Predator-prey relationships between *Molva macrophthalma* and *Gadiculus argenteus*: the role of prey size and bathymetric variations.

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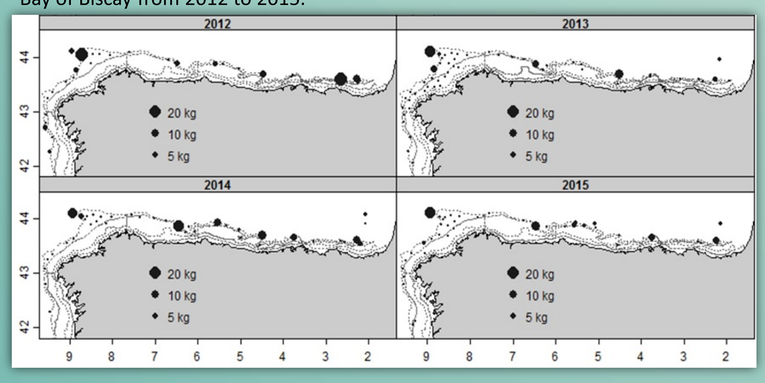
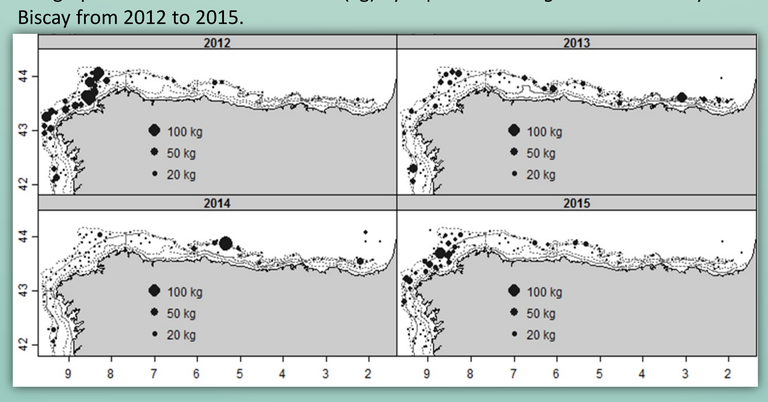
Geographical distribution in biomass (kg) by capture of *M. macrophthalma* in the Bay of Biscay from 2012 to 2015.



Geographical distribution in biomass (kg) by capture of *G. argenteus* in the Bay of Biscay from 2012 to 2015.



Introduction

Molva macrophthalma (Osteichthyes, Class Actinopterygii) is a demersal species restricted to the northeastern Atlantic Ocean, from the southern Bay of Biscay to the Mediterranean Sea, whose diet is based on crustaceans and other fishes. Silvery pout (*Gadiculus argenteus*) is a bentho-pelagic species considered to be a forage fish[1], with broad geographic distribution and high abundance. Considering that silvery pout is one of the main trophic resources of ling *(M. macrophthalma),* we investigated the spatial overlap and the relationship between predator and prey.

Methodology

Data come from the demersal trawl surveys, carried out by the Spanish Institute of Oceanography (IEO) each autumn since 1983 across the southern Bay of Biscay. These surveys were based on a stratified random sampling design considering different depth strata (<70, 70-120, 121- 200, 201-500, >500) and geographical regions (MF: Miño-Finisterre, FE: Finisterre-Estaca, EP: Estaca-Peñas, PA: Peñas-Ajo, AB: Ajo-Bidasoa), using an otter trawl 44/60 gear. A total of 3898 hauls were performed.

Stomach contents of 2777 *M. macrophthalma* were also analyzed from 1992 to 2015. Due to the lack of large specimens, only data from small ones were examined. Diet composition and volume occupied by each prey were recorded and, when possible, prey sizes too. Geographical distribution, mean size by depth range and frequency of occurrence by year were analyzed. Percentage of volume of prey taxa and size structure of *G. argenteus* compared with *M. macrophthalma* sizes was explored too. Size structure of *G. argenteus* in stomachs and that of those caught in the net of the same hauls were also compared.

Fig 3. Evolution of the frequency of occurrence of predator in black (*M. macrophthalma*) and prey in red (*G. argenteus*) during the whole historical series of trawl surveys (1983-2015).

