

Ecological effects of marine protected areas: the case of seagrass macrofaunal assemblages

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Marine protected areas are essential for safeguarding biodiversity and its fundamental services in the face of increasing human pressures. Remarkably, few studies have assessed the responses of small macrofaunal species to different protection levels in the Mediterranean Sea. Using a hierarchical sampling design spanning four orders of magnitude (1 to 1000 m) and two consecutive years, this research investigated if a marine protected area affected macrofaunal assemblages associated with *Posidonia oceanica* seagrass meadows. Based on this investigation, spatial and temporal variability patterns of macrofaunal assemblages in four different protection levels were reported. In addition, potential confounding effects on these areas, such as different habitat features, were discussed. The results showed that the macrofauna is abundant and rich in taxa at the order and class levels. Decapods, mysids, ostracods and gastropods presented lower abundances in totally protected area compared with partially protected areas, while pycnogonids showed an inverse pattern. Moreover, the results showed differences among zones in assemblage composition. Although a number of natural factors can contribute to the variability of the abundance of these taxa, this study suggests that the observed patchiness is likely to occur for multiple and interrelated reasons, ranging from ecological and behavioural traits (e.g. dispersion, mobility and reproduction) of macrofaunal species to protection-dependent factors, such as fish predation. This work suggests that total protection within a marine protected area seems to contribute, at least partially (via fish predation), to the patterns observed among zones. Multiscale spatial and temporal monitoring of macrofaunal assemblages in a long-term perspective, as well as experimental manipulations that assess the contributions of each factor, are needed to discover the origin of these patterns, and better understand the ecological effects of marine protected areas.

Keywords: marine protected area; macrofauna; seagrass; *Posidonia oceanica*