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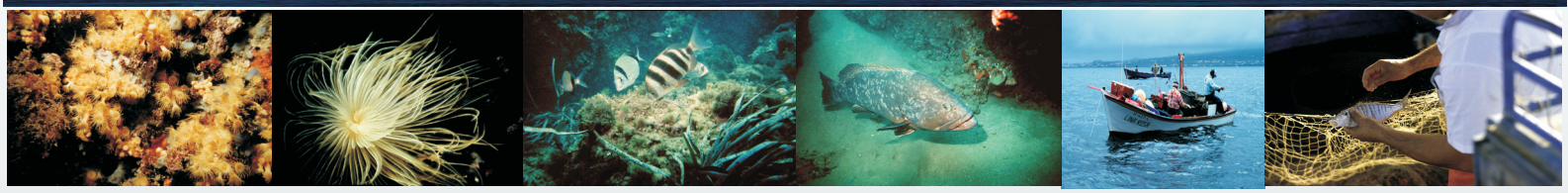
EMPAFISH

(European Marine Protected Areas as tools for Fisheries management and conservation)

Contract no. 006539



The aims of workpackages 4, 5 and 6 of EMPAFISH have been to evaluate and select a subset of indicators of MPA performance (WP4), create and refine a bio-economic model of MPA effects (WP5), and proportionate guidelines and tools to be integrated into the decision-making and management process (WP6). The present issue summarises the main results of these workgroups.

WP4: Indicators of MPA performance

Leader: UA

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

In this workpackage we reviewed studies that evaluated all aspects relating to the effectiveness of MPAs in order to describe how the studies were conduced and to detect fields in which research is lacking. In total 224 publications were reviewed. Since the early 1980's there has been a near exponential increase in the number of peer reviewed publication on MPAs which peaked in the period 1998-2001 (Fig. 1). Most of the studies concentrated on biological parameters, though there have been a few socio-economic studies. Most peer reviewed studies were based on control *vs*. impact designs, while technical reports involved only a protected area replicated in time and/or space. BACI and mBACI designs were used in very few studies. We have identified gaps in the objectives assigned to MPAs and the way in which they have been evaluated. From these results we proposed to analyze some study subjects that remain poorly or not at all considered. Moreover standardised methods of study, to be applied by both researchers and administrators, should be implemented enabling *a posteriori* comparison of obtained results over a wide geographical range.

On the other hand, we stated the different components related with the presence and functioning of a MPA and the relationships among them using the driver-pressure-state-impacts-response (DPSIR) framework.

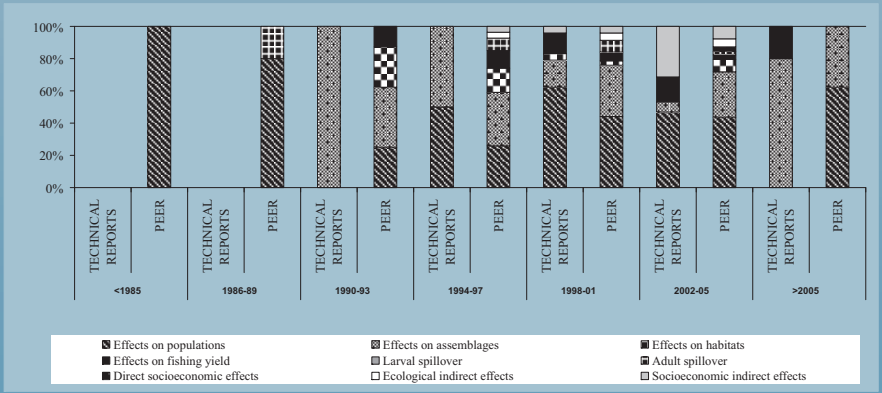


Figure 1 Variation of the different types of study purposes for technical reports and peer reviewed publications from 1983 to 2006

By means of a participatory process we developed a conceptual framework that helped to select an appropriate suite of 167 parameters potentially usable as indicators to support an ecosystem approach, an evaluation of the MPAs functioning and policy considerations. Gaps from management and policy responses can be derived too. DPSIR it's a suitable tool simplifying the analysis of the complexity of MPAs management, showing specific strategies to improve the assessment of the effectiveness of MPAs.

Combining three different approaches –managers' expertise knowledge, availability in institutions and statistical analysis- we evaluated the suitability of each proposed parameter. From the experts' point of view parameters categorized as driving forces and responses were the best evaluated meanwhile those so used that are categorized as states or impacts were did not obtain a high scoring. The existence of information about these parameters in the institutions is around 70% but the accessibility is quite low. From the statistical analysis the results exhibited a change of the importance of MPA characteristics such as total size or the size of the buffer area over time, increasing the role of management issues such as hours of enforcement or budget. Relating parameters descriptors of the fish assemblage and captures with MPA characteristics by means of multiple linear regressions, total biomass of fish assemblages, the delta plus diversity index and the total catch in trammel net were the best correlated. Joining the results of the three different approaches, only 16 parameters can be selected as good indicators to assess the effects of MPAs.

