Marine Protected Areas as a tool for fishery management and ecosystem conservation: an Introduction

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This special issue of the ICES Journal of Marine Science is dedicated to Marine Protected Areas (MPAs) and presents a range of papers from the "European Symposium on Marine Protected Areas as Tool for Fisheries Management and Ecosystem Conservation". This introduction provides a brief overview of key points from presentations, and discussions, and two science-policy roundtable sessions.

The symposium was convened by two European research projects, PROTECT (2005–2008; www.mpa-eu.net) and EMPAFISH (2005–2008; www.um.es/empafish), funded by the Sixth Framework Programme of the European Commission. The projects address the application of MPAs as a tool for ecosystem conservation and fishery management, from offshore fishing closures to coastal MPAs in temperate waters. The symposium was hosted at University of Murcia, Spain, with support from the European Commission, International Council for the Exploration of the Sea (ICES), Spanish Ministry of Agriculture, Fisheries and Food, Regional Ministry for Agriculture and Water (Murcia) and Fundación Séneca (Region of Murcia), Nordic Council of Ministers, Fundación Cajamurcia, National Institute of Aquatic Resources (Denmark), and University of Murcia.

The symposium organizing committee consisted of Erik Hoffmann (PROTECT coordinator), Ole Vestergaard and Thomas Kirk Sørensen (National Institute of Aquatic Resources, Denmark), Ángel Pérez-Ruzafa (EMPAFISH coordinator), Concepción Marcos, Fuensanta Salas, and José Antonio Garcia Charton (University of Murcia), and Jean Boncoeur (University of Western Brittany, France). The review and selection of papers and organization of sessions were undertaken by a committee of scientist from across Europe covering a broad range of disciplines (members are listed below).

The symposium was attended by 397 marine scientists, managers, and stakeholders from 32 countries. In all, 255 papers were presented, including 122 oral presentations. All abstracts plus extended abstracts are available from the symposium website, www.MPAsymposium2007.eu. Manuscripts submitted for publication in this special issue were reviewed by at least two independent scientific referees. The editorial work was carried out by Erik Hoffmann and Mette Blæsbjerg, National Institute of Aquatic Resources, Denmark, in collaboration with the ICES editor and copy-editor.

Symposium rationale and objectives

The symposium brought together scientists, managers, stakeholders, and policy-makers from relevant fields and sectors to discuss new findings and approaches to the ecological, economic, and social aspects of MPA development and management, primarily in European waters. The overarching goal of the event was to explore the use of MPAs as a tool for reconciling marine ecosystem conservation with fishery management. The implementation of ecosystem-based approaches to marine management calls to mind several objectives shared by conservation and fishery management that may be integrated through MPA development. The integration of new research and experiences across research fields and sectors may help to develop this further. In pursuing this goal, the symposium emphasized presentations of crosssectoral, innovative, and broadly applicable approaches in MPA development and implementation, including interaction with broad groups of stakeholders when dealing with multiple management objectives.

Symposium themes

Addressing its all-embracing objectives, the symposium was organized into the following themes.

Theme 1. *Ecological effects of MPAs*: MPA effects on marine species and habitats; biological and ecological processes and interactions, e.g. spillover effects and recruitment; spatial distribution of life stages and the implications for MPAs.

Theme 2. *MPA effects on fisheries and other uses*: Economic and bioeconomic effects of MPAs; the impact of MPAs on uses, including fishing effort reallocation; tourism, recreation, and MPAs.

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Theme 3. Assessing MPA performance-monitoring, models, and indicators: Defining management objectives and criteria; construction of indicators; MPA monitoring strategies; integration of multiple criteria; modelling MPA effects.

Theme 4. *Tools for MPA planning and design*: Marine spatial planning and zoning approaches; mapping of habitats, species, and fisheries; coherent MPA networks; MPAs and migratory species.

Theme 5. *Science, management, and stakeholders*: Cross-sectoral and transnational MPA planning; law, enforcement, and compliance; participatory mechanisms in MPA planning; future priorities in MPA development.

Keynote presentations

Callum M. Roberts (University of York, UK), "Lessons from the past for marine conservation and management in Europe", emphasized the historical perspective of marine conservation by establishing reference points for harvested populations at much longer temporal scales, making it apparent that reversing the damage to European seas requires a greater level of ambition, including, for example, extensive networks of MPAs; although many benefits will become apparent soon after protection begins, full ecosystem recovery will require decades to centuries.

Anthony Charles (Saint Mary's University, Halifax, Canada), "Human Dimensions of Marine Protected Areas", stressed the importance of human dimensions, social, economic, and institutional considerations that can dramatically affect the outcome of an MPA implementation process. The talk highlighted the role of participatory processes and community involvement as key elements to the success of MPAs.

