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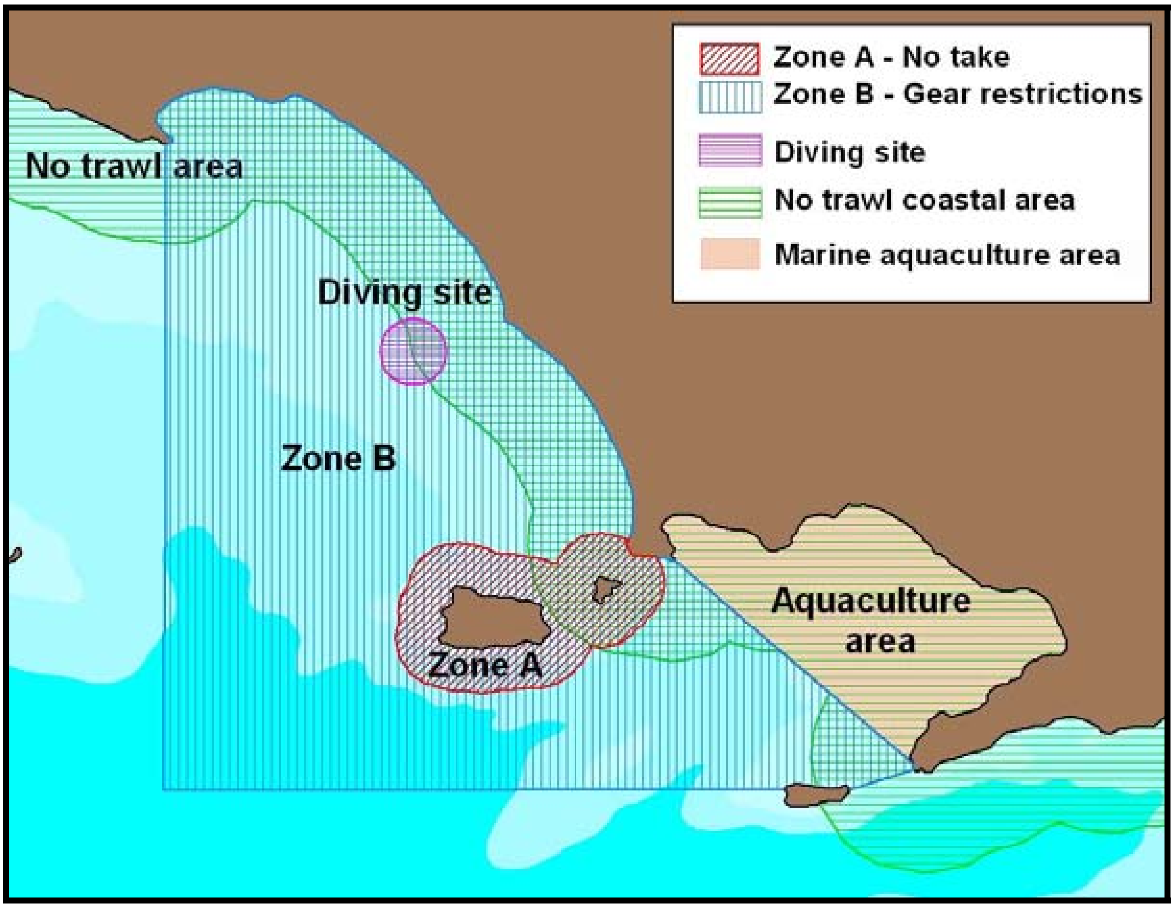
Report and documentation of the

EXPERT WORKSHOP ON MARINE PROTECTED AREAS AND FISHERIES MANAGEMENT: REVIEW OF ISSUES AND CONSIDERATIONS

Rome, 12–14 June 2006



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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2007

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PREPARATION OF THIS DOCUMENT

In 2001, marine ecosystems and marine capture fisheries figured prominently in the World Summit on Sustainable Development (WSSD). In response to WSSD, FAO, with funding from the Government of Japan, initiated a project entitled "Promotion of sustainable fisheries: support for the Plan of Implementation of the World Summit on Sustainable Development" (referred to as the "FAO WSSD Project"). It focuses on specific activities that assist FAO Members with addressing the WSSD recommendations, in order to work towards achieving sustainable fisheries. Phase I of that project consisted of three distinct tasks aimed at providing information and assessments on (a) subsidies that contribute to overcapacity and to illegal, unreported and unregulated (IUU) fishing, (b) implementation of the International Plan of Action (IPOA) for Management of Fishing Capacity (IPOA–Capacity), and (c) implementation of the IPOA on Illegal, Unreported and Unregulated Fishing (IPOA–IUU).

Phase II of the project started in early 2006. In addition to providing some support to the implementation of the IPOA–Capacity and IPOA–IUU, two new tasks have been initiated under this project with the aim of providing information, assessments and guidance on deep-sea fisheries and marine protected areas (MPAs) in relation to fisheries management.

The twenty-sixth session of the FAO Committee on Fisheries (COFI) recommended that FAO develop technical guidelines on the design, implementation and testing of MPAs, to help assist its Members in achieving the WSSD goal of establishing representative networks of MPAs by 2012. Under the FAO WSSD Project an expert Workshop on MPAs and Fisheries Management was convened as an initial activity to review and characterize MPAs in a fisheries management context.

This document contains the report of the workshop and the background papers commissioned for the meeting. The report, and in particular the "Key Points" adopted by the workshop, will serve as basis for further work on developing technical guidelines for the design, implementation and review of MPAs.

The co-conveners of the workshop were Kevern Cochrane and Dominique Gréboval. Michael Sissenwine served as a consultant, Jessica Sanders (FAO Consultant) and Anthony Charles (FAO visiting expert) provided extensive input and assistance, and Louise-Anne Le Bailly provided secretarial support. Together they prepared this meeting report that provides a record of activities at the meeting and outcomes of the meeting in the form a statement agreed to by the invited experts. The latter is contained in the "Key Points" section of the document.

Distribution:

Participants in the workshop
FAO Fisheries and Aquaculture Department
FAO Fisheries Officers, Regional and Subregional Offices

FAO.
Report and documentation of the Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations. Rome, 12–14 June 2006.
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ABSTRACT

The Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations was held in Rome from 12 to 14 June 2006. The workshop is a response to the FAO Committee on Fisheries' call for technical guidelines for marine protected areas (MPAs) to assist Members to establish representative networks of MPAs by 2012, as agreed at the World Summit on Sustainable Development. During the workshop, invited experts and FAO staff discussed characteristics of marine protected areas (MPAs) relevant to fisheries management. Their discussions were informed and stimulated by six background papers on a wide range of topics including concepts and definitions, case studies of MPAs, biological factors, economic and social considerations, governance, legal aspects, and the interface between MPAs and fisheries management. The workshop also considered a draft framework outline for technical guidelines on MPAs and fisheries management. Participants agreed upon "Key Points" on definitions, terminology and concepts; design, implementation and monitoring; and guidelines.

CONTENTS

PART 1: REPORT OF THE EXPERT WORKSHOP ON MARINE PROTECTED AREAS AND FISHERIES MANAGEMENT: REVIEW OF ISSUES AND CONSIDERATIONS

1. BACKGROUND

The “Expert workshop on marine protected Areas and Fisheries Management: Review of Issues and Considerations” was held in Rome, Italy, from 12 to 14 June 2006.

The Workshop was organized as a component of a project entitled “Promotion of sustainable fisheries: support for the Plan of Implementation of the World Summit on Sustainable Development,” funded by the Government of Japan. The project is focused on specific undertakings based on activities recommended by the World Summit on Sustainable Development (WSSD), in order to work towards achieving sustainable fisheries. It responds to the FAO Committee on Fisheries’ (COFI) call for technical guidelines on marine protected areas (MPAs) to assist Members to achieve the WSSD goal of establishing a representative network of MPAs by 2012.

Experts from a wide variety of disciplines and experiences were brought together to review and characterize MPAs as a fishery management tool which served as the main purpose of the Workshop.

The scope of the Workshop was broad in terms of the range of fisheries, considering the role of MPAs for fisheries from small scale to industrial, developing country to developed country, domestic to international, and near-shore to high seas.

2. OPENING SESSION

The Workshop was attended by 16 invited experts from a variety of disciplines, backgrounds, and geographic regions. In addition, ten FAO staff from both the Fisheries and Legal Department attended portions of the Workshop. The participant list is given in Appendix B.

Co-conveners Kevern Cochrane and Dominique Gréboval of the FAO Fisheries Department called the Workshop to order. Background on the Workshop was provided and the decisions related to marine protected areas (MPAs) of the twenty-sixth Session of the FAO Committee on Fisheries’ (COFI, March 2005) were brought to the attention of Workshop participants. COFI had recommended that FAO prepare technical guidelines on MPAs and fisheries. The co-conveners noted that the Workshop was an initial step in a process to prepare technical guidelines.

Assistant Director General Ichiro Nomura, of the FAO Fisheries and Aquaculture Department, addressed the Workshop. He welcomed participants and thanked them for their willingness to assist FAO. He stressed the mission of the Department “to facilitate and secure the long-term sustainable development and utilization of the world’s fisheries and aquaculture”. He noted the potential importance of MPAs as a fishery management tool to achieve the goal of long-term sustainable development and utilization, but he also noted that there were limitations that needed to be considered. He recalled that COFI has stated that “the use of MPAs as a fisheries management tool should be scientifically-based and backed by effective monitoring and enforcement and an appropriate legal framework”. Assistant Director General Nomura’s complete address is given in Appendix C.

Workshop participants selected Ana Parma as chair, and Magnus Ngoile, Marea Hatziolos and Patrick Christie as co-chairs.

The preliminary Workshop agenda was introduced and approved by Workshop participants. It is given in Appendix A.

3. REVIEW OF BACKGROUND PAPERS

Six background papers were prepared for the Workshop. They are included in this report in Part II. The papers were reviewed by FAO staff and a consultant, and were revised after the Workshop by their respective authors in response to reviewers' comments and taking into account comments made by Workshop participants. The authors are solely responsible for the content and accuracy of their paper and the views expressed in them do not necessarily reflect the views of FAO in any way.

The background papers were designed to cover a range of topics related to MPAs and fisheries management from: concepts related to MPAs and case studies; to biology; to social and economic considerations; to governance; to legal issues; to the interface between MPAs and fisheries management. The background papers are summarised briefly in the paragraphs that follow.

3.1 Background, concept and definitions

The background paper titled "Experiences in the use of MPAs with fisheries management objectives: a review of case studies" by K. Martin, M.A. Samoilys, A.K. Hurd, I. Meliane and C.G. Lundin was considered by the Workshop. The paper highlighted the IUCN definition and its system of six categories of MPAs. It gave seven cases studies of MPAs which identified key aspects of MPA design, such as MPA designation and stakeholder processes, legal and institutional frameworks, and management aspects. The paper concluded that a thorough case-to-case assessment and further empirical evidence is needed to define MPA benefits and limitations.

3.2 Biological and ecological considerations

"Biological and ecological considerations in the design, implementation and success of MPAs" by L.W. Botsford, F. Micheli and A. Parma reviewed empirical evidence on: (a) changes in the density, biomass, diversity and size of organisms within no take reserves; (b) the contribution of larvae produced within no take reserves to recruitment outside the reserves; (c) catch per unit effort of mobile species near reserves; and (d) aspects of MPA design, such as size and spacing. It also reviewed modelling studies on the size and spacing of MPAs relative to sustainability of populations.

3.3 Social and economic considerations

"Marine protected areas: the social dimension" by R.S. Pomeroy, M.B. Mascia and R.B. Pollnac reminds us that MPAs "as management tools, are the product of social institutions" and "are a human creation whose purpose is to manage behaviour of people in their use of coastal and marine resources." The paper emphasizes social factors as a major determinant of success or failure of MPAs. Since fishers, fishing households, and fishing communities are not homogeneous, the authors point out the importance of recognizing the unique context of each MPA. This uniqueness can also make it difficult to transfer lessons from one situation to another. The potential social benefits and costs, in both the short and long term, of MPAs are discussed. In addition, the authors identify crucial aspects of and variations in the distributional benefits and costs of MPAs (i.e. who are the winners and losers?).

3.4 Governance

"Best practices in governance and enforcement of marine protected areas: an overview" by P. Christie and A.T. White focuses on decades of experience from the Philippines where the standard planning process generally has five main phases including: (1) issue identification and baseline assessment; (2) plan preparation; (3) implementation and enforcement; (4) monitoring and evaluation; and (5) education. In this context, MPAs are designed to fulfil both artisanal fishery management and biodiversity conservation goals. The paper draws attention to embedding of MPAs within a larger planning framework such as integrated coastal management (ICM) or ecosystem-based management (EBM). An MPA rating system from an international monitoring guidebook, and that is being used by nationally declared MPAs in the Philippines, is introduced as a management tool.

3.5 Legal issues

"The legal framework for MPAs and successes and failures in their incorporation into national legislation" by T.R. Young addresses terminology and legal processes by which protected areas and legal frameworks are adopted. It describes the overall international framework of binding and non-binding laws and instruments relevant to MPAs, experiences developing legislation, legal opinions that have been used or proposed for addressing MPA development, and lessons applicable to MPA guidelines. As for other aspects of MPAs, the paper notes that legal issues and the development of legislation is situation dependent.

3.6 General issues and considerations

"Issues arising on the interface of MPAs and fisheries management" by A.T. Charles and J.S. Sanders emphasizes the various steps in MPA decision making in three major groupings: (1) initial aspects and policy/legal framework; (2) design stage; and (3) implementation, management, monitoring and assessment. It highlights the commonalities between discussions of marine protected areas and of fisheries management, in terms of their mutual use of spatial measures and ecosystem approaches. The paper draws on the other Background Papers prepared for the Workshop, as well as a range of additional literature, to produce a fairly comprehensive compilation of issues and considerations relating to the development and implementation of MPAs within a fisheries management context. In addition, a focus on the first of stage of the decision making process – the preliminary scoping steps of the "early decision-making stage" – explores the key decision-making elements involved in this 'early stage'.

Each paper was discussed by the workshop after it had been presented and key points arising from the papers and the discussion were considered in relation to the guidelines and, in some cases, included in the list of key points provided at the end of this report.

4. DISCUSSION OF INITIAL DRAFT FRAMEWORK FOR GUIDELINES

An initial draft of a framework for guidelines for MPAs and fisheries management was introduced by the FAO staff. The draft framework is given in Appendix D.

