

Short- and long-term impacts of a large no-take zone on the spatio-temporal dynamics of local artisanal fisheries (Northwestern Mediterranean)

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Summary

Marine protected areas (MPAs) are effective management tools for restoring fish biomass and community structure in exploited areas in need of conservation. Fisheries limitations and in particular implementation of no-take zones, force the spatial redistribution and adaptation of the fisheries in the area. We show the spatio-temporal changes underwent by the artisanal fisheries affected by the establishment of the Llevant de Mallorca-Cala Rajada MPA (Northwestern Mediterranean). Notable changes are evident with the expansion and spatial redistribution of fishing effort of longline métiers in particular, gradually coalescing towards the no-take boundaries, and increases in catch rates of métiers targeting species whose habitats are protected within the no-take area such as red mullet and sparids.

Introduction

Establishing marine protected areas (MPAs) is one of the important measures that governments take to conserve coastal ecosystems all over the world, no doubt in response to the rapid degradation of coastal habitats and fisheries. Benefits to fisheries production are closely linked to conservation benefits and arrive through net emigration of fish across protected area boundaries ('spillover'), and export of eggs and larvae from an MPA into to fished areas outside ('recruitment subsidy') (Gell and Roberts, 2003). The creation of a marine reserve involves implementing regulations for each of the different managed areas, enforcing spatial and temporal changes in the fishing activity. In order to maintain the artisanal fishing activity, the Llevant de Mallorca-Cala Rajada MPA was created in 2007 in the eastern coast of Mallorca Island (Balearic Islands, Spain) with a surface of 11286 ha, of which 1192 ha are no-take. The rest of the MPA was a restricted use area where some limitations on fishing effort (time and/or gear) for the different métiers were established. The aim of this study was to determine how the creation of the MPA has affected the dynamics of local artisanal fisheries overtime by: 1) assessing temporal changes in the characteristics of artisanal fisheries operating in three MPA sectors: the no-take-area, and the western and eastern buffer (restricted use) areas, and 2) assessing short- and medium-term changes in the spatio-temporal distribution of effort and catch rates of the various métiers in the three MPA sectors.