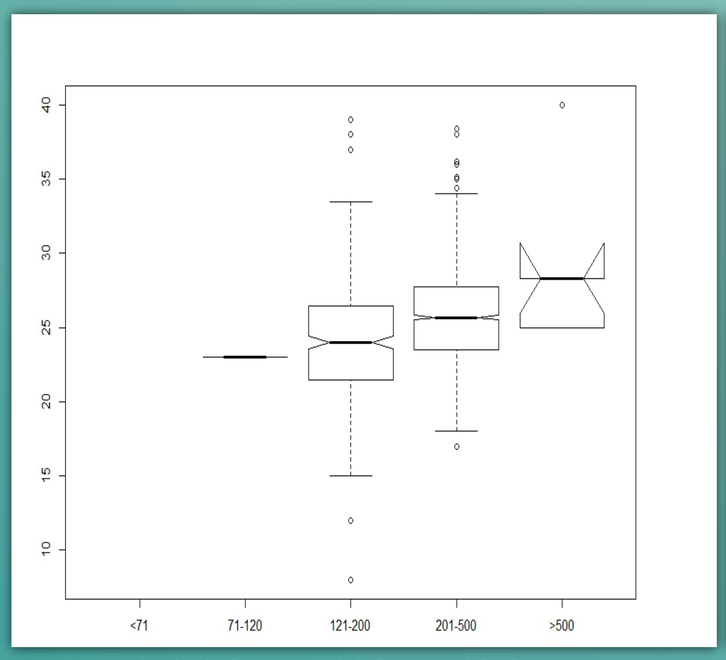


Fig 1. Mean sizes (cm) of *M. macrophthalma* in each bathymetric strata (meters).

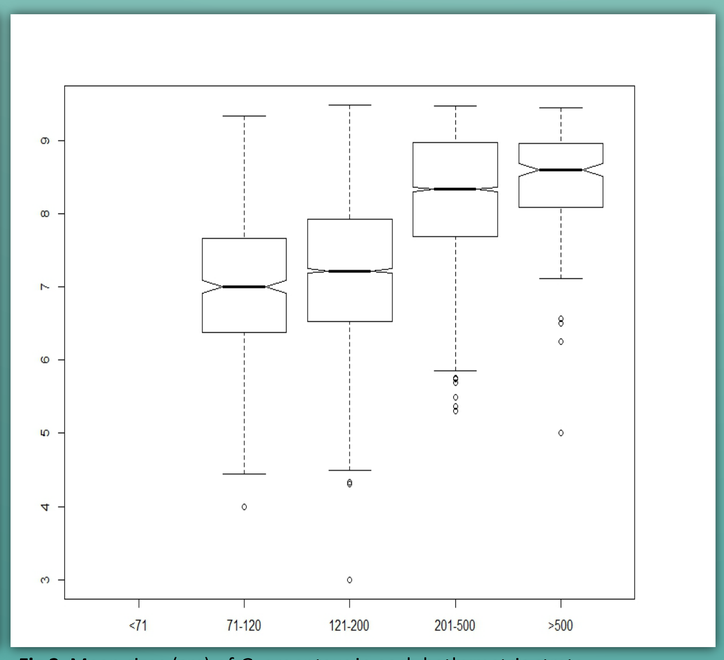


Fig 2. Mean sizes (cm) of *G. argenteus* in each bathymetric strata (meters).