The draft framework for guidelines on MPAs and fisheries management calls for guidelines that give usual **background information** on MPAs, including:

- policies such as the WSSD goal for a representative network of MPAs by 2012;
- characteristics of MPAs including definitions and the potential consequence MPAs; and
- the fisheries management process and the potential role of MPAs as a fisheries management tool.

The draft framework emphasizes the **design stage** for MPAs including factors that need to be considered in the design of MPAs such as:

- consideration of legal regimes and governance, and management strategies;
- biological, ecological, and economic aspects of MPA design;
- institutional issues and options; and

the process to be followed in designing MPAs, including:

- objective setting and issue identification; and
- preparation and adoption of MPA plans.

Sections of the draft framework on **implementation and monitoring** of MPAs address:

- formalization of the MPA through legal processes,
- compliance and enforcement issues,
- revenue generation, conflict resolution and capacity building involving stakeholders,
- identification of indicators of performance,
- strategies for data collections, periodic review, and adaptation.

The draft framework was extensively discussed and a number of important suggestions were made for improving it in subsequent development of the guidelines. In addition to those suggestions, the workshop arrived at a number of conclusions and recommendations that are listed in the form of Key Points in the following section of this report.

5. CONCLUSIONS AND RECOMMENDATIONS – KEY POINTS

5.1 Setting the stage

1. The workshop was pleased that COFI had responded to the WSSD policy commitment to implement a network of MPAs by 2012 by asking the FAO Fisheries Department to prepare guidelines on the role of MPAs in fisheries management.

2. WSSD made a policy commitment to MPAs, but not explicitly as a fishery management tool. However, given the widespread acceptance of the concept of an ecosystem approach, which recognizes the importance of habitat and biodiversity, robustness to uncertainty, and the human dimension of fisheries, it should be expected that fisheries management will increasingly apply a diverse set of management tools, including MPAs. Furthermore, there are many cases where MPAs have not performed well relative to objectives, thus highlighting the need to improve the design and implementation of MPAs. FAO guidelines should facilitate such improvements.

3. The points that follow emerged as important during the workshop. However, they are not comprehensive or a complete list, nor do they necessarily represent the views of FAO. The workshop agreed on the sense of the points below, but not necessarily on the exact wording.

5.2 Definitions, terminology, concepts

4. Several definitions of MPAs have been prepared by various national and international governmental and non-governmental organizations, and by individual authors. While there are differences in the definitions, there are consistent similarities that are more important. The workshop felt it was better for FAO to build on these consistencies to advance understanding of what is meant by an MPA, rather than attempting to advance its own definition.

5. Fisheries management applies to fishery management units with a geographic specification, which to the extent practicable, correspond to the geographic range of the fishery resources that are the subject of management. At a minimum, an MPA should include explicit objectives concerning the conservation and sustainability of the fishery resources. The workshop agreed that MPAs as a fishery management tool:

   - are intended to contribute to achieving conservation and sustainability objectives of fisheries management, while contributing to biodiversity and habitat conservation (with intended or unintended social and economic consequences);

- are temporally and geographically specified in three dimensions for a portion of the geographic range of the fishery management unit;
- would afford fishery resources a higher degree of protection within the geographic boundaries of the MPA than the resource is afforded elsewhere within the geographic range of the fishery management unit;
- are established through legally binding mechanisms and/or other effective means;
- are usually expected to have resource conservation and sustainability benefits, other ecological benefits, and/or social benefits, beyond the boundaries of the MPA.

6. WSSD refers to networks of MPAs. A network of MPAs may refer to:
   - at a minimum, more than one MPA,
   - more usefully, a collection of MPAs either as representative networks and/or with some degree of connectivity which could be ecological or social, including sharing of governance resources;
   - ideally, a synergistic system of MPAs with the "whole greater than the sum of the parts" relative to objectives.

7. In the context of MPAs as a fishery management tool, networks should be employed, rather than a single MPA, to the extent that they are advantageous relative to conservation and sustainability objectives, biodiversity and habitat benefits, and social impacts. Networks may serve to:
   - account for dispersal of early life history stages of fishery resources or movement of later life stages;
   - conserve and sustain multiple species of fishery resources which typically have different distributions and patterns of dispersal;
   - afford protection to diverse types of habitat and/or ecosystem types;
   - affect distributional aspects of social benefits and costs;
   - enhance effectiveness of governance; and
   - improve learning through sharing experiences.

8. The utility of an MPA relative to achieving objectives depends to some degree on the effectiveness of governance.

9. MPAs and networks of MPAs may be initiated from the bottom up (e.g. by individuals and local communities seeking sanction from higher scales of governance) or from the top down (e.g. high level policies implemented locally). Effective governance in the long term is likely to depend on sharing responsibility over a hierarchy of scales, with responsibility delegated to the lowest (i.e. most local) scale that has the ability to achieve objectives.

10. Ideally, governance structures and processes for MPAs should incorporate relevant multi-sectoral interests (e.g. mining, transportation, tourism, fisheries) as a means to facilitate improved implementation and compliance. However, a pragmatic approach is required and it may be useful for MPAs to start within a single sector, such as fisheries, but to be allowed to evolve as participation and buy-in is expanded to other sectors with time. Nevertheless, it needs to be recognized that there is a trade-off between the extent and impact of externalities on the ability to govern and the extent of participation by multiple sectors.

11. Integrated Coastal Management (ICM), an Ecosystem Approach (EA), the Precautionary Approach, and MPAs all interface with fisheries management and each other.

12. ICM applies broadly to all use sectors, including fishing, such that geographic areas may be zoned to either allow or exclude specific uses. MPAs are a specialized form of geographic zoning, which can be nested within ICM.

13. EA is a process for design and implementation of management that broadens stakeholder involvement, considers direct and indirect impacts on an ecosystem, and takes account of uncertainty. It is applicable to ICM and fisheries management (EAF). The precautionary approach is a way of accounting for uncertainty and managing risk. FAO has prepared useful guidelines on the precautionary approach and the ecosystem approach for fisheries.

14. MPAs may be a valuable element of a precautionary approach, for example, when:
    - MPAs protect components of ecosystems that are not protected by other forms of fisheries management;
    - they can be more effectively enforced than alternative forms of fisheries management;
    - they are more robust in the face of social and ecological change, and resource assessment uncertainty.

    However, MPAs do not necessarily provide these precautionary benefits. Applying a diversity of fishery management tools, including MPAs, is likely to be more precautionary than overly depending on any one tool.

5.3 Design, implementation and monitoring of MPAs for fishery management

15. The design of MPAs as a fishery management tool should be integrated within the overall design process for fishery management. It usually involves a preliminary or scoping stage, and a secondary or analysis stage.

16. The scoping stage of design is the stage when the viability of MPAs as a tool for managing a specific fishery is considered. It takes account of:

    - availability of spatial and temporal information about fishery resources, ecosystems, fishing activity, community dependencies and other social considerations, which might be used to design MPAs;
    - objectives of fisheries management (what are the problems and opportunities), and the amenability of MPAs for addressing them;
    - applicability of governance options to MPAs;
    - stakeholder opinions about MPAs relative to other management tools;
    - feasibility of implementing MPAs relative to other fishery management tools, for example taking account of enforceability;
    - entry points such as the current existence of MPAs that might serve as a building block.

    The product of the scoping stage includes a set of viable fishery management tools to be more rigorously analyzed in the next stage of design.

17. The analysis stage of design compares the performance of viable fishery management tools (including MPAs, assuming they emerged from the scoping stage as viable) relative to objectives and costs of implementation. Both quantitative models and analyses and objective qualitative evaluations may be used.

18. Within the broader framework for design of fisheries management, MPA design should take account of ecological and social connectivity between MPAs, costs and benefits including distributional effects, and robustness to uncertainty

19. Fishery management tools may produce benefits that go beyond the scope of explicit benefits of fishery management. For example, MPAs are likely to have habitat and biodiversity benefits that may not be explicitly included as fishery management objectives. Nevertheless, such benefits should be considered in the fishery management design process.

20. There is potentially a role for MPAs in fisheries management from near shore areas to the high seas. There are important differences in settings, such as governance regimes, the state of natural science and social science knowledge, nature of fishery resource and ecological threats, degree of user conflicts, and implementation costs. These differences will be important in both the scoping and analysis stages of fishery management design.

21. Regional Fisheries Management Organizations (RFMOs) have a prominent role in international fisheries management, particularly for straddling and highly migratory fish stocks as mandated by the UN Fish Stocks Agreement. RFMOs should consider MPAs as a fishery management tool to the extent they are an effective way to achieve conservation and sustainability objectives, and fulfill mandates and policy agreements.

22. FAO can contribute to improved management of fisheries in areas beyond national jurisdiction by providing technical guidance on effective means of management, including the potential role of MPAs. Greater collaboration between FAO and CBD would help to integrate initiatives to achieve conservation of biodiversity with efforts to ensure sustainable use of fishery resources in these areas.

23. The requirements and structures for effective governance of MPAs, within a broader framework of fisheries governance, will differ according to the scale and international scope of the MPA. Governance needs to be appropriate to the scale of the MPA or MPA network and of the management unit in which it is embedded. Some general principles include the following.

    a) MPAs should not be seen in isolation but as part of larger governance systems.

    b) Governance and management strategies should explicitly address uncertainty, robustness and precaution.

    c) Small-scale, coastal MPAs should give due attention to community rights and participation. The policy framework needs to enable this.

    d) Coastal MPAs will frequently need to be embedded not only in a broader fisheries management system but also within an integrated coastal zone management system.

    e) MPAs in inshore, offshore and areas beyond national jurisdiction will frequently include a variety of stakeholders within and outside the fisheries sector and the governance and management structures and processes must accommodate this.

    f) As the number of stakeholders and sectoral groups involved in MPA management increases, the need for strong and formal overarching arrangements to ensure coordination across users will similarly increase.

    g) Zoning systems and management planning systems can be useful for managing multiple use of an area. Zoning and management planning systems should be supported by primary legislation which provides guidance to the process, and devolves actual zoning and management planning decisions to the appropriate level. An important aspect of zoning should be to avoid prohibitions except where useful in order to achieve defined objectives, to improve compliance and reduce enforcement requirements.

    h) Large-scale MPAs may be beneficial in order to encompass macro-scale features that serve critical functions in populations or ecosystems. Zoning will often be important in such cases and consideration should also be given to the relative advantages and disadvantages of a single large-scale MPA compared to a network of smaller MPAs.

i) The potential contribution of MPAs in areas beyond national jurisdiction is under intense discussion at present and there are differences of opinion on the adequacy of the international legal regime governing areas beyond national jurisdiction. Nevertheless, the guidelines to be developed by FAO should provide technical guidance on the potential advantages and disadvantages of MPAs as tools for fisheries management in relation to other tools in these areas. Such information could be useful, amongst others, to RFMOs and to States considering entering bi-lateral or multi-lateral arrangements to improve fisheries management and conservation in areas beyond national jurisdiction.

j) MPAs on the high seas could address deep sea resources and communities, for example on sea mounts and oceanic ridges, pelagic resources and communities, or both. High degrees of endemism in deep sea communities and the vulnerability of some deep sea stocks and species require particular consideration for fisheries and conservation of biodiversity. Enforcement and IUU fishing are likely to be problematic. Flag States have an important role to play in ensuring responsible and sustainable use of resources in areas beyond national jurisdiction and could contribute by a range of methods, including through effort management of their national fleet, gear regulations and where applicable, compliance with MPAs and other spatial controls.

24. The design of MPAs would benefit from more support for effectively designed and conducted studies of MPAs, emphasizing the diversity of situations in which MPAs have been applied, design and implementation processes, monitoring and performance, and ultimately, lessons learned. To make this possible, systematic databases on all aspects of MPAs, such as inventories of MPAs, their legal frameworks and governance regimes, objectives, enforcement and monitoring, etc., would be valuable.

25. Like most fishery management tools, the effectiveness of MPAs depends on compliance, which will often require effective enforcement with large enough penalties to serve as a deterrent. Joint enforcement arrangements that take advantage of enforcement assets from multiple jurisdictions and sectors should be developed. There are many opportunities to enhance compliance through application of modern technologies, such as vessel monitoring systems (VMS), although for small-scale fisheries this may pose a challenge.

26. Many factors can lead to "voluntary" compliance and self-enforcement, such as involvement of stakeholders, education, and the recognition and/or allocation of rights.

27. Enforcement of MPAs should build on the IPOA for IUU and the FAO Compliance Agreement, among others.

28. One important aspect of sustainability of MPAs in fisheries management is a sustainable source of funding after the initial flux of external or donor funds runs out. Accordingly, costs should be kept as low as possible. Several potential sustainable sources of funding should be considered, such as:

- establishing a trust fund from the initial flux of external or donor funds;
- funds from enforcement penalties;
- fees paid by people who benefit from the MPA, such as fishers, tourists, hotel owners, etc.

29. Where possible, mechanisms and policies should be designed so that funds generated by an MPA are available to be used locally to sustain the MPA. If the funds are absorbed by a central government, funding to sustain the MPA is likely to be inadequate and there will be less local support for generating revenues.

30. It was suggested that there can be discrepancies between the goals of international governance and goals at the national scale. This could lead, for example, to countries responding to initiatives from

donor agencies and NGOs to implement MPAs in the short-term but lacking the national and local commitment to sustain them in the longer term. It is essential for more effective and sustained governance that there is greater coherence between international and national goals and processes. Principles that could contribute to improving the coherence include adherence to transparency and participatory decision-making.

31. While the charge of the workshop was to consider the role of MPAs in fishery management, in reality, MPAs almost always explicitly and implicitly serve multiple objectives, and interest in MPAs is cross sectoral, including commercial and recreational fisheries, tourism, other industries, and environmentalists. The workshop suggested that FAO should consider initiatives to close gaps between these interest groups and improve cooperation.

32. One advantage of harmonizing the role of MPAs as a fisheries management tool and as a tool that serves broader conservation objectives, is the possibility of broadening the funding for MPAs, such as joint funding from fisheries and conservation agencies.

33. Conflicts associated with MPAs are frequent, as with other forms of fisheries management. MPAs should be designed and managed to minimize conflicts before they occur, but mechanisms for conflict resolution should also be designed into the governance of MPAs. Enhancing capacity to do so in developing countries may be particularly important.

34. While there are many examples of developing countries "leading the way" in the application of MPAs to fisheries, in general most developing countries require assistance in building capacity for research, governance, monitoring, and enforcement. The capacity needs to be sustained beyond the initial period of involvement by external donors.

