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Harmonising data from heterogeneous sources to characterise small pelagic fish habitat in the Mediterranean Sea.

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Summary

Within the current work, the habitat of small pelagic fish populations in the Mediterranean was assessed combining historic survey data (i.e. acoustic, ichthyoplankton, bottom trawl surveys) from five different areas along with satellite environmental and bathymetry data. Selected models were used to produce annual habitat suitability maps over the period 2000-2010 addressing different life stages (i.e. adults, juveniles and eggs) of the target species at a spatial resolution of 4x4 km. Based on these annual maps, habitat persistency maps were produced using GIS techniques where persistent and occasional locations suitable for nurseries and spawning grounds were identified. These areas are discussed in relation to existing fishing restricted areas in the Mediterranean Sea.

Introduction

The Ecosystem Approach to Fisheries highlights the importance of the protection of areas where fish concentrate for recruitment and spawning. All throughout the world, small pelagic fish dynamics represent an incredibly important stake both from an ecological and economic point of view. They have been shown to be key-species in the Mediterranean Sea, a highly diverse ecosystem not as well-studied as the large upwelling systems. Our objective was to assess the potential habitats (nurseries and spawning) of the most commercially important small pelagic fish species in the Mediterranean Sea. Preferential and occasional species habitat areas were defined based on mean probability and variability maps for the study period. Subsequently, these habitat sites were evaluated in relation to existing fishing restricted areas which in most cases were established in the past decades and not on the basis of ecological criteria and priorities (i.e. FRAs: defined as areas closed to fishing permanently, temporary or seasonally and might concern one or more gears).

Materials and Methods

Data from acoustic, ichthyoplankton and bottom trawl surveys from the Spanish Mediterranean waters, the Gulf of Lions, the Strait of Sicily, the Adriatic Sea and the Aegean Sea were used to model the potential nurseries and spawning habitat of the main small pelagic species (i.e. anchovy, sardine, mackerels and horse mackerels) in the basin. Acoustic sampling was performed by means of scientific split-beam echosounders operating at 38 kHz.

Generalized additive models were applied for this purpose in a presence absence approach using the available datasets along with satellite environmental (e.g. Sea Surface Temperature, Chlorophyll, Sea Level Anomaly) and bathymetry data. Selected models were applied to produce annual habitat suitability maps for the entire Mediterranean basin, over the period 2000-2010, at a spatial resolution of 4x4 km. Habitat persistency maps were subsequently produced using GIS techniques, taking into account for each grid cell the occurrence of high probability for suitable conditions as well as the temporal variability of this occurrence (Bellier *et al.*, 2007, Giannoulaki *et al.*, 2013). Thus persistent and occasional habitat areas were determined. In addition, the overlapping of these areas with existing FRAs in the Mediterranean was estimated.

Results and Discussion

The Mediterranean Sea is highly heterogeneous in terms of hydrography, bathymetry and productivity and includes different types of ecosystems (Giannoulaki *et al.*, 2013). Results showed that highly persistent, suitable spawning and nursery areas of small pelagic species were located mainly within the continental shelf (Figure 1). In the Mediterranean, to a large degree, suitable locations for spawning and nurseries of small pelagic fish are strongly linked to food availability, which is often localized and limited in extent. Existing FRAs, for different gears, were set based on various criteria during the last decades, at a national or international level which in most cases have not been evaluated since. The degree of overlapping between existing FRAs and small pelagic sensitive habitat varies from 5.19% (for purse seine FRAs and persistent Mediterranean horse mackerel nurseries) to 24.85% (for bottom trawls and persistent sardine nurseries). Actual protection levels might vary depending on how many other gears are allowed to operate in the area. The re-evaluation of existing FRAs within a Marine Spatial Planning Strategy is critical for spatial prioritization and becomes very important within an ecosystem management perspective. Since small pelagic fish are often part of the same mixed fishery, areas where persistent spawning grounds or nurseries overlap for more than one species, are good candidates of an effective FRA network.

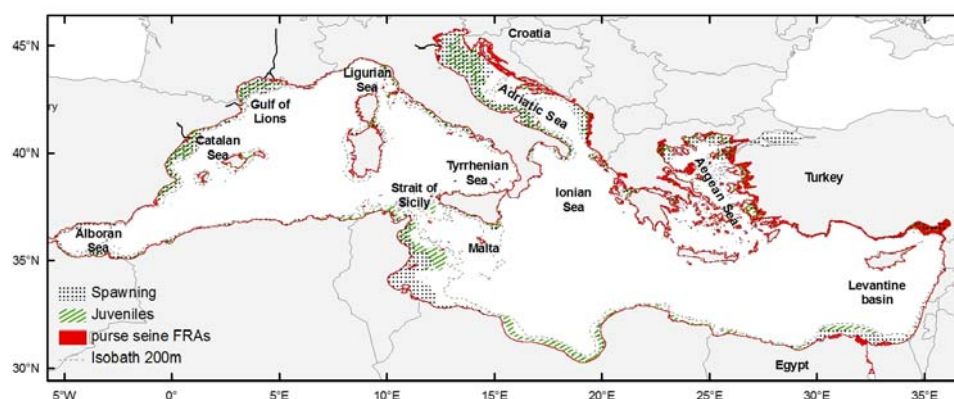


Figure 1. Persistent spawning and nursery grounds of anchovy along with existing fishing restricted areas in the Mediterranean Sea over the period 2003-2008.

Acknowledgments

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References

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