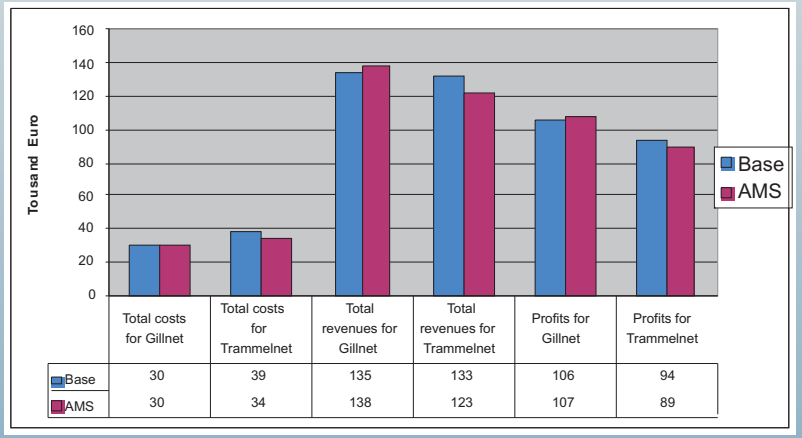
WP5: Bio-economic modelling of MPAs

Leader: ICM

Participants: UBO, PM

To assess the ecological and economic impacts of MPA a simulation program was built in workpackage 5, based on a bio-economic model developed during the EMPAFISH project (BEAMPA: Bio-economic Analysis of Marine Protected Areas). The bio-economic model allows testing the result of management measures on extractive (commercial or recreational fishing) and non-extractive (eco-tourism) activities. The application of the model as a simulation tool allows the scientist or the manager to assess the outcome of alternative management strategies, which could help reduce undesired pressures on the MPA system, diminish conflicts among users or enhance the productivity of the MPA in a sustainable way.

The bio-economic model is based on a 3-layer grid derived from a Geographic Information System analysis of a real MPA. Each layer contains information on protection regime (No Take Zone, Partial Protection Zone and Unrestricted Fishing Zone), habitat type (user-defined, e.g. rocky, sandy, seagrass beds) and depth. The basic grid layout is populated with biological data on biomass, number of recruits and mean weight of adults, derived from field data surveys, for each fish species considered. Additional spatial components of the model are the distribution of fishing effort. The basic configuration of the model MPA is projected forwards in time (simulation) according to the parameters and equations of the bio-economic model. Running the model under different simulation scenarios allows comparing the likely evolution of the MPA system under different management strategies and should help the manager choose a strategy based on the policy objectives set.



	Total costs for Gillnet	Total costs for Trammelnet	Total revenues for Gillnet	Total revenues for Trammelnet	Profits for Gillnet	Profits for Trammelnet
Base	30	39	135	133	106	94
AMS	30	34	138	123	107	89

Figure 2 Comparison of economic indicators (Costs, Revenues, Profits) for two artisanal fleets operating around Medes Islands MPA, projecting the current conditions ("Base") and an Alternative Management Strategy ("AMS") for 5 years. The AMS consisted in increasing the marine protected area (Fig. 3). According to the simulation results, this AMS would increase profits for gillnetters, while reducing profits for the trammel net fleet.