35. Capacity building, community involvement, and ocean literacy throughout society are related, and may be necessary for MPAs to be initially accepted, and effectively sustained.

36. There should be a sustained commitment to a balanced monitoring program so that performance of the MPA can be evaluated relative to objectives, and more generally, to support research. A monitoring program needs to be designed to account for connectivity between the area inside and outside MPA boundaries. Monitoring and performance evaluation needs to address fishery resources and ecosystems, fishing activity, and costs and benefits including distributional effects.

37. In many cases, local communities and stakeholders can conduct or contribute to monitoring, which may enhance credibility of results with stakeholders. It may also be cost effective, contribute to capacity building, and indirectly be a way of recovering management costs. However, care needs to be taken to assure the quality of the results. There is increasing experience with cooperative research involving members of the fishing industry and science professionals, which can help to guide cooperative monitoring for MPAs.

5.4 Guidelines

38. The meeting agreed that FAO should prepare guidelines on the role of MPAs in fishery management.

39. There are many documents that address MPAs, including definitions, descriptions of specific applications, and guidelines for design of MPAs. FAO should build on the existing body of knowledge, specifically elaborating on it in the context of MPAs as a fishery management tool. It should not attempt to "reinvent the wheel."

40. FAO guidelines should be comprehensive with respect to applications of MPAs to fisheries management, with emphasis on policy aspects, but not exhaustive in detail. The guidelines should help policy makers to understand concepts and approaches, and to realistically shape expectations.

They should also serve as a point of entry into more detailed literature on MPAs. FAO should not attempt to create an all inclusive body of knowledge about MPAs.

41. The guidelines should present an overview of the international legal context relevant to MPAs as tools for fisheries management. In the case of national MPAs and MPAs in areas beyond national jurisdiction this will need to include consideration of the rights of other States resulting from, for example, their membership of RFMOs with an overlapping mandate.

42. The guidelines also need to consider the implications of a State's international obligations and commitments in relation to its implementation of MPAs in its own jurisdiction. Although there may be no legally binding international instruments requiring countries to implement MPAs for fisheries management, their commitments to a number of non-binding instruments, such as the WSSD Plan of Implementation and the Code of Conduct for Responsible Fisheries imply such implementation.

43. The guidelines should highlight the importance of capacity building, including the role of community involvement and ocean literacy, as requirements for effective MPAs, particularly for developing countries. Fishery managers and policy makers would also benefit from capacity building.

44. The Workshop agreed that "Draft framework for technical guidelines on the design, implementation, and review of MPAs as a tool for fisheries management" addressed the appropriate topics to be considered in guidelines. Several suggestions for improving the framework were offered during the meeting (as indicated in the previous paragraphs), and these should be considered in the next draft of the framework. The meeting also urged FAO to draw on the six background papers prepared for the meeting.

45. In developing the Guidelines, the need for a balance in the treatment of the biophysical aspects and the socioeconomic aspects was highlighted, and indeed the Guidelines should avoid this division of disciplines, where possible.

5.5 Closing of the Workshop

46. The Workshop thanked the Chair (Ana Parma) and Co-chairs (Magnus Ngoile, Marea Hatziolos, and Patrick Christie) for their valuable contributions, the authors of background papers, FAO Fisheries Department for organizing and implementing the workshop, and the government of Japan for financial sponsorship.

47. The Chair thanked participants for their contributions and closed the Workshop at approximately 1700 hours on 14 June 2006.

APPENDIX A

Workshop agenda

Monday, 12 June 2006

Morning:

Opening
Introduction

- **Background, concepts and definitions**
  Experiences in use of MPAs: a review of case studies (presented by Carl Gustaf Lundin)
- **Biological and ecological considerations**
  Biological and ecological considerations in the design, implementation and success of MPAs (presented by Louis Botsford)
- **Social and economic considerations**
  Social, economic and institutional considerations in the design, implementation and success of MPAs (presented by Jean-Yves Weigel)
- **Governance**
  Best practices in governance and enforcement of MPAs: an overview (presented by Patrick Christie)

Afternoon:

- **Legal issues**
  The legal framework for MPAs, including international binding and non-binding instruments and their incorporation into national legislation (presented by Tomme Young)
- **Overview of issues and considerations**
  Issues Arising on the Interface of MPAs and Fisheries Management (presented by Anthony Charles)
- **Discussion of the initial draft framework for the guidelines**

Tuesday, 13 June 2006

Morning:

- **Step 1: Preliminary considerations** [and Policy/legislative issues]

Afternoon:

- **Step 2: Design** [Goals & Objectives; Criteria; Principles of design]

Wednesday, 14 June 2006

Morning:

- **Step 3: Implementation and Review** [Management; Evaluation/monitoring]

Afternoon:

-Drafting of conclusions and recommendations
-Opportunity for informal presentations

- **Adoption of conclusions and recommendations**

APPENDIX B

List of participants

BOTSFORD, Louis W.
Department of Wildlife,
Fish and Conservation Biology
University of California
One Shields Avenue
Davis, California 95616
United States of America
Tel.: (+530) 752 6169
Fax: (+530) 752 4154
E-mail: lwbotsford@ucdavis.edu

CASTILLA, Juan Carlos
Departamento de Ecología
Facultad de Ciencias Biológicas P.
Universidad Católica de Chile
Alameda 340
Santiago, Chile
Tel.: (+56) 2-6862610
Fax: (+56) 2-6862621
E-mail: jcastilla@bio.puc.cl

CHARLES, Anthony
Visiting Expert (FIPP)
Management Science / Environmental Studies
Saint Mary's University
Halifax, Nova Scotia, Canada B3H3C3
Tel.: (+902) 420-5732
Fax: (+902) 496-8101
E-mail: tony.charles@smu.ca

CHRISTIE, Patrick
University of Washington,
School of Marine Affairs
3707 Brooklyn Ave. NE
Seattle, WA 98105-6715
United States of America
Tel.: (+1)206-685 6661
Fax: (+1)206-543-1417
E-mail: patrickc@u.washington.edu

HATZIOLOS, Marea
Senior Coastal and Marine Specialist
Environment Department MC5-512
The World Bank
1818 H St., N.W.
Washington, DC 20433
United States of America
Tel.: (+1) 202 473 1061
Fax: (+1) 202 522 0367
E-mail: Mhatziolos@worldbank.org

HERRERA, Angel
Parque Marino del Pacifico
Puntarenas, Costa Rica
Tel.: (+506) 6615272
Cell Phone: (+506) 3882353
Fax: (+506) 6610633
E-mail: herrera@una.ac.cr
or fherrera@racsa.co.cr

JAPP, Dave
Unit 15 Forgate Square
Table Bay Boulevard
Foreshore, Cape Town
P.O. Box 50035
Waterfront, Cape Town 8002
South Africa
Tel.: (+27) 21 4252161
Fax: (+27) 21 4251994
Cell Phone: (+27) 82 7886737
E-mail: jappy@iafrica.com

KELLEHER, Graeme
AO. FTSE. FIE Aust. FEIANZ
12 Marulda Street
Aranda, Canberra ACT 2614
Australia
Tel.: (+61) 2625 11402
E-mail: g.kelleher@gbrmpa.gov.au

KONDO, Yoshikiyo
Deputy Director
Ecosystem Conservation Office
Fisheries Agency of Japan
1-2-1 Kasumigaseki, Chiyoda-ku
100-8950 Tokyo, Japan
Tel.: (+81) 3 3502 8487
Fax: (+81) 3 3502 1682
E-mail: yoshikiyo_kondo@nm.maff.go.jp

LUNDIN, Carl Gustaf
Global Marine Programme, Head
IUCN – Marine Programme
Rue Mauverney 28
CH-1196 Gland
Switzerland
Tel.: (+41) 22-999 00 01
Fax: (+41) 22-999 00 20

MOLENAAR, Erik Jaap
Senior Research Associate
Netherlands Institute for the Law
of the Sea (NILOS)
Utrecht University
Achter Sint Pieter 200
3512HT Utrecht
The Netherlands
Tel.: (+31) 0 30 253 7066
Fax: (+31) 0 30 253 7073
E-mail: E.Molenaar@law.uu.nl
http://www.law.uu.nl/nilos

NGOILE, Magnus
Team Leader, Marine and Coastal
Environment Management Project
J.M. Mall, 5th Floor
P.O. Box 72463
Dar es Salaam
United Republic of Tanzania
Tel: (+255) 22 2123387
Fax: (+255) 22 2123347
E-mail makngoile@yahoo.com

PARMA, Ana
Centro Nacional Patagonico (CENPAT)
9120 Puerto Madryn, Argentina
Tel.: (+54) 2965 451024 (ext.229)
Fax: (+54) 2965 451543
E-mail: parma@cenpat.edu.ar

SISSENWINE, Mike
Marine Science Consultant
500 Harborview Dr.
Baltimore, MD 21230
United States of America
Tel.: (+1) 508 555 3144
E-mail: m_sissenwine@surfglobal.net

WEIGEL, Jean-Yves
Directeur de recherche, IRD
UMR C3ED
UVSQ
47 bd Vauban
78200 Guyancourt
France
Tel.: (+33) (0)1433 18080
E-mail: weigeljy@ird.fr

YOUNG, Tomme
Consultant International and National
Marine Law and Policy
In der Lies 4
53129 Bonn, Germany
Tel.: (+49) 228 9156 892 or
(+49) 228 2692 224
Fax: (+49) 228 2692 250
E-mail: Tomme.Young@gmail.com

FAO Secretariat

GRÉBOVAL, Dominique
Senior Fisheries Planning Officer
Development and Planning Service (FIEP)
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: dominique.greboval@fao.org

COCHRANE, Kevern
Senior Fishery Resources Officer
Fisheries Manangement and Conservation
Service (FIMF)
Fisheries and Aquaculture Management
Division (FIM)
E-mail: kevern.cochrane@fao.org

SANDERS, Jessica
FAO Consultant
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: jessica.sanders@fao.org

LE BAILLY, Louise-Anne
Secretary
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: louiseanne.lebailly@fao.org

FAO headquarters

NOMURA, Ichiro
Assistant Director-General
Fisheries and Aquaculture Department
E-mail: ichiro.nomura@fao.org

PULVENIS DE SÉLIGNY, Jean-François
Director
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: jeanfrancois.pulvenis@fao.org

DE YOUNG, Cassandra
Fishery Planning Analyst
Development and Planning Service (FIEP)
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: cassandra.deyoung@fao.org

KUEMLANGAN, Blaise
Legal Officer
Development Law Service (LEGN)
Legal Office
E-mail: blaise.kuemlangan@fao.org

SKONHOFT, Anniken
Associate Legal Officer
Development Law Service (LEGN)
Legal Office
E-mail: anniken.skonhoft@fao.org

WATANABE, Hidenao
Fisheries Planning Officer
Development and Planning Service (FIEP)
Fisheries and Aquaculture Economics and
Policy Division (FIE)
E-mail: hidenao.watanabe@fao.org

APPENDIX C

Welcoming address by Mr Ichiro Nomura, Assistant Director-General, FAO Fisheries and Aquaculture Department

Ladies and Gentlemen,

Welcome to Rome, and Welcome to FAO.

I am pleased to welcome you to this Workshop on Marine Protected Areas and Fisheries Management. I would like to thank you all for joining this Workshop, and express my gratitude for your agreement in serving as experts.

As you may know, the FAO Fisheries Department mission is "to facilitate and secure the long-term sustainable development and utilization of the world's fisheries and aquaculture". This implies necessarily an awareness of the fundamental social and economic role which is played by the fisheries sector in meeting three basic objectives: global and national sustainable food security, alleviating poverty in fishing communities through employment, and generating national income.

The three objectives mentioned above can only be met, of course, through responsible management of fisheries, and through compliance with the standards and principles contained in the FAO Code of Conduct for Responsible Fisheries.

It is in this context that the FAO has begun to address the role of MPAs in fisheries management. As a start, the Organization is supporting efforts to achieve a better understanding of the linkages between MPAs and fisheries management, and to develop guidelines for the implementation and development of MPAs which would fully take into consideration these linkages.

As background to this Workshop, it must be recalled that the FAO Advisory Committee on Fisheries Research (ACFR) noted the emerging importance of MPAs as a fisheries management tool in 2002, and noted, as well, the possible significant positive and negative effects of MPAs on fisheries resources, and on social and economic conditions of fishers.

The subject was again raised at the twenty-sixth Session of COFI, that is the FAO Committee on Fisheries, which took place in March 2005. Many members then expressed their support for the use of MPAs as a fisheries management tool and pointed out that an increase in the use of MPAs should be anticipated in response to the call for their establishment and development by the Convention for Biological Diversity (CBD) and the World Summit on Sustainable Development (WSSD) Johannesburg Plan of Implementation.

COFI expressed appreciation for the number of potentially useful properties for fisheries management associated with MPAs, but also recognized the potential limitations and drawbacks, especially if MPAs are not properly designed and implemented. There was wide agreement among members that – and I quote – "the use of MPAs as a fisheries management tool should be scientifically-based and backed by effective monitoring and enforcement and an appropriate legal framework". In addition, members mentioned the importance of several key aspects of MPA development including: using a participatory process in development and implementation, the need to set clear objectives for MPAs, and the need to monitor performance in achieving those objectives.

As a consequence of the twenty-sixth Session of COFI, suggestions and recommendations were made to improve knowledge and use of MPAs as a fisheries management tool.

First, the Committee agreed that MPAs were one of a number of management tools for fisheries and that they may be effective in combination with other appropriate measures such as capacity control;

Second, the Committee recommended that FAO develop technical guidelines on the design, implementation and testing of MPAs;

Third, the Committee drew attention to the need to liaise with and benefit from the experiences of a number of countries, IGOs and NGOs in the preparation of guidelines;

Fourth, the Committee agreed that FAO should assist its Members in achieving the relevant WSSD goals by 2012, in particular the establishment of representative networks of MPAs;

Finally, the Committee stressed that FAO should collaborate with other IGOs working on the topic, in particular the Convention on Biological Diversity (CBD) and the United Nations General Assembly (UNGA).

The final objective of the current project, of which this Workshop is an important component, is to provide benefits to FAO members in the form of enhanced information, methodologies and guidelines for better management of fisheries and for appropriate implementation of MPAs for fisheries management and conservation. Therefore, your contribution over the next few days in assisting FAO to achieve this objective will be very valuable.