Simon Jennings (Cefas, UK), "When do protected areas help to achieve management objectives for the marine environment?", argued that science could play a role in defining MPA objectives by assessing whether these objectives are measurable, achievable, or compatible, and by predicting the effects of combinations of management tools, including MPAs that might be used to meet them. In addition, he emphasized that MPAs that meet local management objectives might not contribute to meeting objectives at larger scales, and these incompatibilities need to be understood and managed.

Steve Murawski (National Marine Fisheries Service, USA), "Matching the Hammer to the Nail", emphasized that several key scientific questions regarding the use of MPAs are largely unresolved, either as general principles or in specific cases, including source-sink recruitment dynamics, potential for subpopulation selection impacts, benthic-pelagic interactions, edge effects and spillover, effort reallocation and concentration outside MPAs, and human behavioural adaptations to the imposition of MPAs.

Peter J. S. Jones (University College of London, UK), "Arguments for Conventional Fishery Management and Against No-take Marine Protected Areas: Only Half of the Story?", discussed the need to "sell" no-take MPAs (NTMPAs) in contrast to conventional fishery management approaches (CFMAs) from a holistic, interdisciplinary perspective rather than a reductive, intradisciplinary one. This approach attempts to accommodate both uncertainty and wider societal values and preferences, both intrinsic to the functioning of MPAs. He emphasized the inappropriateness of extending the reductive approach inherent in CFMA analyses to encompass the broader ethical and scientific concerns embraced by NTMPAs, given that marine biodiversity conservation objectives and fishery management objectives do not always stride in the same direction.

Fostering dialogue

Wide-ranging topics were presented and discussed, with scientific papers, keynotes, and round-table sessions revealing the great diversity of MPA research and management perspectives. A prime focus of the symposium was the search for common ground between fishery management and nature conservation in relation to MPAs and wider, integrated management of the marine environment. The symposium was unique in fostering serious dialogue between two communities that traditionally address different scientific, management, and political objectives, i.e. MPA scientists, planners, and managers, frequently having biodiversity conservation as their principal goal, and fishery scientists and managers with sustainable resource use as their overarching goal. The discussions and informal talks that took place during the symposium were generally regarded as steps towards increased cooperation between environmental and fishery research and management in future MPA development, a way to bridge the gap between them.

Science – policy sessions

New ideas and further attempts at the bridging of fields and objectives emerged during two science–policy round-table sessions, organized to discuss perspectives of new scientific findings, management practices, and policies for future uses of MPAs. These included the identification of common ground in MPA development, MPAs as a tool to resolve divergent responsibilities in nature conservation and fishery management, key knowledge gaps, and the costs and benefits that policy-makers and stakeholders might consider in the MPA decision-making process. Opening remarks were provided by representatives from the Commission of the European Union, with subsequent panel discussions among representatives from relevant fields of the international scientific community, policy advisors, national governments, and representatives from NGOs, fishers' organizations, the EU Commission, and other international organizations.

These discussions, together with a diverse range of scientific papers, introduced myriad aspects pertaining to integrated management of the marine environment in general and the possible role of MPAs in particular. The following key points, however, recurred throughout the symposium and panel discussions.

MPAs in the EU

In its introduction to the panel discussions, the EU Commission emphasized the increasingly important role that MPAs play in the management of European seas and their living resources. The commitment of EU Member States to establish the Natura 2000 network of both terrestrial and MPAs combined with the parallel implementation of environmental protection measures as part of an ecosystem-based approach to fishery management under the EU Common Fisheries Policy are increasingly making MPAs a priority in Europe. Therefore, interdisciplinary scientific research underpinning informed decisions on MPAs continues to be of great importance, not least in the light of the new European Maritime Policy, which emphasizes integration across marine sectors, a development that is currently getting under way.

Defining clear MPA objectives

Formulating crystal-clear management objectives when planning and implementing any MPA was a core message of the symposium and particularly in the round-table sessions. Much too often, this has been neglected in the establishment of European MPAs. Different MPA goals and targets exist, often requiring different types of MPA. Some MPAs aim at biodiversity conservation, others primarily at the management of living resources. Although in some cases, different objectives can be integrated in a single MPA setup, e.g. where priority conservation sites represent important fish habitats, in other cases, this is simply not realistic. In the latter case, this should be communicated clearly to stakeholders. MPAs have sometimes been oversold, promising win-win scenarios in situations where it was neither necessary nor scientifically credible. As a result, support for MPAs from the fisheries sector has traditionally been low. However, in the Mediterranean, for example, some coastal MPAs have successfully achieved both conservation and fishery enhancement objectives, and this has made it easier to convince artisanal fishers of the benefits of marine conservation.

