

## Spatial, bathymetrical and size distribution of deep unexpected well preserved Mediterranean gorgonian assemblages (Menorca Channel, Western Mediterranean Sea)

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### Summary

Knowledge concerning deep Mediterranean gorgonian populations ecology is still widely unknown. To overcome this situation gorgonian assemblages were studied over a large geographical and bathymetrical extent on the continental shelf and upper slope of the Menorca Channel (Northwestern Mediterranean Sea). By means of quantitative analysis of video transects, recorded by a manned submersible and a remotely operated vehicle (ROV), diversity, distribution and demography of gorgonian species were examined. A total of nine species were observed: *Paramuricea macrospina*, *Viminella falgellum*, *Eunicella cavolinii*, *Swiftia pallida*, *Bebryce mollis*, *Eunciella singularis*, *Callogorgia verticillata*, *Acanthogorgia hirsuta* and *Paramuricea clavata*. Gorgonian assemblages on the continental shelf were mostly monospecific, and composed by *P. macrospina*, whereas shelf break and upper-slope assemblages were multispecific. Greatest occurrences and abundance happened in those areas exposed to constant currents. Populations on the continental shelf were mostly immature contrary in the shelf break and upper-slope most populations were mature. Higher environmental stability in deeper areas may allow the development of mature populations. The good preservation status of the observed gorgonian population probably results from the exceptional fishing practices of the local artisanal fleet and the low trawling pressure over the study area.

### Introduction

In marine ecosystems, gorgonians play an important structural and functional role both of which promote high diversity and biomass of associated fauna. Gorgonian ecology on the Mediterranean Sea has mainly been constricted to the depth range of traditional scuba diving. Availability to ROVs, submersibles and towed gears has increased accessibility to deeper areas. However, the main body of research based on this technology has been conducted below 150 m and mainly focusing on cold-water corals. Consequently gorgonian assemblages located on continental shelf and slopes are still widely unknown. Since gorgonians are extremely vulnerable to anthropogenic impacts, especially bottom trawling and long line fishing, assemblages located on the continental shelf and slopes are nowadays highly threatened. Therefore knowledge about their diversity and distribution patterns is urgently needed to implement effective management and conservation of deep benthic ecosystems. The aim of this study was: (1) to quantify gorgonian occurrence and abundance over a large geographical and bathymetrical extent, (2) to assess their population size structure, (3) to obtain insight

about the main factors driving their distribution patterns, and (4) to increase our understanding about deep Mediterranean gorgonian ecology.

## Material and Methods

The Menorca Channel is located in the Western Mediterranean Sea between Mallorca and Menorca Islands. The study area was subdivided into three sub-areas: northern (northern slope), central (continental shelf), and southern (southern slope and Menorca Canyon). A total of 73 video transects were recorded during five surveys with the manned submersible JAGO (IFM-GEOMAR) and the ROV NEMO. Transects were divided into 2 m<sup>2</sup> sampling units. Sampling units were geographically referenced and environmentally characterized (depth, coverage percentage of slope and substrate). Gorgonian presence was quantified by occupancy and abundance. For each species, spatial distribution was studied by mapping the observed density in each sampling unit; bathymetric distribution was studied considering each sampling unit depth and estimating the median density at 20 m depth interval. Population size structure was analyzed by means of skewness and kurtosis. Relationship between gorgonian abundance and the main environmental variables were explored through a canonical correspondence analysis (CCA). Finally spatial covariance between gorgonian species was analyzed with the Three-Term Local Quadrat Covariance (3TLQC) function.

## Results and Discussion

A total of 7802 colonies of the nine gorgonian species were observed occurring in 15.9% of the sampling units. A clear vertical zonation can be established. *E. singularis* and *P. clavata*, both littoral species, were found on coralligenous banks on the continental shelf (45-120 m depth). Their low densities suggest that this might represent the deep extreme of their bathymetrical distribution. *P. clavata* reached higher dimensions than in shallow environments possibly due to higher environmental stability. Maërl beds on the continental shelf were dominated by *P. macrospina*, which covered large areas and reached maximum densities of up to 33 colonies·m<sup>2</sup>. Preservation of these dense populations might be consequence of low trawling pressure over large areas of the continental shelf and to the habitat of local artisanal fishermen to release by catch in the same fishing grounds. *P. macrospina* populations were positively skewed suggesting high recruitment rates (Linares et al. 2008) and limited presence of large colonies probably attributable to the structural instability of maërl under high energy processes. Highest diversity was observed in the shelf-edge (100-180 m depth). In this area gorgonians were found on rocky areas constantly exposed to current that could enhance food availability. Shelf-edge populations were mostly in a mature development stage resulting from past pulses in recruitment (Lasker 1991) and higher environmental stability. The 3TLQC revealed that in multispecific assemblages fine scale spatial covariance responded to the jointed effect of density, occupancy, colony size and morphology. Indeed when a large species such as *V. flagellum* achieved high-densities over extended areas it tended to exclude any other species as possible consequence of thinning effect and competition for space. Below the shelf-break only *B. mollis*, *S. pallida* and *C. verticillata* were observed. Abundance decreased with increasing depth and antipatharians became the dominant species as seen in other areas of the Mediterranean (Bo et al. 2015). The well-preserved state of these gorgonian assemblages could give an approximate idea of how Mediterranean continental shelves and upper slopes were before the impacts of decades of bottom trawling.

## References

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