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European Marine Protected Areas as tools for Fisheries management and conservation

Contract no. 006539

The aims of workpackages 1, 2 and 3 of EMPAFISH have been to identify and quantify ecological (WP1), fisheries (WP2), and socio-economic (WP3) effects of Marine Protected Areas (hereinafter MPAs) included as case studies, based on bibliographic reviews and meta-analysis of available data. The present issue summarises the main results of these workgroups.

WP1: Ecological effect of MPAs

Leader: CNRS

Participants: UMU, ICM, IEO, IMC, IAMC, PML, UA, ULL, IMAR, UPA, UMT, UPI

WP1 was devoted to list, explore, and evaluate the ecological effects of MPAs, using data issued from the 20 EMPAFISH selected case studies. These effects were firstly reviewed case by case, confirming the wide occurrence of several expected effects of protection[1]. In general, increasing abundance (Fig. 1) and changes in size structure of populations of commercial fish species are observed. In addition, spillover is considered to be a general phenomenon, as deduced from the observation of gradients of abundance / biomass across MPA limits, although this process seems to occur at fine spatial scales[2]. Other studies emphasize the reserve effect on benthic communities, the effects of protection on habitats (including the impact of recreational activities), and indirect effects (trophic cascades, changes in assemblage – trophic structure, etc.).

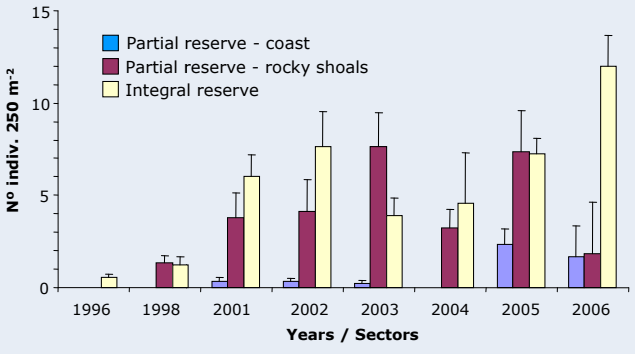
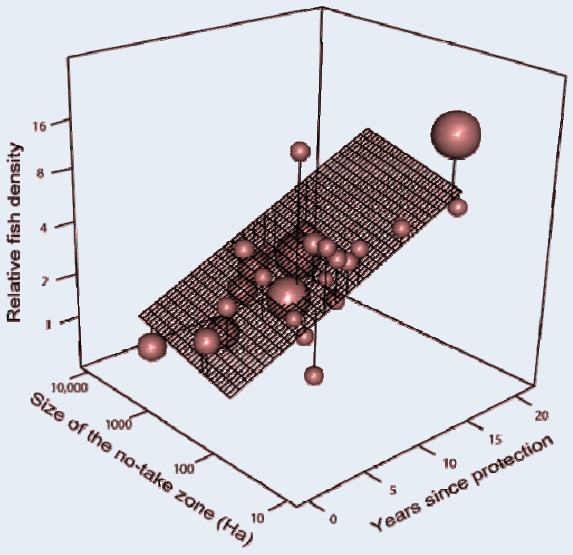


Figure 1 Temporal change in abundance of dusky groupers (*Epinephelus marginatus*), an emblematic fish species, in three sectors of the Cabo de Palos – Islas Hormigas marine reserve (Murcia, SW Mediterranean) after its establishment in 1995.

For each case study, we compiled all ecological data under a common format to allow statistical comparisons. We used a meta-analytical approach to compare fully-protected *vs*. unprotected situations against four potential sources of variation: time since protection, size of the marine reserve and of the buffer zone, and distance to the nearest MPA.

First results indicate that part of the heterogeneity in the response of the abundance of commercial species to protection was attributable to time since establishment and the size of no-take area (Fig. 2)[3].

Figure 2 Effect of EMPAFISH MPAs case studies on commercial fish densities as a function of time since protection and the size of the no-take zone. Plane gives the fitted effect, size of points is proportional to the weight of each study, and stems indicate the distance between the calculated weighted effect size and the fitted effect.