Your task in the upcoming days will be to provide an initial review of issues to increase the understanding of links between fisheries management and MPAs. The work done here, will inform the eventual development of guidelines for effective and appropriate use of MPAs to fisheries management and conservation.

I would like to thank you all for taking the time to assist FAO with this task and for providing your wisdom and insights. I wish you a productive experience in the coming days and look forward with interest to the results of your work.

For those of you who are not familiar with FAO rules and procedures, I should perhaps clarify your role in this Workshop, which you attend in your individual capacity and not as representative of your government or organization. In this line, there is no difference in status between those of you who work with government or those of you who work with a private or non-governmental entity.

I finally wish to take this opportunity to thank, on behalf of the Organization and of the Fisheries Department, the Government of Japan for their support of this important work and through providing the funds necessary for the convening of this Workshop.

Thank you very much, Ladies and Gentlemen, for your attention.

APPENDIX D

Draft framework for Technical Guidelines on the design, implementation and review of MPAs as a tool for fisheries management

A. BACKGROUND

I. Introduction

1. Historical and policy background
2. Properties of MPAs that underlie WSSD goals

II. What is an MPA?

1. Definition of an MPA and types of MPAs
   - Review of existing definitions and categories
   - Proposal for recommended definition and categories for use in fisheries management and bio-ecological conservation
2. Potential consequences of MPA use on stocks and ecosystems
   a) Likely consequences inside reserves
      i. Exploited species
      ii. Unexploited species
      iii. Habitats
      iv. Cascading effects
   b) Likely consequences outside reserve
      i. Larval and juvenile dispersal from reserve
      ii. Spillover of adults
      iii. Yields and catch per unit effort
      iv. Habitats
3. MPA networks

III. The fisheries management process

1. The nature and goals of fisheries management (under EAF)
2. Major steps in the fisheries management process
3. MPAs as a management tool
   a) Comparison of the management properties of MPAs with those of other fisheries management tools
   b) Interaction of MPAs with existing management measures (possible synergies or conflicts)
4. Factors that can affect the potential consequences of MPAs on stocks and ecosystems
   - Habitat and ecosystem types
   - Other management measures in place
   - Other sources of uncertainty
5. MPAs and broader considerations (e.g. sectoral planning, ICM)

B. DESIGN

B.1 Considerations for Design

IV. Legal regime

1. International legal framework
   - Implications for national MPAs
   - Governance regimes

- Considerations for shared MPAs and MPAs in areas beyond national jurisdiction

2. National legal framework and integration with existing laws

V. Governance and management strategies

1. Governance system and decision-making
    - E.g. traditional, centralised, co-management etc.
2. Access and use regulations
    - Access and user rights
3. Enforcement strategy
4. Implementation uncertainty and ensuring robustness

VI. Biological and ecological considerations

1. Designing the physical features
    - Size
    - Number
    - Placement
2. The role of modelling
3. Data and information availability, including traditional knowledge, and their incorporation into design
4. Combining the use of MPAs with other management measures
5. Advantages and disadvantages of the use of MPAs compared to other measures

VII. Social considerations

1. Integration of coastal communities and traditional resource use patterns
2. Addressing societal objectives
    - Recognition of diversity
    - Livelihood strategies
    - Risk reduction strategies
    - Vulnerability
    - Food security considerations
3. Equity considerations
    - Distribution of costs and benefits from MPAs among current and potential new stakeholders
    - Distribution of costs and benefits over time

VIII. Economic considerations

1. Costs and benefits
    - Within fisheries sector and more broadly
    - Economic implications for management system
2. Incentives and compensation

IX. Institutional issues and options

1. Integration of MPA management system with fisheries management plan and system
2. Long-term financial and institutional viability
3.

B.2. The Design Process

X. Setting goals and objectives

1. Setting well-defined and realistic objectives
2. Integration of fisheries management objectives with conservation objectives

3. Conflicts and trade-offs

XI. Issue identification and prioritisation, and baseline assessment

1. Recognition of a need and programme preparation
    - Identification of a problem or a need which potentially could be addressed through one or more MPAs.
    - Why an MPA – biological, ecological, social, institutional aspects that bear on the application of an MPA or MPA network.
2. Integration with community/stakeholders and assessment of issues
    - Identification and analysis of stakeholders
    - Community/stakeholder organization and mobilization
    - Conduct of baseline studies
        i. Biological/ecological
        ii. Social and economic
        iii. Institutional
        iv. Incorporation of stakeholder, including traditional, knowledge
    - Information, education and communication

XII. Plan preparation and adoption

1. Formation of core planning group
2. Definition of goals and objectives
3. Preparation of management strategy and action plan
4. Determination of MPA boundaries and zones

C. IMPLEMENTATION

XIII. Implementation process

1. Formalization of the reserve through appropriate legal process
2. Enforcement
    - Demarcation of boundaries
    - Enforcement responsibility and strategies (who and how)
3. Strategies to improve compliance
4. Revenue generation (e.g. permits and user fees)

XIV. Conflict resolution

XV. Capacity-building and strengthening community/stakeholder involvement.

D. REVIEW AND MONITORING

XVI. Indicators and information to be collected

1. Biological and ecological (including physical/oceanographic)
2. Social, economic and institutional
3. Compliance and enforcement
4. Use of traditional and stakeholder knowledge

XVII. Strategy and mechanisms for information collection, storage and analysis

XVIII. Periodic management review and adaptation

XIX. Feedback into information management, education and outreach

PART 2: DISCUSSION PAPERS

BACKGROUND PAPER 1

EXPERIENCES IN THE USE OF MARINE PROTECTED AREAS WITH FISHERIES MANAGEMENT OBJECTIVES – A REVIEW OF CASE STUDIES[1]

by

Kirsten Martin, Melita A. Samoilys, Andrew K. Hurd, Imène Meliane and Carl Gustaf Lundin[2]

Summary

Global fish stocks are in decline and associated habitats are being damaged at an alarming rate, both within Exclusive Economic Zones (EEZs) of states and increasingly also in areas beyond national jurisdiction. To date, conventional fisheries management approaches have typically focused on managing single species rather than maintaining the health of marine ecosystems – the basis for current and future production. However, current management theory and practice clearly point towards implementation of "an ecosystem approach to fisheries that strives to balance diverse societal objectives by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions..."(Garcia and Cochrane 2005). The concept of an ecosystem approach to fisheries management has gained ground in a number of international fora and its elements are now engrained in several international agreements and guidelines (e.g. the United Nations Fish Stocks Agreement, FAO Code of Conduct for Responsible Fisheries). Similarly, several global commitments have been made to establish marine protected areas (MPAs) and representative networks. In recent years, MPAs are increasingly being considered as an important tool for achieving an ecosystem approach to fisheries management.

MPAs are a flexible tool encompassing a range of management options, from smaller, strictly protected no-take reserves to larger, zoned multiple use areas where different activities are carefully managed. Their objectives and characteristics may vary but should, importantly, be clearly defined. MPAs may be viewed as a complement to other fisheries management tools and integrated with sustainable management practices over the wider marine environment. They must be carefully planned and designed in order to achieve realistically defined goals.

Worldwide experience with MPAs provides a number of useful lessons and case studies. The seven case studies described in this paper illustrate different success features with which MPAs can support fisheries management objectives, and they point out challenges and limitations of this potential according to the respective setting. Some key 'ingredients' are extracted from their lessons learnt. They broadly refer to MPA designation and stakeholder processes, to the legal and institutional frameworks, and to management aspects for sustaining MPA benefits.

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[1] This paper was produced for the FAO Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations (12–14 June, 2006).

[2] The views expressed in this paper are solely those of the authors, Kirsten Martin, Melita Samoilys, Andrew Hurd, Imène Meliane and Carl Gustaf Lundin, all IUCN – The World Conservation Union. Principle author contact: marine@iucn.org.

Overall, a thorough case-to-case assessment and further empirical evidence is needed to define MPA benefits and limitations for managing the diverse array of fisheries around the world. There is broad international consensus of recognizing the potential of MPAs as a fisheries management tool for some tropical demersal fisheries, while MPA benefits for sub-tropical/cold water and pelagic fisheries are still less understood and need to be fully explored. The aim of this paper is to move one step closer towards the identification of the role of MPAs for fisheries management, through a desk review of MPA case studies from a range of different scenarios, as well as a brief analysis of the literature.

1. INTRODUCTION

A rapid and often persisting decline in many key commercial fish stocks, together with a global increase in fishing pressure have resulted in a historical collapse of many fisheries (Halpern 2003; Hutchings 2000; Rowe and Hutchings 2003). This has led marine conservationists and fisheries managers to re-assess the exclusive value of conventional management measures such as gear regulations and catch quota adjustments for sustaining fish stocks (Carr and Raimondi 1999). Indeed, "the scientific literature contains numerous diagnoses of the widespread [fisheries] management failures [...]" (Garcia and Grainger 2005). Carr and Raimondi (1999) note that "taken together, the natural, analytical, and social causes of uncertainty in projecting stock trends and adjusting fishery yields have prompted great concern and a more conservative approach to ensuring sustainability of marine resources."

With the emphasis on ecosystem-based management policies, fisheries managers are reviewing conventional, target-resource oriented management and considering a more integrated, area-based management in which Marine Protected Areas (MPAs) are seen as an important tool.

MPAs hold promise as a rational and practical way of managing ocean resources to achieve fishery ecosystem objectives, and they are seen to provide one of the most tangible means for achieving broad protection across the biota and habitats of an ecosystem (Sainsbury and Sumaila 2003). MPAs are also being increasingly promoted as a tool to fulfil both broader conservation goals and fisheries management objectives (COMPASS 2004; Salm *et al*. 2000; Allison *et al.* 1998), and these goals are not necessarily mutually exclusive.

However, opinions still differ widely between conservationists, scientists, fishing sectors and other stakeholders over the effectiveness of MPAs for fisheries management compared to other fisheries management tools (Martin 2005; Hilborn *et al.* 2004; Agardy *et al.* 2003), when applied in a variety of different contexts.

A clear trend in the peer-reviewed literature is, that MPAs are increasingly being considered to be an important complement to existing fisheries management regimes (e.g. Bohnsack 1998; Guénette *et al.* 1998; Russ 2002; Gell and Roberts 2003; Halpern and Warner 2003; COMPASS 2004). Assessments based on existing case studies and the literature have confirmed this potential of MPAs to complement, although not to supplant, the range of existing fisheries management practices (e.g. FAO 2005; FAO Code of Conduct 1995; Sainsbury and Sumaila 2003; Russ 2002; Carr 2000; Allison *et al.* 1998; Lauck *et al.* 1998). "Their [MPA] performance in relation to fisheries resources and livelihoods thus depends greatly on the type of resource requiring protection and the situation of the fisheries exploiting them." (FAO (a) COFI/2005/8). A thorough case-by-case assessment and further empirical evidence is needed to define MPA benefits and limitations for managing the diverse array of fisheries around the world (e.g. Hilborn 2004; Martin 2005). MPAs should therefore not be considered as a one-way street to success by themselves, but rather as an important tool in the fisheries management 'toolbox' that simultaneously addresses ecosystem conservation.

Initiatives to design, implement and test MPAs as a tool for fisheries management and marine conservation have been under consideration internationally (e.g. World Summit on Sustainable Development [WSSD], Convention on Biological Diversity [CBD], United Nations General Assembly [UNGA], United Nations Fish Stock Agreement [UNFSA] and related international agreements) and are starting to be pursued within a regional fisheries management context. The ecosystem approach to fisheries management set forth by the Food and Agriculture Organization of the United Nations (FAO) (Code of Conduct 1995) creates opportunities to integrate MPAs as a management tool, and to assist states in achieving their recent international commitments. At its 26th session in March 2005, FAO's Committee of Fisheries (COFI) recommended that FAO develop technical guidelines on the design, implementation and testing of MPAs and agreed that FAO should assist its members to achieve the World Summit on Sustainable Development (WSSD) goal with respect to representative networks of MPAs by 2012 (COFI Report, para. 103, 2005).

Section 2 of this paper provides a brief overview of MPA definitions, their main characteristics and potential roles for both biodiversity conservation and fisheries management. This sets the stage for a case-by-case exploration of MPAs in a fisheries management context, described in Section 3. Seven case studies have been highlighted as examples of a range of ecosystems and social, economic, institutional and governance contexts: high seas MPAs development in Antarctica; the Channel Islands stakeholder process in California; community-based management in the Philippines (Bohol) and Tanzania (Tanga); the Great Barrier Reef Marine Park adaptive zoning; resident indigenous fishing communities in Banc d'Arguin National Park in Mauritania; and territorial use rights in MPAs (in its wider sense) along the Chilean coastline. The case studies consider a variety of area-based management measures (strict protection zones, multiple-use areas, and management and exploitation areas) and institutional settings, which have been or have further potential to be integrated with other fisheries management measures by using different approaches. Successes and challenges encountered by each MPA in contributing to fisheries management objectives and the distilled lessons learnt are discussed within the context of a progressing international commitment to applying an ecosystem approach in fisheries management, and the increased interest expressed by COFI 2005 in integrating MPAs in the set of existing fisheries management tools. Section 4 then gives some key elements for consideration when designing, developing or revising MPAs in a fisheries management context, as they emerge from the case studies. It also highlights needs for research and management if MPAs are to be efficiently applied as a fisheries management tool. Both the elements and the needs are not complete, but compiled as a basis for further consideration and discussion in the context of the preparation of technical guidelines by FAO.

2. OVERVIEW OF MPAs

2.1 What is an MPA?

There is no consistently applied definition for an MPA. IUCN in 1994 defined a marine protected area as "*any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment".* An analogous definition has been adopted by the 188 parties to the Convention on Biological Diversity[3].

The MPA is a tool, which encompasses application of a whole range of management options. Strictly protected, no-take reserves lie at one end of the spectrum (see the Channel Islands case study of this paper). Zoned, multiple use areas form the other end, with various combinations and options in between (e.g. the establishment of buffer areas). The Great Barrier Reef Marine Park shows that within a single multiple-use MPA strictly protected no–take zones may occur. Different management strategies can be developed through zoning and networks of smaller management areas. Small collaboratively managed areas by user communities in Tanzania, Chile and the Philippines show that the particular focus of the MPA may vary from protection of one key species or species group to

[3] CBD COP7, 2004, Decision VII/5 reflects the MPA definition to be: *"any defined area within or adjacent to the marine environment, together with its overlaying waters and associated flora, fauna and historical and cultures features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings".*

targeted resource maintenance. The actual choice, size, and spacing of these areas depend on the characteristics of the specific ecosystem targeted as well as management and conservation objectives.