MPAs and fishery management

Although the exclusion of detrimental human activities from specific areas is likely to improve the health of the marine ecosystem in those sites, it was pointed out in keynote addresses and some papers that, in terms of using MPAs vs. other fishery management measures, MPAs alone are not necessarily a cure-all that ensures sustainable management of marine living resources. However, it was stated by a fisheries representative from northern Europe that "it does look like MPAs have come to stay, and we should explore their potential as one tool among other fishery management measures". Several cases demonstrated that, for MPAs to deliver maximum management effects, spatial measures should be implemented in parallel with traditional measures, including fishery effort reduction, monitoring, and control. Displacing fishing vessels to adjacent sea areas as a consequence of MPA establishment may have negative effects on species and habitats, thus reducing the benefits of the MPA. Such displacement issues, including the economic and social consequences for fishers and other users of the marine environment, should be taken into account when pushing for new MPAs.

Advancing MPAs through prearranged agreements?

Many participants urged the EU to develop and implement a truly ecosystem-based approach to fishery management as a means of achieving sustainable fisheries. Furthermore, the EU should recognize that sectoral approaches, i.e. addressing fishery management and marine conservation under separate policies, sustain their current disconnect. Substantial challenges stand in the way of EU MPAs as a result of the current political and institutional setup, i.e. where designation and management of MPAs for marine nature conservation (Natura 2000) fall under the responsibility of Member States, whereas fishery management of EU seas falls under a Common Fisheries Policy governed in Brussels. This sector divide is mirrored at national levels, where fisheries and nature conservation are often managed by separate departments. A way to overcome the jurisdictional obstacles and delays of such sectordivided approaches, as proposed in Simon Jennings' keynote address, may be the formulation of prearranged and prenegotiated MPA agreements between involved agencies and partners.

Fishery benefits and large-scale MPAs

Apart from one well-known example from Georges Bank in northeastern US waters (as presented in Steve Murawski's kevnote address), only a few presentations described large-scale offshore MPAs that had resulted in documented benefits in the form of spillover of fish from MPAs to adjacent areas or other reserve effects. This may be the result of the complexity of speciesdependent and/or site-specific issues of a biotic or abiotic nature or the difficulty of finding appropriate sites to study. Large-scale, experimental MPAs have not yet been established in Europe, and one keynote speaker strongly emphasized that such study sites must be established if we are to determine the effectiveness of MPAs in terms of fishery benefits. During panel discussions, it was underlined that, although the European Natura 2000 network of protected areas will in fact include large, offshore areas, these areas are not designed as tools for the management of fish populations, and therefore their efficiency should not be evaluated as such, although their effects on exploited fish populations could nonetheless still be studied or considered.

MPA research: interdisciplinary gaps and challenges

Marine systems are complex and dynamic, involving many disciplines and sectors. A key message from the round-table sessions was the basic need for interdisciplinary research in future MPA development. To encompass the diverse interests and activities at sea and fully understand their respective and cumulative implications, wide-ranging research fields must be integrated, from oceanography, biology, and ecology to economics and social research. Ecosystem goods and services were highlighted as the focus of future research. For interdisciplinary projects to be successful, fishery and conservation communities must work together. Potential barriers must be identified and resolved. It was noted by one round-table member that he, as a non-EU scientist, was impressed that the EU sets up research funding for interdisciplinary projects, such as the ones hosting the symposium (PROTECT and EMPAFISH), and he suggested that interdisciplinary research be a prerequisite in EU-funded projects.

Some, more general, research challenges that were often mentioned in Murcia include: the strengthening of the scientific basis for the selection and design of MPAs; the need for appropriate monitoring and evaluation of the effectiveness of MPAs; and a need to study the effects of MPAs in contrast to or in combination with other management tools. Another important future consideration is the role of adaptive MPA design and management to cope with future climate change effects on habitats, changing species distributions, and migration patterns. In this respect, the development of MPAs with flexible boundaries, establishment of transboundary MPA networks, and considering MPAs within wider marine spatial planning will likely be a prerequisite for success in the future.

Although many participants emphasized the need to improve the scientific basis of specific research fields through targeted, cross-disciplinary research, others made the point that, in many respects, the scientific basis is already strong enough to move forward with MPA development. In fact, many delegates were in favour of simple, intuitive processes for MPA establishment, based on available knowledge combined with expert opinion, good stakeholder engagement, and common sense.

To take or no-take? That is the question

On the question of whether or not MPAs must be fully no-take areas to be effective, several points were made in favour of totally closed areas. As one keynote speaker noted, it depends on the interpretation of the ecosystem approach: an ecosystemorientated view that aims to be cautious and preserve ecosystem resilience would conclude that no-take areas are essential. On the other hand, as pointed out by the representative of a fishers' organization, fishers can rarely see the logic, for example, of excluding pelagic fisheries near the surface if the object of protection is located on the seabed. As a result, support from the fishery sector for such NTMPAs is usually minimal.