[1] For further details, see: Planes, S., García-Charton, J.A. & Pérez-Ruzafa, A. (Coord.). 2006. *Ecological effects of Atlanto-Mediterranean Marine Protected Areas in the European Union*. EMPAFISH Project, Booklet nº 1. 158 pp. http://www.um.es/empafish/

[2] See results of EC research project BIOMEX (http://biomex.univ-perp.fr)

[3] Claudet, J. *et al.* 2008. Marine reserves: Size and age do matter. *Ecol. Let.* 11: 481–489

WP2: Fishery effect of MPAs

Leader: IMAR

Participants: UMU, CNRS, ICM, IEO, IMC, UA, ULL, UPA, UMT, UPI

The objective of WP2 was to explore more fully the fisheries in operation in the vicinity of the selected EMPAFISH case study sites, and to use fisheries data to determine the general effects that this type of marine conservation might have on local fisheries. The first goal of WP2 was to characterise fishery regimes in each area according to the main fishing gears, fished areas, seasonality, target species, and fishing regulations. In addition, the objectives of the MPAs with regard to fisheries were described and illustrated. A summary of this work is available on the EMPAFISH website[4].

We identified four marine zones of interest to fisheries: no-take area or marine reserve; restricted-take area; external-close areas, and external-distant areas. It was expected that, if spillover from the protected area was enhancing adjacent fisheries, the effects would be exhibited first in the buffer zone and to a lesser extent in external-close areas. External-distant areas were not presumed to show benefits of protection and were therefore considered to be "control sites". Data analysis focussed on comparing areas that were most geographically separate since they should demonstrate the greatest effect of conservation measures.

Pre-existing fisheries data were gathered from a variety of sources including: landings records, biological sampling programs, fishing fleet enquiries, on-board sampling, and logbooks. The information assembled focussed on commercially important individual species and specific gears, as well as on aggregated catch from all gears. Working with catch per unit effort (CPUE), catches for regions around each protected area were assessed using meta-analysis. Various parameters were considered as potential determinants of the reserve's effectiveness, including: time since protection started, total size of the reserve, size of the no-take area, size of the no-take area as a proportion of total size, size of restricted-take area, level of compliance with regulations, number of zones present, distance to the closest MPA, etc.

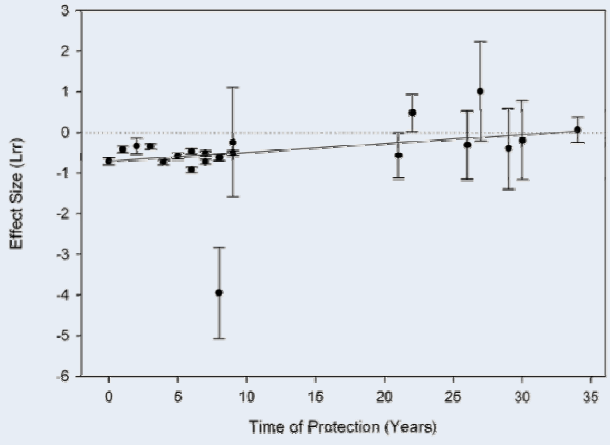


Figure 3 Effect sizes (log response ratios) comparing average CPUEs of target species in sites closer to the reserve with control sites, for MPAs of differing age. A negative effect size reflects lower CPUE at sites closer to the reserve. Error bars represent 95% confidence intervals.

[4] Vandeperre, F., Higgins, R., Santos,R. & Pérez-Ruzafa, A. (Coord). 2006. *Fishery Regimes in Atlanto-Mediterranean European Marine Protected Areas*. EMPAFISH Project. Booklet nº 2. 97 pp. http://www.um.es/empafish/

Results to date indicate that CPUEs increase with the age of the reserve, with older sites providing higher CPUEs in areas influenced by protection compared with young reserves. It is well known that marine protection is often accompanied by increased concentration of fishermen in the surrounding waters, shown by the negative ratio between catches from nearby the reserve compared with distant areas. However, the effect of protection is clearly demonstrated by these ratios becoming less negative with time (Fig. 3). Maintaining overexploitation adjacent to the reserve means higher CPUEs (relative to control sites) may only be detected more than 30 years after protection. Work is on-going regarding the effects of the remaining parameters. Distribution of effort around 5 reserves, being the only sites for which relevant data were available, was explored more fully using spatial analysis. Fishing effort densities were estimated based on aggregated information on catch positions and analysed using Geographic Information Systems with geostatistical and multivariate tools. This approach upheld the concept that effort concentrates around the borders of reserves.