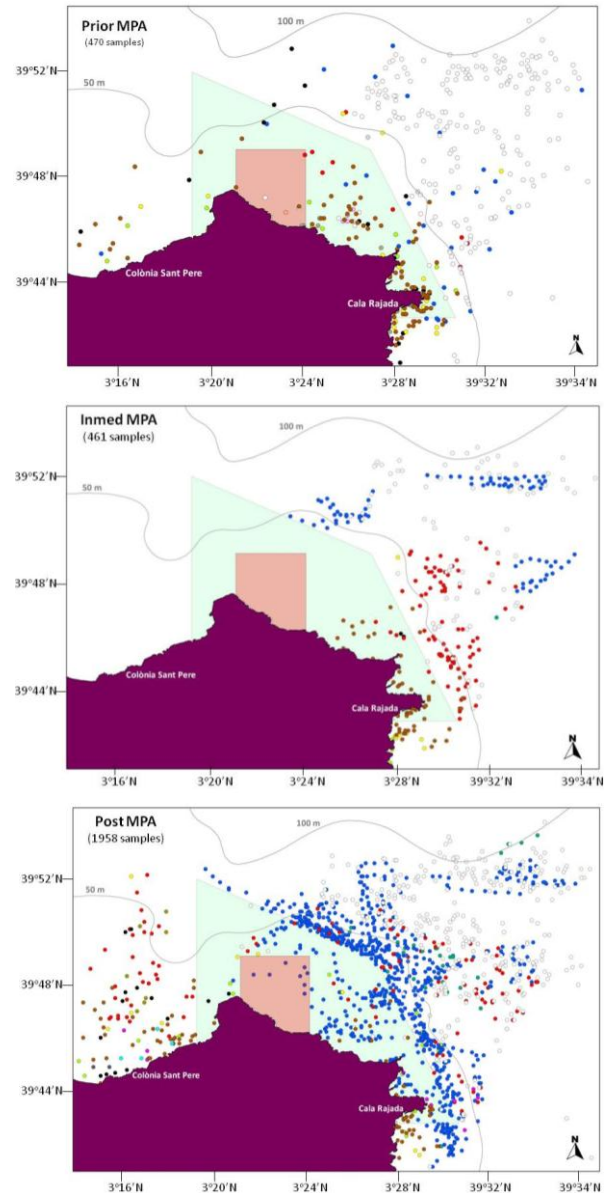
Material and Methods

Artisanal fisheries in the area were described and characterized in 2003, prior to the MPA creation, and a monitoring program was implemented from then on. Onboard sampling was carried out during three periods: 2003-2006 (years -4 to -1 before MPA), 2007-2008 (years 1 to 2 post-MPA) and in 2009-2012 (years 3 to 5 post-MPA). Onboard observer sampling surveys were carried out monthly with eight daily fishing trips per month randomly distributed over the existing métiers, sampling two to five fishing operations per day at sea. On each fishing operation the following data were recorded: a) operational data (i.e. geographical position, depth, soak time, type of substrate); b) technical characteristics of the gear (i.e. length of set, mesh size for nets and size and number of hooks for longlines); c) species composition in number; and d) total length (TL) of all the fishes in the catch. Species biomass was estimated from known size-weight conversions based on own data and the available estimates from the literature of the species present in the study area (Morey et al. 2003).

Geographical position data were plotted using QGIS 1.8.0 'Lisboa' software. CPUE (kg.500 m⁻¹ for nets; kg.100 hook⁻¹ for longlines) was calculated for the all métiers.

Results and Discussion

Throughout the study period the fishing fleet underwent changes in the fishing métiers practiced. As a consequence of the MPA implementation, some métiers have suffered spatio-seasonal restrictions, which have forced a reallocation of the fleet and fishing effort around the new restricted fishing area. Spatial changes distribution observed along the three periods shows that in the prior period of MPA creation main métiers were coastal trammel and gillnets that were practiced near the coast except the spiny lobster fishery. Immediately after the creation of the MPA (2007-2008), fishermen were very conscious with the new protected area and only cuttlefish (*Sepia officinalis*) trammel net was done in the buffer area due to that the main grounds of this species are inside the protected zone. In the post-MPA period (2009-2012) trammel nets and gillnets métiers has increased in the west area outside the MPA where the most important was red scorpionfish (*Scorpaena scrofa*) trammel net métier while longline métiers has increased in the east area outside the MPA (Figure 1). Regarding to the catch per unit effort (CPUE), of some target species exploited, we want to highlight an increasing of CPUE for surmullet (*Mullus surmuletus*) and sparidae species, over the three periods, mainly due to the good response of this species to the protection. Moreover, although the practice of red scorpionfish métier has significantly increased over the three periods the CPUE is not statistically significant different. These could be related with the low resilience of the species. Our results have demonstrated a similar pattern of the effects of MPAs shown in several studies, reporting an evident redistribution of fishing effort that often results in effort concentration near MPA boundaries, at the same time that CPUE values increases, immediately after the MPA creation, or are often higher in the fished areas closest to MPA, caused itself by fishing effort concentration near boundaries.



References

- Gell, F. R., and Roberts, C. M. 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology and Evolution*, 18(9): 448-455.
- Goñi R., Adlerstein S., Alvarez-Berastegui D., Forcada, A., and others. 2008. Spillover from six western Mediterranean marine protected areas: evidence from artisanal fisheries. *Marine Ecology Progress Series*, 366: 159-174.
- Morey, G., Moranta, J., Massutí, E., Grau, A., Linde, M., Riera, F., and Morales-Nin, B. 2003. Weight-length relationships of littoral to lower slope fishes from the western Mediterranean. *Fisheries Research*, 62: 89-96.