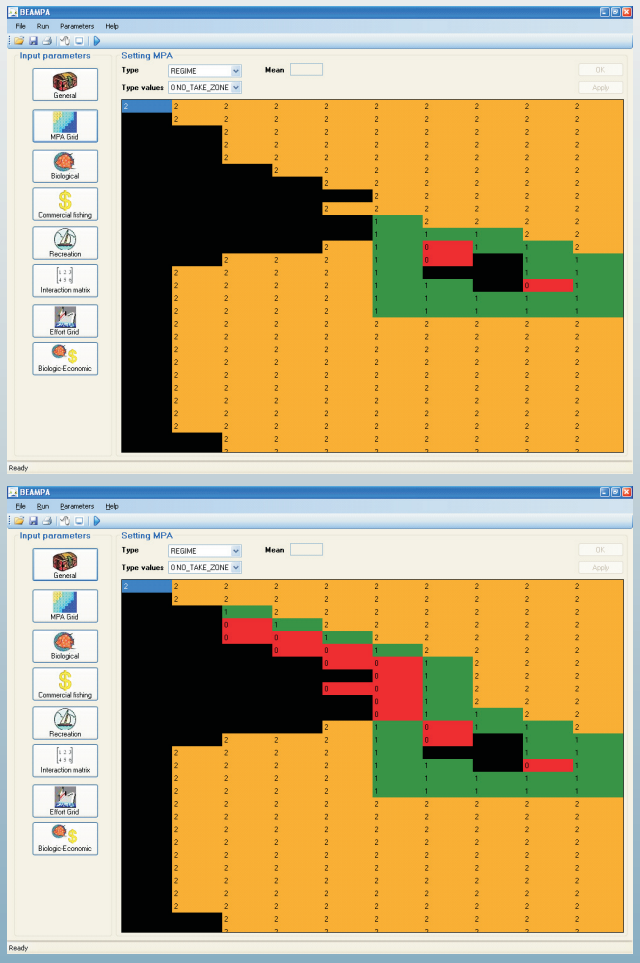


Figure 3 Testing the BEAMPA model: Current configuration of the Medes islands MPA (base scenario, up) and alternative management strategy (AMS, down) consisting in enlarging protection to the adjacent coast. Black cells: land; red cells: No Take Zone; green cells: Partial Protection Zone; orange cells: Unrestricted Fishing Zone

WP6: Socio-economic impacts of MPAs

Leader: PML

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

The aim of WP6 was to provide the EU with guidelines and tools that can be integrated into the decision-making regarding the use of Marine Protected Areas (MPAs) as tools for fisheries management and conservation. In order to reach these objectives, WP6 employed a multi-criteria evaluation using outputs from WP1, WP2, and WP3 with a stakeholder consultation of the objectives and zoning of MPAs.

Using models from WPs 1 and 2, we teased out a wide range of sizes of no-take and partial protected zones for their levels of fish densities and catch per unit effort (cpue) based on different lengths of time. We termed MPAs as small if they were less than 150 ha, medium if they were between 151 to 600ha and large if they were over 601 ha. The sizes of partial protection zones (buffer zones) included having a partial protected zone that was half the size of the no-take zone, or having a partial protection zone that was the same size as the no-take zone, or a partial protection zone that was twice the size of the no-take zone. Using the windows-based software DEFINITE (decisions on a finite set of alternatives), we 1) standardized the data to make the measured units comparable across the scenarios; and 2) weighted each criteria based on ranks of objectives provided by local MPA stakeholders to come up with a value for each scenario. Results indicated that having a large MPA in which the size of the partially protected zone is half that of the no-take zone was the most preferred scenario. This implies that fisheries benefits are maximised by having MPAs that comprise of a fully protected zone (no-take) that is larger than the surrounding buffer zone.

In the stakeholder consultation, we developed a questionnaire, translated it into local languages and used it to assess perceptions of stakeholders towards the main objectives of marine protection, ideal zonation of MPAs and ways of managing stakeholders' competing interests in MPAs. Our main results indicate that:

1) Stakeholders of MPAs in southern Europe agree that the core objectives of establishing MPAs are conservation and fisheries management while research, education and tourism development are secondary;
2) There is a large difference between fishers and other stakeholders regarding which of the two core objectives of marine protection is more important for them. Fishers would like to see MPAs established to manage fisheries while other stakeholder groups see MPAs as places of conservation;
3) Local stakeholders would like to see a hierarchical limitation on the use of marine resources and the separation of conflicting activities;
4) Perceptions of fishers using fishing grounds adjacent to older MPAs show that they are not experiencing the spillover effect. This finding stems from the fact that scores, provided by fishers on MPAs as areas to manage fisheries, decreased with the length of time of protected area management (Figure 1).

Literature shows that the protected areas surveyed in our study have been successful in increasing fish biomass and contributing to the export of fish biomass of some commercial species[1]. It could be that fishers are not aware of these benefits because the scientific evidence has not been made accessible to them. It might also be due to high fishing effort and competition amongst fishers at the boundaries of existing MPAs. There is a need for greater communication between scientists, managers and fishers to improve the disparity in understanding the fisheries benefits of marine protection.