European Symposium on Marine Protected Areas as a Tool for Fisheries Management and Ecosystem Conservation

This symposium was held in Murcia (Spain) from 25th to 28th September 2007, co-organised by EC research projects EMPAFISH and PROTECT. The main goal of the meeting was to integrate ecological, economic and social aspects for the selection, design, and management of marine protected areas, facilitating discussion and exchange amongst stakeholders, scientists, lawyers, and managers. A total of 397 delegates from 32 countries attended the MPA Symposium. In all, 5 invited keynotes, 122 oral communications (spread over 27 sessions), and 133 posters were presented. In addition, 2 roundtables were celebrated which addressed the following aspects: "MPAs for ecosystem conservation and fisheries management – a search for common grounds", and "What are the key costs and benefits policy makers and stakeholders might consider in the MPA decision making process?". Additional information can be obtained at:

http://www.mpasymposium2007.eu

WP3: Socio-economic impacts of MPAs

Leader: UBO

Participants: UMU, CNRS, ICM, IEO, PML, ULL, IMAR, UMT, UPI

Performing an economic valuation of MPAs requires i) to identify the various groups of stakeholders (e.g. professional fishers, recreational fishers, diving clubs...), ii) for each group, to identify potential costs and benefits related to the MPA, and iii) to quantify these costs and benefits. One of the difficulties of this exercise is to assess non-market costs and benefits (e.g. benefits of the MPA for recreational fishers). In many cases, socio-economic data were not available. That is why we had to implement field surveys, mainly during the summer of 2006.

The Table 1 below presents the number of answers, according to the 7 types of surveys that were implemented.

In the context of EMPAFISH, one of the major socio-economic issues was to assess the influence of MPAs on various uses of the ecosystem. According to the result of our field surveys, this influence may vary substantially according to the type of activity, and to case studies (Fig. 4).

Table 1 EMPAFISH socioeconomic field surveys: number of answers

Types of uses / Case studies	Fishing				Non-extractive uses			Total
	Professional	Recreational			Scuba diving		Snorkelling (submarine trails)	
		Individual	Charter					
			Operators	Customers	Operators	Customers		
Banyuls					11	82	164	**257**
Benidorm					6	307		**313**
Bonifacio		10			7	108	17	**142**
Cabo de Palos	4				4	132		**140**
Côte bleue		262			17	689	311	**1279**
Columbretes	20				8	257		**286**
La Restinga	28	142				159		**329**
La Graciosa	14	184						**198**
Malta	184	47			30	250		**511**
Medes	16				6	147		**169**
Monte da Guia	51	56	2	20	3	57		**189**
Sinis	36	25			3	34		**99**
Tuscany	1				1	63		**65**
Tabarca					1	108		**109**
Total	**354**	**726**	**2**	**20**	**97**	**2393**	**492**	**4084**

