

Common octopus (*Octopus vulgaris*, Cuvier 1797) abundance dynamics and its relationship with environmental parameters on the Portuguese Northwest Coast

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Abstract: The commercial landings of the common octopus *Octopus vulgaris* in Portugal increased 50% in the last 20 years. Official landings show that this has been associated with the increasing importance of the common octopus as revenue guaranty in non-octopus targeting fisheries. The stock shows large fluctuations in landings that can reach up to 50 % between consecutive years. The recruitment to fisheries depends mainly on the pre-settlement environmental conditions. Studies made in the Gulf of Cadiz and leeward Algarve, on the south Atlantic Iberian coast reveal that increasing rainfall and extreme sea surface temperature during early life stages affect recruitment. The environment conditions in the Portuguese northwest coast are highly dynamic characterized by strong northwesterly winds during autumn-winter causing a strong seasonal upwelling. By applying multivariate techniques like the Dynamic Factor Analyses (DFA) and time series methods to the landings per unit of effort (LPUE) as a proxy of abundance, we analyzed the correlation between the species abundance and five explanatory variables off the Portuguese coast.

Introduction:

The common octopus *Octopus vulgaris* is an important fisheries resource in Portugal. Most landings are conducted by the small-scale fleet with a part of the fleet using the common octopus as a revenue resource to complement their traditional target species. In fact, despite the growing tendency in landings, recently the annual landings had decreased sharply by 50% leading to serious concerns by the fishermen. With no evidences of overexploitation of the stock, as it recovers from one year to another, abundance variations observed seem to be caused by the environmental conditions. With a short (one to two years) lifespan, high growth rate and terminal spawning, recruitment is strongly dependent of the environmental conditions that paralarvae and pre-recruits are subject to. This dependence of the recruitment success and consequently on landings on the environmental conditions was already demonstrated by several authors (e.g. Sobrino *et al.*, 2002; Sonderblohm *et al.*, 2014). The differences found in the reproductive cycle of common octopus populations of the northwest and the south Portuguese coasts show that both populations adapt differently to the environmental conditions in the South and Northwest coasts. In the Portuguese coast *O. vulgaris* abundance and distribution is poorly accessed by effort independent surveys, being commercial landings by unit of effort (LPUE) of common octopus the best proxy of the species abundance. The aim of the present study is to identify environment drivers for *O. vulgaris* abundances patterns in the Portuguese northwest coast.

Material and Methods:

After identifying trips where *O. vulgaris* is the main landing species, through CLARA, we've used multiple regression trees to inspect for distinctive drivers (ICES rectangle, month and gear) responsible for landing profiles along the Portuguese coast as reported in logbooks. For the identified zones two time series ranging between January 1995 and December 2010 of *O. vulgaris* standard LPUE were obtained. Using consecutive landing days as unit of effort, the LPUE is determined by applying a capturability index to the monthly raw LPUE of the selected landings (Lourenço and Pereira, 2006). The principal component analysis was used to identify seasonality in the LPUE time series, followed by DFA, aiming to identify common trends in both time series.. Five independent environmental variables were selected as explanatory factors: precipitation (rain), North Atlantic Oscillation index (nao), Sea Surface temperature (sst); east-west component of Ekman's transport (ekman) and east-west component of wind stress (wind). A cross-correlation function (CCF) was used to assess the correlation between each environmental variable and the LPUE time series.

Results and Discussion:

The study area defined to this study was the Portuguese Northwest coast. The preliminary analysis showed two zones of different common octopus landings profiles. The LPUE of the northwest zone are low (overall mean = 171.00 kg/day) in comparison with the overall mean LPUE for the north zone (343.16 kg/day) indicating a lower abundance of *O. vulgaris* in the northwest zone. Nevertheless, both zones present an increasing tendency in LPUE in recent years with the year of 2010 recording the highest LPUE for both zones (north mean LPUE = 822.41 kg/day; nw mean LPUE = 292.02 kg/day). PCA results allowed the identification of two LPUE groups depending on month. While the north zone monthly LPUE was separated in first semester group (of lower LPUE) and second semester group (of higher LPUE), the northwest zone monthly LPUE was separated into Winter/Spring months (Jan, Feb, March, Apr, Oct, Nov, Dec) and Summer/Autumn months (May, June, July and August). The DFA analysis identifies 3 common trends in each LPUE series. For the north zone, the first trend is related with the first semester months, the second trend with summer months and the third trend with the second semester months. For the northwest zone, the first trend is related with autumn/winter months, the second trend is related with spring/summer months and the third trend is related with July/August and September. The CCF analysis show that the LPUE series correlate differentially with each environmental variable with rain and ekman presenting higher negative correlations with a time lag of eight to nine months. The signal the environmental signal on the LPUE series is identical between zones .

Bibliographic References:

- Sobrinho I, Silva L, Bellido JM, Ramos F (2002) Rainfall, river discharge and sea temperature as factors affecting abundance of two coastal benthic cephalopod species in the Gulf of Cadiz (SW Spain), Bulletin of Marine Science 71(2): 851-865
- Sonderblohm C, Pereira J, Erzini K (2014) Environmental and fishery-driven dynamics of the common octopus (*Octopus vulgaris*) based on time-series analyses from leeward Algarve, southern Portugal. ICES Journal of Marine Science.
- Lourenço, S, Pereira, J (2006) Estimating standardize landings per unit effort for an octopus mixed components fishery. Fisheries Research 78: 89-95.