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Effects of trawling impacts on mega-epibenthic communities from heavy exploited to undisturbed areas in a Mediterranean fishing ground (Central Mediterranean Sea)

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Summary

Detailed studies of the responses of communities' components to fishing activities are necessary to suggest effective measures of management in a context of Ecosystem-Based Fisheries Management. Multiple case-studies from a wider range of habitats are needed to refine model predictions of the consequences of bottom fishing disturbance. In this context, the study aims to highlight the impact of otter trawl fisheries on epifaunal assemblages to a fishing ground scale in the Southern Tyrrhenian Sea. The study takes advantage of the presence of two Fishery Exclusion Zones. A high-resolution spatial distribution of fishing effort was obtained through Vessel Monitoring System data analysis. Mega-epibenthic organisms were collected in the framework of the MEDITS Project. Fishing intensity effects were tested on each surveyed epibenthic communities across the continental shelf and down to the meso-bathyal plain. Density and biomass indices reached the highest values inside the EFZs. Not-trawled areas had a significantly high abundance of fragile and emerging species. Contrarily the mostly exploited areas had a greater number of scavengers.

Introduction

The recent emphasis on the Ecosystem-Based Fisheries Management (EBFM) approach has emphasised the need to reduce anthropogenic disturbance to marine ecosystems from fishing activities, so as to maintain the structure and functioning of marine communities (Sinclair and Valdimarsson 2003). Although the establishment of Ecosystem-Based Management plans and monitoring of the effectiveness of their implementation are mandatory under current European legislation, to date, the implementation of EBFM in the Mediterranean Basin has been hampered (FAO 2010; de Juan *et al.* 2012; Stelzenmüller *et al.* 2013). The actual failure is mainly due to a lack of good understanding of the ecological role of the species affected by fishing activities and by an inadequate knowledge of their distribution in relation to the distribution of fishing activities. The development of a Mediterranean management plan based on the establishment of a network of sustainably managed areas, together with marine spatial planning could be the way to accomplish an EBM approach (de Juan *et al.* 2012). The study aims to provide important insights into the distribution of fishing disturbance on the seabed in a central Mediterranean fishing ground, a necessary step to evaluate the impact of this activity on the natural environment.

Materials and Methods

The survey area, identified as a part of the GSA 10, extends from Cape Suvero (Calabrian coast) to Cape San Vito (Sicilian coast), within the 700m isobaths encompassing two Fishery Exclusion Zones located along the Sicilian coast: the Gulf of Castellammare and the Gulf of Patti. Following the MEDITS sampling protocols the surveys were carried out according to a random depth-stratified approach. The study analyse the non-target epibenthic component incidentally caught by the net from 2010 to 2012. Bottom otter trawlers VMS data, collected during the same period, were screened and selected based on speeds range. Fishing intensity was calculated by estimating the area swept by the point summation technique (Lambert *et al.* 2011). All analyses were conducted using the VMStools package in R. The fishing intensity was represented with ArcGIS 9.3. Density and Biomass indices (standardised per km²) were calculated at each of the 4 *a priori* defined depth stratum (B: 50−100m; C: 100−200m; D: 200−500m; E: 500−800m). A 1-way ANOVA test was performed to detect significant differences related to fishing intensity. For this test fishing intensity was grouped into 4 categories: EFZ (no fishing intensity), Low (L), Medium (M) and High (H). Post hoc Tukey's tests were used to detect significant pairwise differences among the fishing intensity categories (asterisks indicate p values: *p<0.05, **p<0.01, ***p<0.001). A 1-way ANOVA was performed for species and taxa mostly sampled at each stratum to uncover differences occurred along the detected fishing intensity gradient.

Results and Discussion

The fishing intensity distribution analysis shows non-random behaviour of the fishing fleet, which is presumably influenced by historical patterns of fishing performance and regulatory restrictions. In general, the highest values of fishing intensity were recorded on the continental shelf compared to the upper slope. Generally, density and biomass indices reached the highest values inside the EFZs (Table 1). At the deepest stratum, E upper middle slope, the two indices reached the lowest value in high fishing intensity areas (notably, as the maximum depth within the EFZ was <500m, no samples were collected with zero fishing intensity inside the stratum E). EFZs and low trawled areas had a significantly high abundance of vulnerable organisms, such as fragile echinoderms species living on sediment surface or species emerging by the bottom (Pennatulaceans and *Alcyonium palmatum*; Table 2). Contrarily the most exploited areas are dominated by a greater number of resilient species such as scavenger asteroids (Mangano *et al.* 2013). The obtained results underline the importance of VMS data in fishing activity assessment and marine spatial planning providing a more detailed insight into the fishing effort distribution and the effects of trawling activity on benthic communities to fishing ground scale.

Table 1. ANOVA test of univariate indices.

	ANOVA	df	F	p	Tukey's Test
B	Density	3	9.81	p < 0.05	EFZ > M, H*
C	Biomass (Sq)	3	11.06	p = 0.001	EFZ >L*; EFZ > M, H***
D	Density (Sq)	3	5.18	p < 0.05	EFZ < M **
	Biomass (Log)	3	5.71	p < 0.01	EFZ >H **; M > H*
E	Density (Log)	3	3.68	p < 0.05	L > H*
	Biomass (Log)	3	4.00	p < 0.05	M > H*

Table 2. ANOVA test of the responses of key species and taxa.

	ANOVA	df	F	p	Tukey's Test
B	*Parastichopus regalis*	3	8.03	p < 0.05	EFZ > H*
	Ophiura ophiura (Sq)	3	8.80	p < 0.05	EFZ > L, M*
	Pennatulacea (Log)	3	8.68	p < 0.05	EFZ > L*
C	Asteroidea (Sq)	3	4.78	p < 0.5	H > EFZ, M*
	Mollusca (Log)	3	3.94	p < 0.5	L > H*
	Alcyonium palmatum	3	5.59	p < 0.05	L > H*
	Parastichopus regalis (Sq)	3	13.75	p < 0.001	EFZ > L, M, H***
D	Echinoidea (Sq)	3	4.49	p < 0.05	M > EFZ, H*
	Munida sp. (Sq)	3	8.27	p < 0.05	M > EFZ**

References

de Juan, S., Moranta, J., Hinz, H. *et al.* 2012. A regional network of sustainable managed areas as the way forward for the implementation of an Ecosystem-Based Fisheries Management in the Mediterranean. Ocean & Coastal Management, 65: 51-58.

FAO General Fisheries Commission for the Mediterranean 2010. *Report of the Thirty-fourth Session*. GFCM Report No. 34, Athens, Greece, FAO, Rome. 98 pp.

Lambert, G. I., Jennings, S., Kaiser, M. J., Hinz, H., and Hiddink, J. G. 2011. Quantification and prediction of the impact of fishing on epifaunal communities. Marine Ecology Progress Series, 430: 71 – 86.

Mangano, M. C., Kaiser, M. J., Porporato E. M. D., and Spanò, N. 2013. Evidence of trawl disturbance on mega-epibenthic communities in the Southern Tyrrhenian Sea. Marine Ecology Progress Series, 475: 101-117.

Sinclair, M., and Valdimarsson, G. 2003. *Responsible Fisheries in the Marine Ecosystem*. CABI Publishing, Cambridge, MA. 448 pp.

Stelzenmüller, V., Breen, P., Stamford, T., *et al.* 2013. Monitoring and evaluation of spatially managed areas: A generic framework for implementation of ecosystem based marine management and its application. Marine Policy, 37(1): 149-164.