The term MPA is increasingly used in a context of fisheries management (e.g. FAO 2005), and it is important to clearly define it when assessing the role of a given MPA or network of MPAs for fisheries management. To identify what role MPAs may play in a fisheries management context, it is important to be clear about the type of MPA that can be designed and the grade of protection necessary to meet the key goal of the MPA: see Table 1 (IUCN 1994; IUCN 1998; Kelleher 1999).

Table 1. Overview of the IUCN Protected Area category system, their principle purpose of protection and an example from United States waters.

Category	Protected area managed mainly for . . .	Examples. . .
I	science or wilderness protection	Strict Nature Reserve/Wilderness Area, e.g. Fisheries Reserve
II	ecosystem protection and recreation	National Park
III	conservation of specific natural features	Natural Monument
IV	conservation through management intervention	Habitat/Species Management Area
V	landscape/seascape conservation and recreation;	Protected Landscape/Seascape
VI	the sustainable use of natural ecosystems	Managed Resource Protected Area, e.g. Area for Management and Exploitation of (benthic) Resources (Chile)

It should be noted that a discussion about the application of the Protected Area (PA) categories to a marine context (MPAs) has been ongoing since 2005.

The following list identifies some characteristics of MPAs, based on the presented case studies.

- An MPA has some form of protection, which is usually legally established but can also be established by custom or tradition. MPA have existed in some form among traditional fishing cultures for centuries. In the Pacific region, "*Tabu*" or "*Kapu*" areas, were no-take zones controlled by clans or chiefs. Case studies from California, where no-take MPAs are established in state waters under state law but not federal law, and from Mauritania, where the MPA has its own law established through direct support from the prime minister, provide examples for differing legal frameworks within which MPAs are established.
- The degree of protection is not necessarily the same throughout the area; indeed most large MPAs are zoned into areas of different usage and ecosystem impact, such as shown by the Great Barrier Reef and the Antarctic case studies.
- The MPA (and its various management provisions) often covers not only the seabed but also at least some of the water column with its flora and fauna. An example from a Tasmanian seamount reserve shows that vertical zoning is also possible (e.g. as a vertical buffer zone; Figure 1). Although still a rarely implemented tool, these MPAs show potential for offshore MPAs, and those which cover areas deeper than 100 meters (Simard, pers. com.).

- MPAs are not just relevant for natural features but also for protecting cultural features (such as wrecks, archaeological sites, lighthouses, jetties), and *traditional use/cultural practices*. The Mauritanian case study describes an approach to protect traditional fishing activities of a local community indigenous to the park area, further to biodiversity protection *per se*.
- MPAs, as their terrestrial counterpart, may be permanent as their terrestrial counterparts, their boundaries or management plans should be adaptive and subject to review and modification in order to encompass new knowledge, monitoring results and acquired experiences. Flexible handling of MPAs may permit uses to be further restricted or expanded, with appropriate safeguards to ensure sustainable use with minimal habitat impact. In the case of the Great Barrier Reef Marine Park, re-zoning and boundary adjustment on the basis of the management plan is done every five years. This leaves significant room for integration of fisheries objectives into MPAs with an existing/exclusive focus on biodiversity conservation. It is important to define the degree of MPA flexibility from the beginning, e.g. if an area is permanently or temporarily closed to fishing (depending on species distribution and factors such as the 'life span' of a particular ecosystem feature like e.g. a hydrothermal vent).
- MPAs work at, and across, different scales. For example, the Tanga MPA (United Republic of Tanzania) includes a network of fishing grounds spread over a wider area, while the Philippines case study describes very small no-take zones aiming to protect representative areas of habitat and their associated fishes. The Antarctic and Great Barrier Reef examples work at a large marine ecosystem scale, whereby a variety of MPA tools and other conservation and management mechanisms complement one another under a broad management framework.

There is growing potential for establishing MPAs which would focus on oceanographic features such as fronts, convergence zones or eddies. Where these features are relatively fixed, they could be demarcated as a permanent MPA with traditional boundaries. Where features are temporary and dynamic, area-based protection (such as through closures) would be temporary or follow the natural shift of these features. Satellite tracking and remote sensing enable such features to be monitored on a close to real time basis (Norse *et al.* 2005).

Closing areas of ocean to specific human activities for a defined period of time is commonly used for both nature conservation and for fisheries management. However, the terms used to designate such closures have sometimes been used in a confusing way.

Area Closures are fisheries management tools, often used in combination with other measures within a target-species based management, to support the management of a fisheries resource, or as a restoration tool for a fishery that has been over-exploited. They can encompass areas closed to all fishing activities, areas closed to fishing for single species, or areas with gear or vessel restrictions - both as temporal or permanent measures to manage fishing effort. Area closures usually aim at stock enhancement or recovery, but also include recovery for sensitive habitats and avoidance of specific vulnerable species. Broader ecosystem objectives are increasingly taken into account. Although generally aiming at enhancing the stock of a particular fisheries resource, area closures can also yield positive results for several other associated or dependent species. Traditionally MPAs were established with a conservation and protection focus; however, since they are increasingly being used as a fisheries management tool they could also be termed a form of area closure.

2.2 Potential roles of MPAs

The overall goal of MPAs is to contribute to the conservation of the biological diversity and productivity of the oceans, including ecosystem processes. The Convention on Biological Diversity (CBD), for example, states MPAs have an "effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings". However, a range of existing MPAs developed with biodiversity conservation objectives provide significant benefits for certain fisheries (e.g. Russ *et al.* 2004; McClanahan and Mangi 2000), however the extent and expected incidence of benefits to fisheries is still an open question (Halpern and Warner 2003; COMPASS 2004). Conserving an area of relatively low diversity but high productivity, such as a seagrass bed, may be equally vital for maintaining viable populations of threatened or endangered species as maintaining biological productivity to contribute to human welfare and food security (Kelleher 1999). The Mauritania and Philippines case studies provide good illustrations for this. Conserving an area of high diversity like the Tanzanian coral reefs can safeguard species and genetic diversity for the future, and help to secure the livelihoods of the local communities. By protecting critical breeding, nursery and feeding habitats of fish populations, MPAs can make a contribution to healthy fisheries beyond MPA boundaries. MPAs can protect the spatial complexity of benthic habitats like seamounts, coral and sponge communities, seagrass beds and mangroves, which are particularly important in sustaining biodiversity as well as species of commercial and socio-economic importance. Some of these habitats might also serve to mitigate the effects of coastal storms and tsunamis (see e.g. Kathiresan and Rajendran 2005; Kerr *et al.* 2006 for differing views on the mitigating potential of mangrove habitats).

As a tool within an integrated and ecosystem-based approach to marine conservation, appropriately designed and effectively managed MPAs provide significant benefits for biodiversity and also contribute in achieving fisheries management objectives (Halpern and Warner 2003; Willis *et al.* 2003).

Another way of looking at the role of MPAs is to consider how they help sustain a marine ecosystem's ability to provide essential goods and services. These can include fish and fish products, habitat provision, maintenance of biodiversity and biological resilience, products like medicinal or chemical compounds from marine genetic resources, tourism potential and revenue, nutrient cycling, carbon sequestration and waste assimilation.

MPAs can provide widespread benefits as reference sites or control sites for long-term scientific research and monitoring, including contributing to improving the understanding of a species' population demography, and species interactions within an ecosystem (e.g. Castilla 1999, 2000). As in exploratory fisheries, MPAs may be used to test both conservation and management techniques (Kenchington *et al.* 2003). The still largely unknown Antarctic ecosystem is a good example for the importance of scientific reference areas to complement area-based measures for fisheries management.

The role of MPAs in fisheries management has been extensively discussed in the scientific literature. A range of theoretical assessments have concluded that MPAs have great potential to complement other commonly used fisheries management practices (Sainsbury and Sumaila 2003; Carr 2000; Allison *et al.* 1998; Lauck *et al.* 1998), and that they have positive effects for fisheries (Russ *et al.* 2004; Gerber *et al.* 2003; NFCC 2004; Halpern 2003; McClanahan and Mangi 2000). MPAs are, however, not a panacea for fisheries management problems (Hilborn *et al.* 2004; FAO (a) COFI/2005/8; Murawski *et al.* 2004; Kaiser 2004).

A very limited number of long-term empirical studies exist which are able to demonstrate either MPA benefits, costs or shortcomings (Halpern and Warner 2003; COMPASS 2004), but documented evidence from single MPA sites is growing (e.g. Russ *et al.* 2004; McClanahan and Mangi 2000; McClanahan and Kaunda-Arara 1996). The case studies in this paper summarize some of the benefits and limitations encountered for MPAs in a fisheries management context.

For polar marine ecosystems and especially pelagic fish stocks, the effects of MPAs are still largely unknown (e.g. Kaiser 2004; Hilborn *et al.* 2004). This is partly because most pelagic stocks of commercial importance are more mobile during their life cycle, spawning and nursery areas are often unknown, and exploitation patterns can be widely dispersed. However, a number of studies are emerging that review the effects of various MPAs and closed areas for selected species (e.g. Pascoe and Mardle 2006; Cefas 2005; Sweeting and Polunin 2005; studies for Defra, in 2006). Recent research is also helping to identify distribution patterns such as migratory corridors and open ocean hotspots where pelagic species may congregate to feed, breed, spawn, and possibly also spend their juvenile stages (Hyrenbach 2000; Norse *et al.* 2005; Worm *et al.* 2005). Since many deep sea species, may have defined restricted ranges due to hydrographic or topographic barriers (ICES 2005), similar benefits as seen in nearshore reef areas could possibly apply. More long-term and empirical studies are however needed (Sale *et al*. 2005; Willis *et al.* 2003).

MPAs are seen as important tools for achieving an ecosystem approach to fisheries management (Murawski 2000), and as one of the most tangible means to date for conserving habitats and a broad band of the biota within an ecosystem, thus benefiting both fisheries and marine biodiversity as a whole (Bohnsack 1998; Murray *et al.* 1999; Pinnegar *et al*. 2000 in Carr 2000). At the same time, while most efforts have been directed towards detecting their effects on single species comparatively little is still known to date about MPA effects on community or ecosystem-wide levels (COMPASS 2004; NRC 1999, 2001).

3. CASE STUDY REVIEW: SELECTED EXPERIENCES

This chapter describes certain management aspects from seven MPAs, or sets of MPAs across the globe, which are in one way or another of relevance to fisheries management. The cases span a range of ecosystem types and social, economic, institutional and governance contexts. They also vary in MPA type and degree of protection. See Table 2 for an overview.

For each case study, a couple of key characteristics from planning and designation, implementation or assessment processes are highlighted. The main characteristics are then discussed on the basis of the key lessons learnt for each MPA.

The fourth chapter will then build on the cases and suggest a list of key elements or 'ingredients' for further discussion of the FAO technical guidelines, and for consideration when designing, developing or revising MPAs in a fisheries management context.

3.1 Case study A: Lessons from the stakeholder process of the Channel Islands Marine Reserves, California, United States

This case study describes the stakeholder process to designating no-take MPAs (reserves of IUCN category I) in a developed country setting, characterised by a multitude of uses such as tourism, transport and fishing, by a large array of user groups. The site designation process with stakeholders is known for its high potential for conflict during the consensus negotiations and the way in which science advice guided the conditions for these negotiations. The case study also stresses the importance of integrating participatory reserve design with the fisheries management system. The summary below largely references a United States-based MPA assessment report by Bernstein, Iudicello and Stringer (2004).

3.1.1 Background

The reserves are part of the Channel Islands National Park and the Channel Islands National Marine Sanctuary, covering about 4 350 km^2 of coastal waters. The islands are fished commercially and also provide extensive recreational activities such as sport fishing. They are situated close to a major shipping lane and regular United States military training activities. The main marine habitat features are kelp forests and rocky inter-tidal habitats (Figure 2).

In 1978 the U.S. Supreme Court recognized the state's authority to manage the seabed out to three nautical miles. The marine resources of the islands are managed by a variety of state and federal jurisdictions of which many are overlapping. They include the Californian Fish and Game Department, the California State Lands Commission, the National Parks Service, the National Marine Sanctuary Program, the National Marine Fisheries Service, and the United States Coast Guard.

The Channel Islands Reserve designation followed three principle objectives: to protect ecosystem biodiversity, achieve sustainable fisheries, and to maintain long-term socio-economic viability. The designation process is characterised by a search for consensus amongst stakeholders on the basis of a long-term monitoring programme, running in parallel for California state waters and for the United States federal waters. It was initiated in 1998 by a group of recreational fishermen who were concerned about the potential over utilization of fish stocks around the islands, and who proposed a no-take reserve for 20 percent of the first (one) nautical mile off the shore. The development of reserves in state waters and federal waters was soon split into two separate processes because of differences in jurisdiction. It should be noted that the fishery resources of the reserves span a wider area and are subjected to a comprehensive fishery management plan.

A long-term research and monitoring programme involved regular, intensive and often confrontational discussions on all aspects of MPA designation with a stakeholder working group. The concentration of resource use in the small Channel Islands area, the variety of resource users, and a complex institutional setting for consultation and decision-making complicated the consensus-finding.

The highly participatory approach for site designation included a multi-stakeholder public working group, supported by a science advisory panel and a socio-economic advisory panel (NOAA 2003). The science panel, as a separate entity from the stakeholder group, was tasked with developing overall guidelines that framed the design work of the stakeholder group.

The stakeholder process in the Channel Islands is considered both a success and a failure, depending on the individual or group one talks to and on the criteria used in the evaluation. While a network of reserves was successfully designated for state waters in 2002, the process for a complementary set of reserves in federal waters is not yet complete. The designation process furthermore led to valuable lessons learnt, some of which are documented here. The following lists some of the perceived successes and challenges.

3.1.2 Key successes of the process

The process ultimately led to the implementation of a network of reserves in state waters that considers fisheries issues.

- Despite not finding consensus for site designation in federal waters, the stakeholder working group developed alternative scenarios that were formed into recommendations to the Fish and Game Commission for a network of reserves in state waters.
- A new approach was developed for applying reserve theory to reserve design: as a prominent example, an interactive mapping tool was created that helped stakeholders evaluate the biological and economic implications of multiple design scenarios. (see Robinson *et al.* 2005 for a description and future recommendations).
- Scientific advice was used as the basis for the stakeholder group’s design negotiations.
- Concrete economic data from stakeholders was used to estimate the economic effects of alternative reserve designs.