In addition to the potential benefits of fully no-take areas, regardless of whether the MPA is established for fishery management or conservation purposes, equity of the economic benefits as well as issues of compliance were emphasized in many presentations and round-table sessions. When dealing with offshore MPAs, control becomes an important economic factor owing to the difficult logistics and advanced technology required to enforce MPA boundaries and regulations offshore. Current technology allows managers to monitor offshore compliance via satellite. However, to be effective, procedures must be fairly simple. Allowing certain fishing operations in an MPA while excluding others requires extra effort for interpretation and on-site control, adding substantially to MPA enforcement costs.

Integrated marine management and spatial planning

As suggested by its title, the symposium focused primarily on marine nature conservation and fishery management. However, these are only two of myriad challenges in the management of the marine environment today. In recent years, competition for space and resources at sea has increased dramatically. Fisheries and conservation representatives, traditionally the main actors in MPA discussions, are being joined by other sectors, e.g. energy, tourism, marine aggregate extraction, and transport, to name but a few. As a result, the concepts of integrated marine management and spatial planning have won the support of national governments, regional seas conventions, and NGOs. The new European Maritime Policy, which aims to develop the maritime economy and sea-based activities in an environmentally sustainable manner, supports this development. It was therefore underlined on a number of occasions that the development and use of MPAs can support this development through integrated and coherent planning and by promoting the participation of all relevant authorities and stakeholders. It was proposed that, as a starting point, the fishery sector could map important fishing areas and evaluate its ecosystem services to fisheries in a way similar to that used for wind farm sites, sand and gravel extraction areas, and other activities, for use in coherent and transparent evaluations of management trade-offs. Ultimately, spatial management frameworks for oceans and coasts can form the basis for establishing further common ground on which managers and stakeholders across sectors can work towards common objectives.

Closing remarks

It was a common view among many symposium participants that, although the European political and administrative setup related to MPAs is complex, policies and legal instruments are nonetheless in place to move forward. The WSSD target of establishing a network of MPAs by 2012 is also an EU commitment and a common goal. However, in addition to establishing MPAs directly in response to environmental directives, the integration of environmental aspects across EU policies provides a further basis for creating MPAs. Protection of sensitive species and habitats, together with sustainable fish populations, is a basic aspect of an ecosystem-based approach to fishery management, which is a main objective of the EU Common Fisheries Policy. MPAs may not be the universal key to achieving this objective, but they can be a useful tool if handled properly.

The increasing focus on the state of our seas and oceans by the general public, combined with new policy drivers, has further stimulated the political will at most levels to engage more actively in sound management of the marine environment. The diversity of symposium participants gave clear evidence of this tendency: MPAs are here to stay. However, it also became evident in Murcia that sectoral policies and interests still stand in the way of fully utilizing this momentum. The growing competition for living and non-living resources and space at sea enhances the incentive of anyone that values the marine environment to seek the common ground and progress through sound, science-based use of MPAs for ecosystem conservation and fishery management. The European MPA Symposium in 2007 was a step in that direction.

Symposium Scientific Committee

- Erik Hoffmann (Chair), National Institute of Aquatic Resources, Denmark
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Symposium Technical Secretariat

Fuensanta Salas, University of Murcia, Spain

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Science - policy Round-table Discussions

Session A: MPAs for ecosystem conservation and fishery management—a search for common ground

Tundi Agardy (Chair), Senior Marine Specialist, USA

- Indrani Lutchman, Institute for European Environmental Policy, UK
- Jacques Fuchs, EU Commission, DG Fisheries and Maritime Affairs (DG Mare)
- Jeff Ardron, German Federal Agency for Nature Conservation, Germany
- Leticia Martínez-Aguilar, EU Commission, DG Fisheries and Maritime Affairs (DG Mare)

Michael Andersen, Danish Fishermen's Association, Denmark Miguel Nuevo-Alarcón, EU Commission, DG Research Mireille Harmelin-Vivien, Université d'Aix Marseille, France Peter Jones, University College of London, UK

Session B: What are the key costs and benefits that policy-makers and stakeholders might consider in the MPA decision-making process?

Carl Gustav Lundin (Chair), Head, IUCN Global Marine Programme

Anthony Charles, Saint Mary's University, Halifax, Canada

- Callum Roberts, University of York, UK
- Charles François Boudouresque, Université d'Aix-Marseille, France
- Christian Pusch, Federal Agency for Nature Conservation, Germany
- Fabio Badalamenti, Università di Palermo, Italy
- Giuseppe Notarbartolo, Téthys Research Institute, Italy
- Jessica Sanders, FAO, Fisheries Department
- Martín Fernández Díez-Picazo, EU Commission, Maritime Policy Task Force
- Mark A. Mellet, Commander, National Maritime College of Ireland, Ireland
- Silvia Revenga, Spanish Ministry of Agriculture, Fisheries and Food, Spain

Roundtable organization and synthesis

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