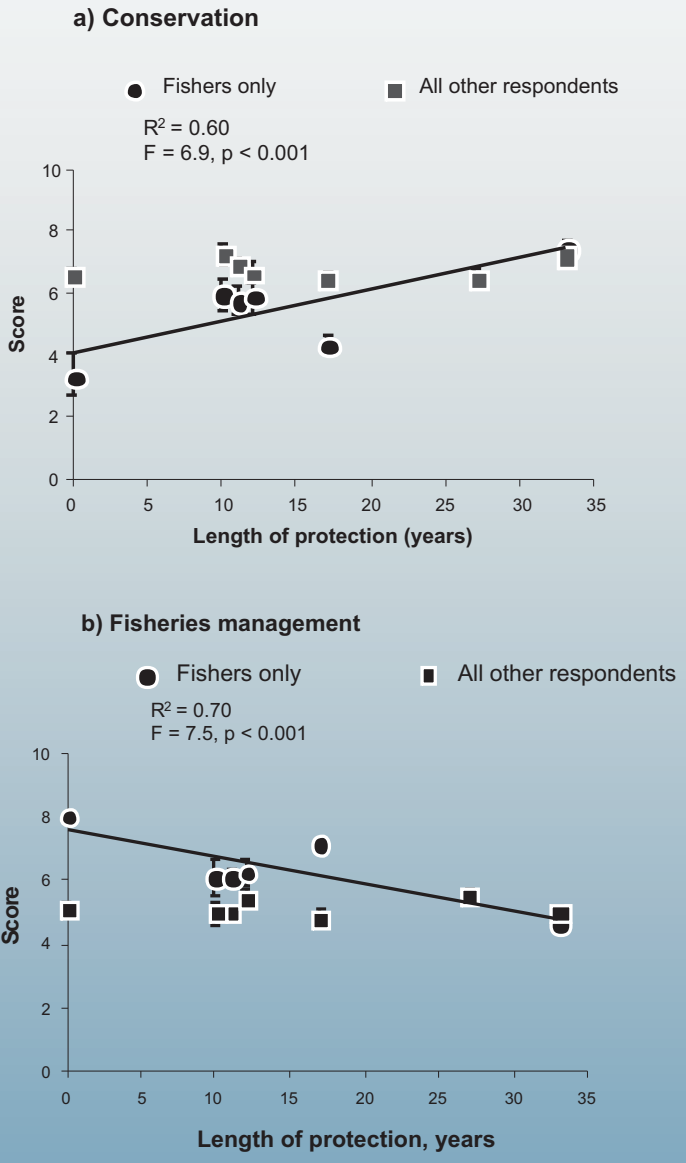


Figure 4 Scores for a) conservation, and b) fisheries management provided by all respondents (excluding fishers) and by fishers only as a function of the length of time of protected area management. Scores provided by fishers significantly differed over time.

Goñi, R., Quetglas, A., & Renones, O. (2006) Spillover of spiny lobsters *Palinurus elephas* from a marine reserve to an adjoining fishery. Marine Ecology Progress Series, 308: 207-219.

Claudet, J., Osenberg C. W., Benedetti-Cecchi, L., Domenici P., García-Charton, J. A., Pérez-Ruzafa A., Badalamenti F., Bayle-Sempere J., Brito A., Bulleri, F., Culioli J. M., Dimech M., Falcón J. M., Guala, I., Milazzo M., Sánchez-Meca J., Somerfield, P. J., Stobart B., Vandeperre F., Valle C., & Planes, S. (2008) Marine reserves: size and age do matter. Ecology Letters, 11: 481-489.

Perspectives

After 3 years of work development, a series of important results has been produced, which allow the scientific partnership of the EMPAFISH project to advance a series of recommendations for management. Therefore, the EMPAFISH contribution to reach the "2012 target" and related initiatives and EU engagements is to translate research results and findings into statements that can be organised in tasks and actions.

Booklets and documents

The following booklets and documents have been produced, to synthesize the data available from the three workpackages:

- Maynou, F. & Boncoeur, J., 2007. A *bioeconomic model of Marine Protected Areas*. EMPAFISH Project, Deliverable nº 20.
- WP4 Consortium, 2008. *Selection, statistical assessment, expert-based evaluation, and global evaluation of indicators to assess the effectiveness of marine protected areas*. EMPAFISH Project, Deliverable nº 21
- Bayle, J., Sánchez-Jerez, P., Barberá, C., Forcada, A., Luna, B., Ojeda, C. & Valle, C., 2008. *Suitable methodologies to collect and analyze indicators, and suitable experimental designs to test different situations on MPAs*. EMPAFISH Project, Deliverable nº 24.
- Maynou, F., 2008. *Results of the bio-economic and cost-benefit analysis of selected case studies*. EMPAFISH Project, Deliverable nº 25.
- EMPAFISH consortium, 2008. *Towards a European strategy for the management and networking of Atlanto-Mediterranean marine protected areas*. EMPAFISH Project, Deliverable nº 26.
- Mangi, S. & Austen, M., 2008. *Developing a management tool for MPAs in southern Europe: the EMPAFISH project*. EMPAFISH Project, Deliverable nº 28.
- García-Charton, J.A., Pérez-Ruzafa, A., Marcos, C. & Salas, F., 2008. *MPA Policy Implementation Plan: Towards an EU MPA Strategy*. EMPAFISH Project, Deliverable nº 33. 4 pp.

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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)

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