3.1.3 Challenges of the process

The stakeholder working group did not reach consensus on a single reserve design that could be applied for state and federal waters, due to several constraints:

- The complexity of roles and relationships involved in the process were not adequately considered [e.g. separation of science advice from stakeholders resulted in perception of an elitist process, one that potentially undermines collaboration].
- Reserve goals were adaptively changed, but without the full agreement of all stakeholders.
- High potential benefits for fisheries were stated while the full range of fisheries science issues had not been explored [e.g. analyses underlying the reserve design did not account for existing

fisheries management regulations outside the reserves, including other extensive closures]. This ended up amplifying resistance and undermining the credibility of the reserve design with fishermen, the Pacific Fisheries Management Council, and the state and federal fisheries agencies. There was no long-term progress monitoring towards the sustainable fisheries goal.

- Reserve design did not plan for experimental situations that would allow for scientifically testing key expectations about reserve performance on both conservation and fisheries goals.
- Limited communication between the stakeholder working group and the science panel.
- No effective monitoring program was implemented (no long-term fisheries or fish stocks monitoring).
- A local commercial fishermen's association and the California Fish and Game Commission still challenge the legitimacy of the reserve, and filed a suit against the Commission in charge. The fishermen's arguments are: failure to adequately address mitigation of negative reserve consequences; procedural failures; and lack of authority by the agency to enforce fishing regulations.

3.1.4 Lessons learnt from the designation process with stakeholders

- It is a common phenomenon that the goals of an MPA shift over time. It is important to periodically re-assess the goal and objectives, and equally important to inform and adapt the process to it. For the Channel Islands, efforts should be made to inform stakeholders of planned and eventual shifts in MPA objectives, and to jointly reformulate new goals through consultations. A long-term management plan should describe implementation of an adaptive management process for the MPA. There also needs to be clear but not overly simplified communication of the rationale for protection and reserve design, as well as other key assumptions provided by scientific recommendations. Roles of working groups and panels need to be clearly defined, regularly evaluated and adapted. Communication and exchange opportunities between panels and working groups are essential to prevent misconceptions and concerns amongst stakeholders.

- The Channel Islands process emphasises the importance of integrating reserve design with the fisheries management system. Especially where a key goal is to promote sustainable fisheries, it is vitally important to include fisheries management and stock assessment expertise in the relevant working groups and to ensure that fisheries management agencies, who will be responsible in whole or in part for implementing policies regarding fishing, are fully involved and committed to the process (Bernstein *et al.* 2004) to prevent conflicts. It is of special importance for the Channel Islands where there were parallel designation processed for state and federal waters.

- Monitoring is a crucial tool to determine the role of the Park for fisheries resource conservation. Although the Channel Islands national Park has a long-term monitoring programme, it did not include the fish stocks that were fished commercially or recreationally (this has been modified and they are now included). More broadly, it is important to incorporate experimental monitoring and evaluation into the reserve design, to be able to draw comparisons and controls, to measure outcomes and adapt. Monitoring is an important tool to document that stakeholder 'sacrifices' and behaviour modifications are worthwhile.

- Identifying consensus as the single criterion of a successful process can promote unrealistic expectations, be difficult to achieve and provide an opportunity for political lobbying and other gaming behaviour that might undermine the decision-making process. A variety of measures for decision-making should be considered (for example majority or super-majority votes).

- The role of science against economic and social aspects of reserve designation remains a balancing act. In hindsight, some of the stakeholders involved stated that potential benefits of the reserve were probably oversold in the process, while financial costs for planning and consultations were underestimated. While the designation of reserves in state waters is a significant event, it remains a solution in flux in a dynamic scientific, social, and policy context. Events have continued to move forward since the designation of reserves in state waters in 2002. There are ongoing efforts to find funding for monitoring and a continued planning process of reserves in federal waters. Local fishermen have meanwhile filed suit against the Fish and Game Commission and organized collaborative and community-based data gathering and management initiatives. New efforts are being made for integrating conservation (reserve) science and fisheries management.

3.2 Case study B: User-driven fisheries monitoring and management in the Tanga Collaborative Management Areas, Tanzania

In Tanga region, on the northern coast of Tanzania, six contiguous collaborative management areas (CMAs) have been established, two being gazetted, with the primary objective of sustainable fisheries and marine resource extraction. Their main characteristic is full participation and ownership by local stakeholder groups, including a user-based monitoring programme.

3.2.1 Background

Taken together the areas span 1 600 km^2 of marine and coastal habitats comprising coral reefs, mangrove forests and some seagrass beds (Figure 3). Around 500 000 people live scattered along the coast neighbouring these CMAs, in 49 main villages and two principal towns, Tanga (pop. ~246 200) and Pangani (pop. 6 000).

The force behind the establishment of the CMAs was concern from local government officers and local communities in the mid 1980s about the degradation of the coral reefs from dynamite fishing and other illegal and destructive fishing techniques, and uncontrolled cutting of mangroves.

After a long phase of consultations, the Tanga Coastal Zone Conservation and Development Programme (TCZCDP) was formed in 1994 in response to this concern, with funding from Ireland and technical support from IUCN. The TCZCDP aims to improve the integrity of the Tanga coastal zone ecosystem so that its resources support sustainable development. This is being achieved by improving collaborative coastal and marine resource management by district administration, resource users and other stakeholders. The primary tool developed to achieve these objectives are the collaboratively managed multiple-use MPAs– the CMAs– the first of which were established in 1998.

The selection process for the collaborative management areas was based on common natural resource use, primarily fishing, by neighbouring villages, and did not necessarily overlap with political boundaries of villages or districts. This was innovative for its time and was a result of a lengthy and thorough consultation phase in the TCZCDP (Makoloweka and Shurcliff 1997).

A significant element of the CMAs is that one or two reefs were fully closed to fishing in five of the six CMAs. After monitoring and assessing the impacts of these fisheries closures (see below), the villagers voted to maintain them as permanently closed reefs in recognition of their benefits to local fisheries (Table 3a,b).

On an institutional basis, Central Coordinating Committees (CCCs) comprised of village and district government representatives, have been formed to manage each CMA and to develop a management plan, with the assistance of regional government officers. Regular patrolling of the CMAs is carried out by joint community and government patrol teams, and this was for many years done in partnership with the Navy. TCZCDP from the onset has placed a strong emphasis on female participation and has increased the involvement of women in the CCCs and overall management of the CMAs with 30-40 percent representation of women in key decision making positions, a marked increase from the beginning of the Programme.

The main fisheries management activities carried out within the CMA frameworks are patrolling and monitoring, subsequent review and analysis by the CCCs, and the review of the CMA plans in an adaptive management cycle.

A monitoring and evaluation programme was established in 1998 to monitor the coral reefs, fisheries, mangrove forests, patrols and socio-economic status of the villagers. The CMA management plans are reviewed every three to five years and the analysis of monitoring data is used to inform and adapt the plans (Pabari *et al.* 2005). However, analysis of monitoring data has been infrequent and not very thorough, though has indicated that the CMAs have had a positive impact on habitats and neighbouring fisheries (Verheij *et al.* 2004). A recent thorough analysis of the long-term data sets has revealed that the impacts of the CMAs on the surrounding fisheries are not immediately obvious. Nevertheless analysis of trends in catch rates (catch per unit effort, CPUE) over six years are encouraging for two of the primary artisanal fisheries of the region: the basket trap fishery for rabbitfish and the hook and line fishery for snapper and emperors.

The hook and line fishery for snapper and emperor remained stable and CPUE increased in 2004 (Figure 4a); in contrast the basket trap fishery for rabbit fish declined initially but CPUE has increased since 2003 (Figure 4b). Both recent increases may be interpreted cautiously to be an improvement of the fishery as a result of the CMAs which had almost eliminated destructive fishing methods and contain fully protected reefs. A recently increasing CPUE in these two fisheries when the coastal population increased by 60 percent from 1994 to 2005, can be seen as a positive outcome of the CMAs. Another monitoring study (McClanahan *et al.* 2006) found that overall fish biomass on the Tanga reefs has increased from 260 kg/ha in 1996 to 457 kg/ha in 2004, indicating that the CMAs are successfully increasing fish stocks within the managed area. The increase was most noticeable in the herbivorous group of species, which included parrotfish (Scaridae) and rabbitfish (Siganidae), but there was a significant decline in the carnivorous group comprising snappers, emperors, and grunts. These results differ somewhat from the catch rate analyses by the TCZCDP, but do provide some support for positive fisheries impacts from the CMAs.

The CMAs are managed by three district government offices in Tanga region, with advice, facilitation and funding from the regional government office. The CCC is the actual management body which manages each CMA, develops and maintains the existing management plan with the assistance of regional government officers. Regular patrolling of the CMAs is carried out by joint community and government patrol teams. CMA Plans have been enacted through village by-laws, but have now been approved nationally by the Director of Fisheries. These are reviewed every two years. The Director has suggested that the CMAs and their management bodies change their terminology to Beach Management Unit to comply with the new Fisheries Act (2003), which would give the CMAs legal backing.

3.2.2 Key successes to date

- The main success of the TCZCDP has been the development of a collaborative system that is broadly satisfactory to both communities and the government for preparing fisheries management plans based on multiple use MPAs, the CMAs. Management plans are key tools for sustainable fisheries, recommended by the FAO Code for Responsible Fisheries (FAO 1995) and are described in Tanzania's national 2003 Fisheries Act as 'management agreements'.
- A second key success is that the TCZCDP has explored structures for collaborative management within Tanzania's political and institutional framework, developed a collective natural resource management system within communities, and in so doing has introduced a strong sense of ownership of resources in the face of what was has been largely open access.

Of particular note is the establishment of management units (the CCCs) which span villages and correspond to fishing grounds rather than political boundaries.

- The fact that reef closures are included in all the CMAs, that these are being established for increasingly long periods or permanently, and that most communities see them as an acceptable fisheries management tool, is also a key success.

3.2.3 Challenges encountered

- One of the key challenges for Tanga is that there is no specific legal framework for the CMAs as established at present. The Fisheries Division approvals of the most recent plans have included the recommendation that once the by-laws have been approved, they should be considered as operational beach management units (BMUs). This will give them legal backing because BMUs can be established under the 2003 Fisheries Act. However, unlike the CMAs, BMUs are based around individual landing sites and operate at village level (Ogwang *et al.* 2004), which the TCZCDP has demonstrated is not a suitable management unit for coastal fisheries. This advice was provided by the TCZCDP who had significant input to consultations during the development of the Fisheries Act.
- Other challenges include difficulties in demonstrating a clear increase in catch rates as a result of closed areas, and the difficulty in completely eliminating destructive fishing methods, especially the use of dynamite (e.g. *Latimeria* fishing has been repeatedly reported).
- Tropical multi-species fishery monitoring is difficult – the data are highly variable and indicator species are still poorly understood, thus demonstrating a casual link between the closed zones and improved fisheries is difficult. Analysis of indicator species from datasets around the world could provide interesting insights.
- Empirical data on the link between improved fish resource management through MPAs and improved livelihoods or alleviation of poverty is not really available – the socio-economic monitoring and analysis lags behind the bio-physical – this gap needs to be filled.
- Understanding the suitability of the governance model of the MPA for the socio-economic, cultural and political context is lacking and would provide an interesting analysis to assist in the establishment or improved management of MPAs.

3.2.4 Lessons learnt

Several lessons can be drawn from the Tanga collaborative management experience.

- Collaborative co-management between local communities and local government were a crucial factor for success in Tanga. It led to the conclusion that local fisher participation and consultation is extremely important from the onset, and that government participation in MPA designation and management is essential at all levels (local to national).
- The long consultative phase and local community involvement in all aspects of the programme, as well as monitoring of resources and their distribution by the local fisher groups themselves created a sense of resource ownership by the local communities. Accurate and regular monitoring of key fishery indicators (based on sound science) is vital to demonstrate causal relationships between MPAs and improved fisheries. In this particular case, monitoring of important socio-economic factors started only late in 2004.
- Management area fisheries plans based on resource use (fishing grounds) have proven to be more relevant than village-based management plans, leading to the establishment of resource-based management units.
- Enforcement by village teams in collaboration with government and police, with financial support from government is one key aspect of the co-management principle put into practice. Importantly, dynamite fishing has resurfaced in 2005 indicating that current enforcement and compliance have not fully succeeded to address the problem.

- A weakness of the Tanga Collaborative Management Areas is inadequate recognition of the management programme at the national level and a resulting lack of legislative support and backing.

3.4 Case study C: Establishment of a spectrum of fisheries management activities in Banc d'Arguin National Park, Islamic Republic of Mauritania

The case study from Banc d'Arguin National Park showcases how fisheries management objectives may be added to existing MPAs with conservation objectives. It highlights the need for full integration of needs of residential communities and their traditional resource use patterns inside an MPA, as well as the utility of an efficient enforcement and compliance scheme for new and existing regulations.

3.4.1 Background

The Banc d'Arguin National Park (PNBA) covers an area of approximately 12 000 km^2, of which 6 300 km^2 are marine and 5 700 km^2 are terrestrial. It stretches along ca. one third of the Mauritanian coastline. Its shallow but steadily nutrient-rich waters provide a habitat for hundreds of fish species, crustaceans, molluscs, marine mammals, turtles, birds and other marine organisms. The main ecological habitat features are seagrass beds (important role as nursery grounds for fish), sand islands and islets, mudflats and sand dunes (Figure 5).

The Park also houses ca. 1 500 people, the Imraguen, in nine traditional fishing communities, on the sandbanks and the adjacent desert area.

Declared as National Park in 1976 by the Mauritanian government, the PNBA became a Ramsar site in 1982 and listed as a World Heritage site in 1989 (together with Satellite Reserve Cap Blanc to its north). The PNBA is commonly known as the oldest and most extensive MPA in West Africa.

The Park is managed by a government-associated institution (tutored by the prime minister) and technically, as well as financially, supported by international partnering institutions. A special law for the Banc d'Arguin National Park (2000/024) was passed in 2000, which takes into consideration habitat and species conservation objectives and for the first time legally recognizes the Imraguen people as resource users.

The initial objective of the Park was to conserve the Park's landscapes, and an important ornithological site in the region. Its potential as an equally essential tool for fisheries management has been revealed successively over the last ten years. Due to its large size, the Park has a significant impact on the national fisheries of Mauritania.