Updated in May 2007

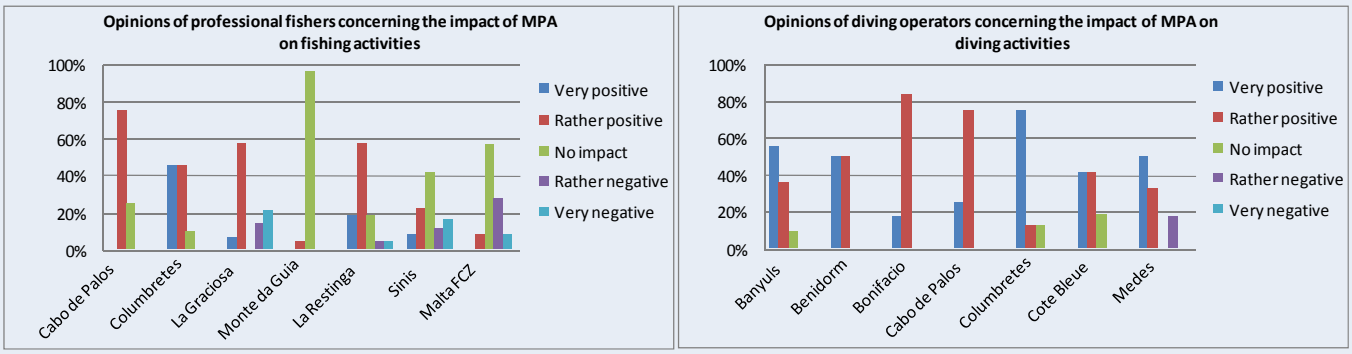


Figure 4 EMPAFISH socioeconomic field surveys: opinions of professional fishers and of scuba divers

Field surveys provide three types of information on users of ecosystemic services provided by MPAs[5]: (i) their characteristics (e.g. boat size, geographical origin…); (ii) their activity (e.g. share of catches or number of dives realized inside MPA…); (iii) their perceptions (e.g. knowledge of the MPA, opinions concerning its ecological and economic impact, relations with other users…). Part of this information is used as an input for bio-economic modeling of the MPA (WP5). Other outputs of the surveys may be used for building socioeconomic indicators of MPA performance (WP4). Finally, information provided by the socioeconomic field surveys contributes to the debate with stakeholders (WP6).

[5] Alban, F., Roncin, N. & Boncoeur, J. 2006. *Methodological guidebook for socio-economic field surveys of MPA users.* EMPAFISH Project. 38 pp. http://www.um.es/empafish/

Perspectives

Results from WP1-3 are being used by subsequent Work Packages to:

- list, evaluate, and validate a set of potential indicators of the ecological, fishery, and socio-economic effects of MPAs, in function of the MPA objectives, and under the different management regimes and MPA typologies identified (WP4);
- produce, enhance, and run a bio-economic modelling tool of MPA implementation in the EMPAFISH geographical scope (WP5);
- proportionate guidelines and tools to be integrated into the decision-making and management process, to constitute an improved basis for the design, the selection and the management of European MPAs (WP6).

Booklets

The following booklets have been produced, to synthesize the data available from the three workpackages for subsequent meta-analyses, indicator evaluation, and bio-economic modelling:

- Planes, S., García-Charton, J.A. & Pérez-Ruzafa, A. (Coord.) 2006. *Ecological effects of Atlanto-Mediterranean Marine Protected Areas in the European Union*. EMPAFISH Project, Booklet nº 1. 158 pp.
- Vandeperre, F., Higgins, R., Santos, R. & Pérez-Ruzafa, A. (Coord.) 2006. *Fishery Regimes in Atlanto-Mediterranean European Marine Protected Areas*. EMPAFISH Project, Booklet nº 2. 97 pp.
- Alban, F., Appéré, G. & Boncoeur, J. 2006. *Economic Analysis of Marine Protected Areas. A Literature Review.* EMPAFISH Project, Booklet nº 3. 51 pp.

In addition, a methodological guidebook has been produced to provide methodological assistance to socioeconomic field surveys organised within the framework of the EMPAFISH project:

- Alban, F., Roncin, N. & Boncoeur, J. 2006. *Methodological guidebook for socio-economic field surveys of MPA users.* EMPAFISH Project. 38 pp.

EMPAFISH partners

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3- ICM: Institut de Ciències del Mar – CSIC (Spain)

4- IEO: Instituto Español de Oceanografía – COB (Spain)

5- IMC: International Marine Center (Italy)

6- IAMC: Instituto dell'Ambiente Marino Costiero - CNR (Italy)

7- PML: Plymouth Marine Laboratory (UK)

8- UA: Universidad de Alicante (Spain)

9- ULL: Universidad de La Laguna (Spain)

10- IMAR: Universidade dos Azores – DOP (Portugal)

11- UPA: Università di Palermo (Italy)

12- UBO: Université de Bretagne Occidentale - CEDEM (France)

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14- UPI: Università di Pisa (Italy)

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