

Principal spatio-seasonal patterns of *Octopus vulgaris* in the Mauritanian waters from 1987 to 2017

By means of appropriate factorization and dimension reduction, we demonstrate the usefulness of empirical orthogonal maps (EOM) to sketch spatio-seasonal patterns from large series of georeferenced scientific/monitoring surveys. This was applied on *Octopus* spatial distributions in the Mauritanian waters for the two annual spawning seasons over the last thirty years (1987-2017). It allowed reducing the two sets of thirty-four and twenty-seven surveys respectively down to very few informative and symptomatic maps whose dynamic was linked to abundance. Our study revealed that:

For the hot season:

- One single principal map (the first EOM) explained nearly half (48%) of the overall variability of the initial data and was predominant all along the study period. Its amplitude was strongly correlated with the abundance of octopus during this season (correlation coefficient of 0.79 and p-value 7.4×10^{-7}). It is also the only one among the first five EOM, which explain 72% of the variability, to have a significant correlation with abundance.
- This suggested that, over the last thirty years, the biogeography of octopus during the hot season was stable and well represented by a single spatial pattern whose dominance explained biomass. The symptomatic pattern of the hot season consisted in a north-south decreasing gradient of concentration.

For the cold season:

- The dominant spatial pattern was more composite as the first ten empirical orthogonal maps were needed to explain 67% of the initial variability (the first one alone explaining only 18%). Five of these ten EOMs were correlated with abundance and had strong spatial structures.
- These abundance-correlated EOMs allowed us to characterize the major spatio-temporal fluctuations and trends in abundance over the study period. An average spatial pattern of the cold season was therefore highlighted, as well as its average temporal evolution, exhibiting two rich zones with an increasing trend for the recent period after having decreased at the beginning of the period.
- One principal map (the ninth one) showed significant correlation with the upwelling index few months before and represented the spatial patterns that was connected with this key environmental controlling factor.