The main activities of the Park (described in detail below) with relevance for fisheries management include (1) surveillance, (2) research and (3) supporting the traditional fishing of the local Imraguen population, including rehabilitation of the 'lanche' (these are sailing boats used by the Imraguen since the middle of the 20th century for the meagre fishery, originating from the Canary Islands).

1) Due to constantly rising external fishing pressure and illegal fishing, surveillance is the most important management activity inside the Park. A surveillance system has been active since 1998, and comprises three small motorized boats stationed at control points, and three radar stations. Current resources permit ten to twelve surveillance trips per month per boat. The Park works in collaboration with the Delegation for Fisheries Surveillance and Maritime Control (DSPCM, which forms part of the Mauritanian military), and the Mauritanian Oceanographic and Research Institute (IMROP). The DSPCM runs the three radar control stations and reinforces the surveillance system with its own surveillance boats. The radars efficiently localize and track motorized boats entering the Park. Each surveillance boat in the Park includes a team of DSPCM staff, a Park guard and a member of the Imraguen community.

Illegal boats entering Park waters are fined up to Mauritanian ouguiya (~UM) 35 million (100 000 Euros) for industrial trawlers, and UM 2–10 million for freezer vessels. Most illegal fishing in the Park now comes from motorized pirogues, which are fined between UM 50 000 and UM 200 000 (140 – 570 Euros) if caught.

The system of surveillance and the follow-up to ensure the conviction of those caught illegally fishing within the Park is implemented successfully. The Park administration reported that the system was able to significantly decrease illegal activities since put in place in 1998. The threat particularly from large commercial trawlers entering the Park's waters seems to have been effectively minimized.

However, local Imraguen fishermen state that a threat from illegal fishing persists and that more surveillance is needed. Full coverage and enforcement of the 6 300 km^2 of marine area in the Park is limited by the capacity of the operating surveillance vessels. The surveillance boats and radar stations also need repair and replacement. A major drawback in this context is that money raised through fines via the State Treasury does not come back to the Park authority for covering the costs of surveillance. There is room to enhance the collaboration and regular communication flow between the partners (on technical and material aspects between Park Authority and DSPCM, and including relevant capacity development with the local communities).

2) Research and monitoring of fish populations in the Park area is steadily increasing. Since the very beginning the Park area has been considered a nursery ground for juvenile fishes, given that they are the source for feeding the populations of over two million waders, ~40 000 nesting birds and a huge quantity of migrating birds. Active research and monitoring of fish species however began only in the late 1990s with a project on the conservation and ecosystem-based management of the Banc d'Arguin ('ACGEBA', supported by the French Cooperation and led by the Mauritanian Oceanographic and Fisheries Research Institute 'IMROP'). Local fish capture data have been collected in the Park since 1997 with the aim to study the Imraguen fishery in the PNBA. Special efforts have been undertaken to monitor cartilaginous fish, mullets (*Mugil cephalus*, *Liza amata*) and meagre (*Argyrosomus regius)* since 2000, with implementation of three projects that supported the fisheries monitoring system in PNBA until 2005: sharks and rays; support of the re-orientation of the Imraguen fishery – Project ARPI; and conservation and sustainable use of the mullet in Mauritania. Since 2006, they have formed an integral part of the 'monitoring system for artisanal and coastal fisheries' which is executed by IMROP along the entire coast of Mauritania.

The fisheries monitoring system for PNBA will allow for a more regular and representative track record of monitoring data, encompassing oceanography, fish biology, ecology, fisheries technology and a socio-economic survey.

The findings of the monitoring efforts seem to confirm an important role of the park area as reproduction and nursery ground for a number of fish species. All outcomes (scientific data collected, development of management measures) are discussed at annual inter-institutional stakeholder meetings, which were established in 2001. Unfortunately, most of the information and results are not publicly accessible, complicating a quantitative estimation of the stated success to outsiders.

An important sub-region wide role of the PNBA is the protection of several shark species such as scalloped hammerhead (*Sphyrna lewini)*, nurse shark (*Ginglymostoma cirratum)* and spinner shark (*Carcharhinus brevepinna)*. One previously undiscovered species of guitar fish, *Rhinobatos cemiculus*, was found in 1998 and described in 2006 by the French Natural History Museum.

Practical and strategic application of the monitoring data is still limited. The main problem at this point stems from the isolation of the Park administration from other institutions, including from the Ministry of Fisheries.

Recommendations that can be formulated in this context are that:

- analysis of the collected monitoring data should be done in close collaboration with and between partners and relevant institutions in Mauritania;
- the results from the analysis should feed into strategic planning of the Park area, i.e. to develop a long-term strategy that specifically addresses fisheries issues; and
- additional efforts should strengthen institutional collaboration with the aim of harmonizing and integrating the fisheries management strategy of PNBA with the national management plan for artisanal and coastal fisheries in Mauritania (PADPAC).

3) The Park successfully supports traditional fishing practices of the local Imraguen population. However, efforts need to be made to improve the living conditions of local residents of the Park.

The Imraguen have a centuries-old tradition of subsistence fishing in the Park area. Formerly, their mainstay was fishing for grey mullet. The original tradition shifted however, as huge quantities of mullet were harvested south of the Park in association with external operators and merchants in the 1980s. Today, the Imraguen fisheries have moved from subsistence to small-scale artisanal fishing. While motorized 'pirogues' are being used for artisanal fishing activities outside the park boundaries, motorized fishing is prohibited inside the Park and local fishermen use sail boats instead.

Ray and shark fishing developed in the park through economic incentives provided by wholesale fish merchants: the Imraguen received fishing equipment on loan and attractive prices for their elasmobranch captures for shipping to the Southeast Asian fin market. Declines in captures of sharks and rays appeared rapidly, but were compensated for by increased fishing effort with new fishing nets. This accelerated overexploitation in the Park finally resulted in increased fishers' debts towards the merchants.

Over the past seven years, more environmentally friendly fishing activities have been developed inside the Park, such as abandoning of certain fishing gear, financial incentives, and increased valuation of local fish products. Buy back of unsustainable fishing gear and stakeholder consultations have ultimately led to a ban on ray and shark fishing inside the Park in 2003, based on an agreement with local fishermen.

Up to 110 traditional fishing boats are authorized to operate within the Park today and there is international support for the restoration of these boats. The local annual fish catch inside the PNBA is around 2 000 tons, of which (very roughly) one third are mullets, one third are meagre and one third remain smaller species of sharks and rays. Sharks and rays are still caught as bycatch in the meagre fishery, or through uncontrolled Imraguen fishing practices, while illegal fishing for sharks is controlled.

Despite these successes in supporting traditional fishing, the social and economic well-being (i.e. health, access to water, education) of the resident Imraguen population remains unsatisfactory.

There is plenty of movement between the village communities inside, and the villages outside the Park. Management action to improve the socio-economic conditions of the Imraguen population as well as regulations should be applied for all villages, inside and outside the Park. In regard to the application of Park rules and regulations, 'the Park resident' status needs to be clearly defined. Supporting the living conditions (e.g. funding partnerships; alternative income opportunities other than tourism; capacity development) is urgently recommended.

There is a feeling of discontent among some villagers over recreational fishing activity by Park visitors, although this activity is unlikely to have any significant impact on the fish stocks if properly regulated. The PNBA very recently produced a sport fishing 'chart' with the aim of regulating this activity.

3.4.2 Successes of the Park

The Park has provided a concrete (legal and administrative) framework for:

- A Park surveillance system and enforcement of specific fisheries regulations.
- Involvement of the residential Imraguen community in Park activities from the very beginning, and the establishment of a community cooperation scheme with stakeholders.
- A range of successfully implemented projects through international cooperation, and funding support dedicated to Park management resulted in a first track record of monitoring data, and finally supported establishment of a national fisheries monitoring system. A participatory research and monitoring programme on fish captures now exists, and is advised by a scientific committee.
- New fisheries management measures were established within the Park's boundaries, based on stakeholder agreement. They led to the protection of certain fish species and all species of sharks and rays.
- The large size of the PNBA management area can be seen as an advantage for extending the application of management measures to a national level. It also enables conservation of Park-endemic species, including species that may produce fisheries benefits beyond the Park's boundaries.

3.4.3 Challenges

- Tough, unsatisfying living conditions of the local Imraguen residents (health, access to water, etc.), and high poverty levels due to lack of alternative income opportunities and changes in fishing activities are a significant challenge that needs to be tackled.
- Involvement of the full range of stakeholders can be improved through ongoing communication between actors and institutions involved in shared activities, and regular consultations with fisheries managers. For example, the PNBA regulates merchandizing and trading of fisheries catches inside the Park. Integration of all actors involved in the fishery into the stakeholder consultation system and thus in fisheries management, including the merchants and other fisheries stakeholders from outside the Park boundaries can be optimized. Ownership from residential communities of the management issues inside the Park may be difficult due to the deficient living conditions and a lack of local managing capacity, but can be further promoted. Lastly, monitoring data collected should be publicly available to all stakeholders, to prevent time delays in consultations and potential distrust.
- An effective legal and governance scheme needs to be put in place. Currently there is a lack of implementation schemes for existing Park legislation (i.e. there is no decree to apply the Park law 2000/024), and unclear legal formulations that may lead to illegal activities (e.g. for people moving between the Park and its surroundings). A formalized residential status has not been established for the Imraguen, which makes it difficult to apply existing regulations. Changes in the national support system for the Park and leadership issues may pose a challenge for the overall Park management, stressing the need for collective and concerted support from the Ministries for Fisheries and Environment.
- There is a lack of long-term financial sustainability to maintain and extend surveillance measures, as well as to implement research and communication strategies. The current system is highly dependent on foreign financial support.

3.4.4 Lessons learnt for fisheries management

- The Park serves as a tool for habitat and species conservation which, through protecting the ecosystem on which fisheries depend, also enhances the local fisheries. It serves as a refuge for critical stages in the life cycles (e.g. breeding, juvenile) of fish species which migrate or whose ecological range exceeds the Park boundaries during other phases of their life cycle. This is the case for the commercially important mullet, meagre and some shark species.
- The PNBA constitutes an important shark sanctuary within the sub-region and as such may serve as a pilot site for using a participatory approach and joint research programme towards implementing a shark fishing ban.
- Fisheries scientists recognise the protective value of the Banc d'Arguin National Park but also recommend that other measures should urgently be implemented to ensure protection at a national or regional level for economically and ecologically important fish species.
- The Park was originally established for conservation purposes, but has also demonstrated significant benefits for fisheries. Where fisheries rules and regulations on national/regional levels did not exist, the Park provided an opportunity to apply other measures, while existing legislation could be more easily enforced in the context of the National Park.

3.5 Case study D: Integrated, multiple use perspectives for the Great Barrier Reef Marine Park, Australia

The Great Barrier Reef Marine Park provides an example of a large multiple-use MPA which is zoned to allow for different uses and human activities by sub-area, to an extent that ensures a healthy condition of the overall ecosystem. Zones include fishing limitations as well as no-take areas or closures where no extraction of any sort is permitted (Figure 6). Development and adaptation of a zoned management plan with stakeholders has recently increased the area closed to fishing from 4.5 percent to an overall 33 percent of the Park area.

3.5.1 Background

The Great Barrier Reef Marine Park, encompassing an area of 344 400 km^2, was authorised to be established in 1975 through the Great Barrier Reef Marine Park Act by the Australian Commonwealth Government. The Marine Park covers the entire Great Barrier Reef (GBR) of eastern Australia with the outer boundaries extending to straight lines approximating the 200m depth contour. The GBR is also a World Heritage Area and the largest barrier reef system in the world stretching for over 2 300km along the Queensland coast. Consequently there was little doubt as to its significance, bio-physical uniqueness and need for conservation, protection and wise management.

A wide number of fisheries occur in this multiple use Marine Park, ranging from bottom trawling for prawns and scallops, to line fishing for demersal reef fish and pelagic species. The fisheries focus in this case study will be the coral reef fin fish fishery taken by hook and line, which is almost wholly contained within the Marine Park, operating around the ~2 500 individual coral reefs.

The Great Barrier Reef Marine Park Act (1975) constitutes the legislative framework for the GBR and this is administered by the Commonwealth Great Barrier Reef Marine Park Authority (GBRMPA), a statutory authority within the Ministry of Environment and Heritage. GBRMPA acts as the principle adviser to the Commonwealth Government on the management of the GBR.

There is no specific mention in the GBRMP policies and legislation that the no-take zones have a fisheries management function. Their function is described as biodiversity protection and conservation. However, the Great Barrier Reef Marine Park Act (1975) does require that ecological sustainability is ensured, so all uses, including fishing, must be ecologically sustainable within the GBR Marine Park. Consequently, GBRMPA works with the Queensland State Fisheries Agency, the

Department of Primary Industries and Fisheries (DPI&F) to ensure that fisheries in the GBR Marine Park are ecologically sustainable. Through the legislation the GBRMPA can request DPI&F to take action if a fishery is deemed unsustainable or has unacceptable impacts on other species, habitats and other users. As federal legislation the GBRMP Act overrides conflicting State legislation including fisheries legislation.

Contrary to the GBRMP under federal law, the primary legislation for the coral reef fin fish fishery is the Queensland State Government’s Fisheries (Coral Reef Fin Fish) Management Plan (2003) through the Fisheries Act (1994). The Plan invokes many standard fisheries input and output controls such as minimum and maximum size limits, limited entry (licenses), gear restriction, vessel restrictions, etc. and DPI&F manages all fisheries in accordance with the principles of ecologically sustainable development. The Coral Reef Fin Fish Management Plan makes no mention of the GBRMP closures with which the fishery must comply; however, the zoning plans of the GBRMP do identify reef line fishing as a reasonable use within certain zones of the Park.

Further relevant legislation is contained in the Commonwealth Government’s Environment Protection and Biodiversity Conservation Act (EPBC) 1999. All fisheries that export products from, or that occur in a World Heritage Area, or that interact with endangered or protected species must comply with the EPBC Act and demonstrate that they are sustainably managed before they can operate. In 2004 the coral reef fin fish fishery was approved as a Wildlife Trade Operation (WTO) which allows for the continued export of reef fish. This approval acknowledged that 33 percent of the GBR (up to 30 percent of reef habitat) is protected through no-take zones and that this contributes to ensuring the fishery is being managed in an ecologically sustainable manner.