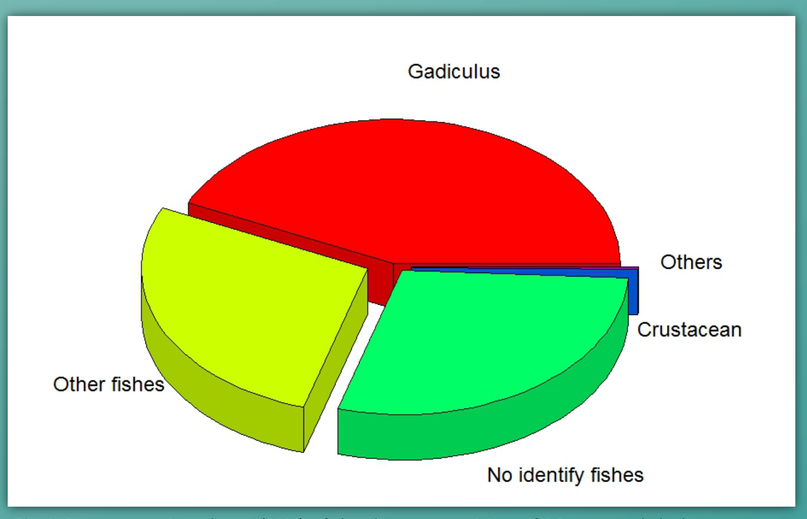


Fig 4. Percentage in volume (% V) of the diet composition of *M. macrophthalma.*

Results

- Mean sizes by depth strata are shown in Fig. 1 and Fig. 2. In both cases, a bigger-deeper trend was observed.
- The evolution of frequency of occurrence of predator and prey along the time series (Fig. 3) reflected a decreasing trend of the prey (*G. argenteus*) in the 90' along with an increasing trend of its predator (*M. macrophthalma*).
- Figure 4 showed that almost 50 % of *M. macrophthalma* diet (in volume) was composed of *G. argenteus* showing a clear dependence on this forage fish. However, it should be taking into account that a high percentage of unidentified fishes could be silvery pout.
- When sizes of predator and prey were compared (Fig. 5), no clear trends in predator size-prey size were observed.
- When comparing prey size in the stomachs with those caught in the hauls (Fig. 6), a predilection for the smaller ones was detected.

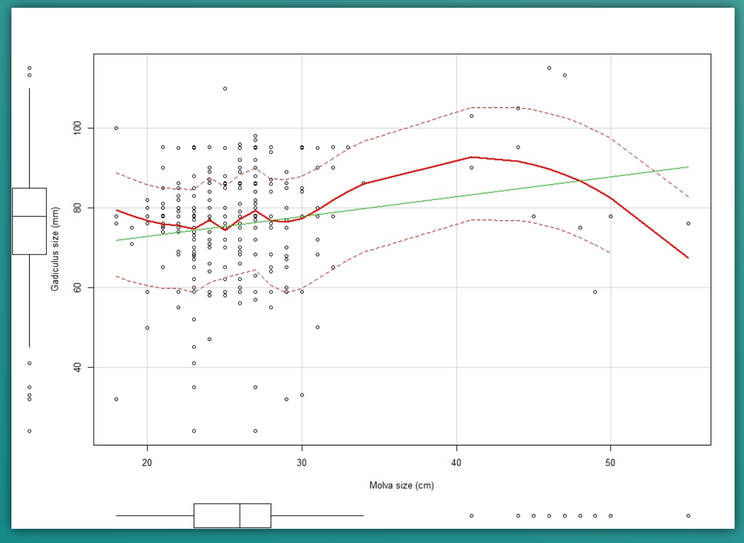


Fig 5. Relationships between predator size in cm (*M. macrophthalma*) and prey size in mm (*G. argenteus*).

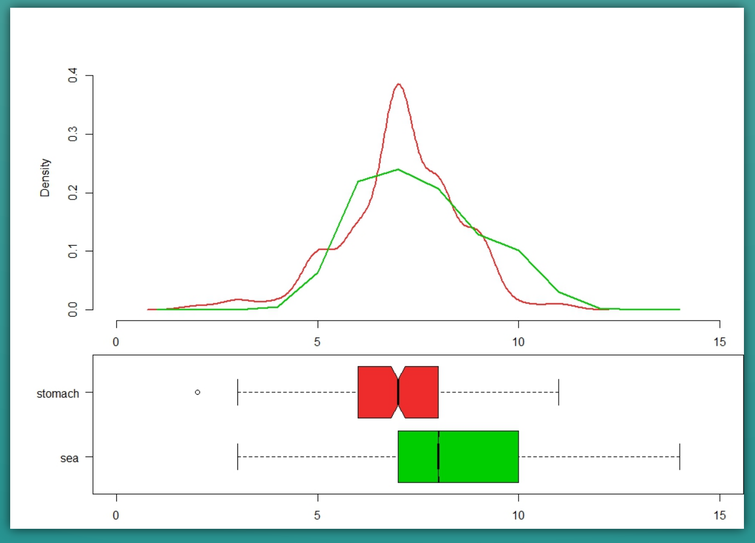


Fig 6. Comparison among sizes (cm) of *G. argenteus* found in stomachs (red) with those collected in hauls (green).

Main conclusions and next steps

- The relevance of *G. argenteus* as forage fish and its importance as the main food source for *M. macrophthalma* has been established.
- The evolution of the frequency of occurrence in both species showed an interesting alternation in predator-prey relationships that should be investigated in more detail.
- Further studies should be focused on increasing the data with larger specimens of *M. macrophthalma*.

Acknowledgements

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References

1 Preciado, I., Velasco, F., & Olaso, I. (2008). The role of pelagic fish as forage for the demersal fish community in the southern Bay of Biscay. *Journal of Marine Systems*, *72*(1), 407-417.