of the direct methods available to estimate total fishing morality (Z) (Cadima, 2003). In this paper we use a simple method to analyse the age composition of *P. bogaraveo* from the Azores and to estimate total fishing mortality. The method is also applied for data (age length keys and fishery length compositions) diagnostic purposes.

Materials and methods

Fishery length compositions of *Pagellus bogaraveo* from commercial landings for the period 1995-2013, collected under the national Data Collection Framework (DCF), were used. Annual length compositions were converted to age compositions using annual age length keys (ALK) data collected from the annual spring bottom longline survey (ARQDAÇO). Age length compositions were used to estimate total mortality (Z) by year applying the catch curve method. A pseud cohort (equilibrium) approach was used. Points corresponding to the fully recruited individuals to the fishery were selected manually for each year by analyzing visually the correspondent annual catch curve plot. A regression analysis was then performed to the selection interval and a value for total mortality (Z) estimated. Fishing mortality (F) was then estimated assuming a constant value of natural mortality (M) for the full recruited age interval.
Results and discussion

Survey sampling for aging presents problems for the extremes of the length distribution, juveniles (<20cm) and older individuals (LF>50cm). This problem was overcome by computing a plus group at age 9 (representing the ages 1-8 more than 80% of the total landings) and grouping ages 0-1. Otoliths sampling follows a stratified design by length and represents well the annual survey length distribution for red seabream, being as expected proportional to the annual abundance of the species.

Age of full recruitment, detected graphically, vary between age 3 and 5 (Fig. 1). Annual catch-at age show a decrease of larger individuals along time and may suggest growth overexploitation (ICES, 2014; Diogo et al. 2015). The selection interval of ages for the regression analysis vary between years being usually selected the range of ages 4-7 or 4-8. Annual total mortality (Z) estimated from the regression on the selected range of ages presented an increase trend but with high fluctuations with peaks during 1996-1997, 2003-2004, 2008 and 2011-2013. Fishing mortality (F) follows the same trend (Fig. 2). Estimates of fishing mortality, lower than the adopted value of natural mortality (M=0.2) were observed for the period 2000-2002.

Pinho et al. (2014) have already suggest an increase on fishing mortality on the recent years considering the actual exploitable level unsustainable. However, some level of variability on the vulnerability of the mega spawners is observed. This problems seems to be reflected on the form of the catch curve by year, affecting the slope of the descending portion of the curve and so producing potential bias on the total fishing mortality (Z) (Fig. 1). Low mortality values are estimated for the period 1999-2002 and large variability are observed for the estimates for the very recent years (2011-2013). Confronting the abundance indices estimates from the catch curve and from the bottom longline survey (ARQUADACO) high correlation is observed (with both time series in temporal phase) except for the years 2001 and 2002, which may suggest that those estimates may be underestimate (Fig. 3). It appears from this result that annual mortality variability is probably related with catchability variability of the mega spawners (LF>37cm age 6) which seems to be correlated with the species annual abundance variability on the Azores.

References