

“BIOMEX”

Estimating biomass export from Marine Protected Areas in the Mediterranean

Mediterranean coastal fisheries have decreased over the last 25 years, and this has had subsequent socioeconomic consequences on rural employment. In recent years, Marine Protected Areas (MPAs) have been strongly advocated as a tool for the management of these fisheries, and in an attempt to halt further deterioration of sensitive habitats, a large number of MPAs have been established. They are intended to protect critical spawning stock biomass, intraspecific genetic diversity, population age structure, recruitment supply and ecosystem balance, while maintaining fisheries. Despite their popularity, however, there is little clear empirical evidence currently available of their effectiveness.

In theory, the effects of fishing restrictions are important not only for the preservation of the populations where fishing is prohibited, but also for ensuring the gene flow between populations and **to export biomass to the surrounding areas so that fisheries take advantage of the protection without damaging the MPA itself**. This biomass export or spillover, which can be defined as “*the enhancement of production (in catch rates and/or fish size) of a fishery species within the fished locations surrounding one or more no-take reserves, owing to the net movement of eggs, juveniles and adults out of the reserve*” is a major economic output of MPAs and it has been emphasised as one of their major prospective benefits. Not a single study, however, has been able to produce estimates for this biomass export.

In this framework, the main objective of the **BIOMEX** project was to **test and develop methods to estimate export of fish biomass from MPAs to surrounding areas**. These measures of efficiency of MPAs for biomass export were based on a multidisciplinary approach that included biological and fisheries aspects. For the study, 6 littoral MPAs in the Northwestern Mediterranean were chosen –

Columbretes, Tabarca, cabo de Palos, Masía Blanca, Cala Ratjada and Cabrera – because they are well established (over 10 years of protection) and there is a large knowledge base concerning the benthic and nektobenthic fish communities in these reserves. Pelagic fish species were not considered, as they are usually not affected by coastal MPAs.

Three main components for estimating the impact of fish biomass export from MPAs were identified, corresponding to the three BIOMEX objectives:

1. Biomass export of adult fishes from MPAs

Gradients of biomass were investigated using underwater visual census and baited-video census techniques (whereby the latter were being tested for the first time in the Mediterranean). These techniques demonstrated a general evidence of significant increases in mean species richness, abundance and biomass of fishes inside marine protected areas. Based on underwater visual censuses, mean fish abundance for the 6 MPAs together was 1,3 times higher inside the MPAs than in adjacent fished areas, while **biomass was 4,7 times higher inside the MPAs**. The cause of this difference was that mean fish weight is greater inside than outside MPAs.



Project acronym:

BIOMEX

Full title of Project:

Assessment of BIOMass EXport from marine protected areas and its impacts on fisheries in the western Mediterranean Sea.

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**“THE RESULTS OF THE
BIOMEX PROJECT HAVE
BROUGHT EVIDENCE OF
FISH BIOMASS EXPORT
FROM MPA TO FISHED
AREAS IN THE WESTERN
MEDITERRANEAN”**

2. Biomass export of eggs and larvae from MPAs

To allow for the collection of eggs and very young larvae in very shallow water, new plankton nets were developed. In addition, an identification guide of eggs and early developmental stage larvae was compiled to enable the identification of eggs and very young larvae of certain species not previously described.

Although there was a high variability in eggs and larvae distribution due to current patterns, the project team was able to observe an increase in the number of eggs and larvae in the MPA with a tendency of a decrease when moving away from the MPA area, consistent with production inside reserves and exportation to outside fished areas.

3. Contribution of adult fish export to fisheries

To quantify the impact of MPAs on fisheries, gradients of experimental and commercial fishery yields were assessed as a function of distance from the MPAs. Overall results from the experimental fishing indicated higher yields near the boundaries (up to 1000 m) that declined rapidly with distance to the MPA. In the commercial fisheries survey the catch per unit effort (CPUE), the catch per unit area (CPUA) and the mean body size showed significant negative trends with distance in about 20 to 30% of the cases studied.

In summary, the results of the BIOMEX project have brought evidence of fish biomass export from MPA to fished areas in the Western Mediterranean, for adults as well as for eggs and larvae of some species or groups of species, depending on the MPA. However, this exportation would benefit local fisheries only at a small spatial scale, from tens to hundreds of meters, even if fishes were able to migrate longer distances. The small spatial scale (100 to 1000 m) on which fish biomass gradients from the MPAs studied were revealed was probably related to the high fishing pressure existing in the Western Mediterranean outside MPA and, where relevant, to habitat discontinuities.

But, even if fish biomass export from MPA varies greatly in space and intensity according to fish species, and is restricted to a small distance from MPA border, it is likely to have positive effects on adjacent fisheries. Studying these effects was outside the scope of the BIOMEX project. However, the methods and the results obtained from the BIOMEX project have provided a basis for developing a common management strategy for European MPAs, which is currently being further developed as part of the EMPAFISH project (FF-ALL-MPA-03).