Since inception the GBRMPA has focused on strong participatory input from all users and other stakeholders of the GBR in managing the GBRMP, particularly in the formulation and review of the zoning and management plans. To engage stakeholders the GBRMPA employs different communication and consultation methods for four target groups: i) users of the GBR (e.g. fishers); ii) local communities that live adjacent to the Marine Park; iii) the broader Australian public who view the GBRMP as a national heritage; and iv) the global community.

The first zoning plan for the GBRMP was developed in the 1970s for the southern Capricorn-Bunker section of the Park which covered 12 000 km^2. Subsequently, additional sections were added over several years and zoning plans were developed for each section in which permanent no-take zones or closures were established with the primary objective of biodiversity conservation (Lawrence *et al.* 2002, FIGURE 6). Adaptive re-zoning of the Park generally every five years has been an ongoing periodic process.

In the early 1990s GBRMPA’s management plan review process identified that there were several problems with the zoning, and that the increasing pressures on the GBR, from, among others, tourists/recreational users, fishing and pollution, were inadequately addressed through the number and size of no-take areas within the Park. In addition, the closures were focused on coral reefs with little regard to the other major habitats in the Park (Fernandes *et al.* 2005). The latest rezoning of the GBR, completed in 2004, was a massive undertaking and has increased the number of fully protected no-take areas for biodiversity conservation from 4.5 percent to 33 percent of the Park (Fernandes *et al.* 2005).

Compliance and enforcement of the closures (and all other regulations of the GBR Marine Park Act) is delegated to the Queensland Environment and Protection Agency – the Queensland Parks and Wildlife Service. This is primarily done through boat patrols and plane surveillance conducted by a number of agencies (Queensland Parks and Wildlife Service; Queensland Boating and Fisheries Patrol (DPI&F); Customs; Coastwatch; and State and Federal Police). These agencies are coordinated on a risk-based intelligence assessment. Thus, the likelihood of a particular infringement in a particular area/time causing environmental harm is assessed and patrols target those areas and times. At the same time the Queensland DPI&F conduct boat patrols to enforce the Coral Reef Fin Fish management plan within the GBR Marine Park.

The Minister of Environment offered a compensation package for fishers rather late in the recent re-zoning process, after strong lobbying from the fishing industry. (The package was offered by the Ministry of Environment to compensate for restricted access to fishing areas and potential loss of revenue from fishing, given that the main aim of the closures was biodiversity conservation rather than effort control or yield management.) Commercial fishers can now have their licenses bought out (a total package of around AUD 30 million), while they do not have to demonstrate a direct impact from the re-zoning. However, DPI&F provided information on the potential level of impact and the level of fishing effort for each fisher who applied for compensation. Licences were selected by the Department of Environment & Heritage (DEH) in part on this basis so that those licences that applied significant fishing effort in the Marine Park would be removed and compensated. Contrasting to this, people requesting compensation from fishing related business impact due to closures had to demonstrate the impact. The total package available for restructure package is about AUD 80 million to cover all fisheries in the GBR Marine Park (trawl and line fisheries, i.e. prawn, scallops, coral reef fin fish, crab, pelagics, etc). Clearly the DEH have demonstrated a commitment to compensating the fishing industry for the increase in closed areas in the Park.

3.5.2 Successes of the Park

- One of the key successes of the GBR Marine Park is the recent re-zoning that has resulted in 33 percent of the Park now closed to fishing and other extractive uses, a substantial increase from 4.5 percent. This increase was promoted on the basis that it is generally accepted that at least 20 percent of a multiple use MPA should be closed to conserve biodiversity (Fernandes *et al*. 2005). Modelling studies have suggested that the percentage should be as high as 40-50 percent to maintain sustainable coral reef fisheries (Russ 2002).
- Education campaigns on the new zoning plan ensured that 78 percent of the Queensland population knew about the plan when it became effective and consequently the incidence of infringement was significantly lower than during previous re-zoning times.
- A better understanding of the Park's potential and value by local authorities enabled effective coordination of enforcement and compliance between various agencies and the risk based approach to surveillance. This has increased the number of infringements reported and increased the number of prosecutions. In 1999 the Minister for Environment increased the level of fines significantly, up to AUD 220 000 to an individual fisher for illegal fishing and up to AUD 1 million to a company. In addition, investigators are now able to build cases against environmental crimes. This has been accompanied by training of the judiciary and strong awareness campaigns in the media. The recognition by the EPBC Act assessments of ecologically sustainable management by GBRMP through closures is also seen as a success.
- A strong scientific information basis justifying closures, their location, size and number, added significantly to the stakeholders' recognition of the Park's benefits (with exception of the fishing industry). Despite the fact that the two authorities responsible for the sustainable management of exploited coral reef fishes of the GBR employ different legislative approaches, and do not formally acknowledge each other's legislation, collaborative research between these authorities and others (e.g. James Cook University) has demonstrated benefits of the closures by showing increases in the biomass of fishery target species within the closed areas. Although likely, benefits through spillover effects for the surrounding fishery were however not evidenced.
- This research, on the effects of line fishing by the Cooperative Research Centre for the GBR World Heritage Area, has shown that two main target species of the reef fin fish fishery, the common coral trout and the red throat emperor, were significantly more abundant, larger and older in areas zoned closed to fishing than in adjacent areas that have always been open to fishing (Mapstone *et al.* 2004). The magnitude of these differences varied in relation to levels of fishing effort and natural patterns in abundance of these two species. Thus where fishing effort is high and population abundance is naturally high the difference between closed and

open reefs was greater - closures were more effective. Experimental manipulations of reef zoning status and fishing effort provide further evidence that the Marine Park zoning strategies have been effective in protecting sub-populations of the reef fin fish fishery resource from the impacts of harvest. The impacts of fishing effort were felt within a year of opening previously closed reefs indicating rapid decline in densities and size from fishing on these target species.

- Lessons learnt from over 40 years of engaging with stakeholders have recently led to a new approach of building relationships between individuals within local communities and Authority staff, to strengthen trust between the two and hence engage in collaborative management. Strong community links have been developed via the establishment of Local Marine Advisory Committees and Regional offices. Encouraging signs can be seen in the Keppell Islands, southern GBR, where a community group called “Capreef” (Capricorn Reef monitoring group) representing the recreational fishery, are supportive of the reef closures and want to monitor them with GBRMPA. They supported a total closure of >20 percent of their area and helped GBRMPA select areas that represented both healthy and depleted fish populations and habitats. They recommended closed zones for both replenishment (depleted fish stocks) and conservation (healthy fish stocks).

3.5.3 Challenges

- A critical challenge to the GBR Marine Park is poor acceptance of closed areas by the fishing industry. This is compounded by the fact that despite extensive research, conclusive evidence that high biomass of target species in closed areas will benefit the surrounding fishery is not readily apparent. The commercial and recreational coral reef line fishers are already regulated through the Queensland state’s fisheries management plan, and therefore they are understandably unsympathetic to further regulation through closures which are primarily established for the purposes of conservation of biodiversity.
- The real benefits of closures as a fisheries management approach have not yet been well-enough demonstrated on the GBR. Research to demonstrate benefits of closures to surrounding fisheries needs to be carefully designed to tackle this issue. It would be important to look at spillover (larval supply and adult movement of fish) and catch rates in surrounding areas open to fishing. Information is equally needed on fisher behaviour in relation to closures. Monitoring of key indicators in the reef fin fish fishery (e.g. population density and biomass) in response to closures before and after is essential for measuring impacts.
- Clear and synthesised publication of research results is needed, e.g. on the effects of line fishing experiments, to help fishers understand the benefits of closures to the reef fin fish fishery. Awareness raising through educational materials such as videos is an option.
- It is clear that the results of the Effects of Line Fishing experiment need to be communicated carefully back to the fishing industry so that the results are clearly understood. It appears that there is still a large gap between researchers/managers and fishers in terms of trust and understanding. The informal understanding between GBRMPA and DPI&F staff regarding the merits of closures for fisheries management could be made more public to improve fishers’ understanding of the positive impacts of closures. Further, the lack of recognition in the two legislations (GBRMPA and DPI&F) of each other’s regulations does not foster a cohesive approach to the management of the reef fin fish fishery on the GBR.

3.5.4 Lessons learnt

- Legislation and other management measures for closures (no-take zones) within a large multiple-use MPA such as the GBR should specify to address both sustainable (reef) fisheries management as well as biodiversity conservation. Combining the dual benefits of biodiversity conservation and sustainable reef fisheries as objectives in an MPA management plan adds value and benefits and reaches a wider stakeholder base.

- Adaptive re-zoning as an ongoing periodic process is a key requirement for successful management of a large multiple-use MPA. For example, the GBRMPA Fisheries Issues Group worked closely with DPI&F during the re-zoning of the GBRMP and it was recognised informally that closures were working for fisheries management and therefore more stringent fisheries management measures by DPI&F would not be needed.
- Monitoring the effects of closures (before and after) should combine both biodiversity monitoring and fisheries monitoring to measure impacts.
- Education and awareness material especially video should be produced to illustrate the concept of closed areas as a fisheries management tool for demersal reef fisheries, with the reef fin fish fishery operators on the GBR as the target audience.
- A fully participatory and consultative process is essential to get support from stakeholders. Users, especially fishers, should be part of the monitoring programmes so that they can directly see the effects of the GBR closures.
- The protection of sub-populations of reef fish through closures (with sufficient compliance) was seen as the most effective way to increase total spawning biomass of harvested species over the GBR (Mapstone *et al.* 2004). However, this research cannot demonstrate, though it is implied, that the high biomass within closed zones will in turn benefit the surrounding areas open to fishing through larval flow and adult spillover.
- Enforcement of closures remains essential. A focus on compliance is necessary because of the large scale of the GBR, and this is best achieved by fishers believing in the net benefits of the closures to their fishery.

3.6 Case study E: Territorial use rights in coastal fisheries through Areas for Management and Exploitation of Benthic Resources (*Áreas de Manejo y Explotación de Recursos Bentónicos*), Chile

The number of Areas for Management and Exploitation of Benthic Resources (AMEBR) has rapidly expanded in Chile over the last decade in an effort to reduce the overall fishing effort in Chilean near shore fisheries and to improve compliance with coastal fisheries regulations. The AMEBR provide an important tool for transferring management responsibilities from a central authority to artisanal fishing communities. This case represents an important and ambitious initiative of introducing territorial use rights in a coastal fishery where property rights had never been in place.

3.6.1 Background

The Chilean Fisheries and Aquaculture General Law, enacted in 1991, provides for the establishment of MPAs as fisheries management tools. It lists three categories of MPAs: areas for management and exploitation of benthic resources, marine reserves, and marine parks, with different sets of objectives, management and conservation actions. Marine reserves and marine parks are scarcely applied in Chile; however, the Areas for Management and Exploitation of Benthic Resources (AMEBR) have rapidly expanded over the last decade.

The AMEBR areas aim to ensure sustainable use of marine resources by assigning exclusive territorial use rights to legally recognise artisanal fisheries organisations. Initially developed in the early 1990s as pilot experiments, AMEBRs are now a common management tool and adopted by most artisanal fisheries organisations in Chile.

The main objectives of the management area regime are:

- conservation of benthic resources (invertebrates and macroalgae)
- sustaining artisanal economic activities
- maintaining or increasing biological productivity of benthic resources

- increasing knowledge on the functioning of the benthic ecosystem
- promoting and encouraging participative management

The AMEBR areas fall into Category VI of IUCN's protected areas management categories. They can only be established within five nautical miles from the shore and in inshore areas (rivers and lakes). Over 430 declared AMEBRs with a management plan exist, and ca. 1 200 have been requested (see Figure 7 for region IV of Chile). The average surface extent is 190 ha; the number of fishers involved is around 16 500 out of a total number of ca. 52 000 artisanal fishers in Chile.

The legal provision for the establishment of the AMEBR is set out in article 48 of the Fisheries and Aquaculture General Law Nº 18.892. A specific regulation for management areas is set out in the Supreme Decree Nº 355/95 and outlines the rules and criteria for establishing and managing such areas.

In order to be granted an AMEBR, a community must constitute a legal organization (e.g. artisanal fishers' associations or fishers' cooperatives). There are two main steps for the establishment and implementation of an AMEBR: the first, administrative, aims to delineate the geographic area in which a management project would be undertaken. It involves extensive consultation with several governmental organizations and local communities that need to analyse the feasibility of establishing a management area and ensure compliance with existing uses in order to grant the exclusive use right to the fishers association.

After such consultation and if there are no major conflicts with other uses, the area is declared available and the implementation of a management project can start. This requires the development and execution of a proposal for a base line benthic resources assessment, and the presentation and results delivery of a management and exploitation proposal. The technical requirements for these steps are set out in the management area regulation.

Once the management and exploitation plan (hereafter management plan) of an area is approved by the Under-Secretariat for Fisheries (Subpesca), the second process involves the National Fisheries Service (SERNAPesca) establishing an "agreement of use" for a period of four years with the fisheries organization in order to transmit the obligations and privileges that the management of benthic resources of the declared area implies. Annual monitoring studies are mandatory to evaluate implementation of the proposed management objectives by Subpesca.

In addition to the provisions of the Fisheries and Aquaculture General Law, the management plan of an AMEBR specifies a set of actions to ensure the sustainable management of the fishery. Based on the baseline assessment of the area, the management plan identifies, on an annual basis, target species, harvest periods and techniques, as well as the criteria applied to determine allowable catch rates. The most commonly targeted benthic species within the Chilean management areas are "locos" (*Concholepas concholepas)*, limpets (*Fissurella* spp.), sea urchins (*Loxechinus albus*) and macha clams (*Mesodesma donacium*). The management plan can also include aquaculture activities provided that they have no impact on natural resources and are in compliance with the national fishing regulations.

For every AMEBR, a norm for enforcement of the management plan is established, which defines individual extraction levels, rights and obligations for each member of the fishing community. By this norm a code of conduct among fishers is set independently of the external regulatory authority. The control of the fishing area is done by the fisher's organization themselves, generally through the establishment of a control committee (of often rotating responsibility). Typically, the executive board of the fishers association identifies potential violations of the norm and establishes the appropriate sanctions (Palma and Chávez 2004).

The implementation of the management plan is controlled indirectly through the evaluation reports by Subpesca. SERNAPesca has the mandate to undertake inspections and sanctions. The presence of SERNAPesca during the fishing operations is necessary to certify that the resource was extracted from the management area in accordance with the management measures in place. The fishers' organization might lose the exclusive right to manage the area if the exploitation is in infringement of the management plan.

In Chile, there are several local studies on the effectiveness of the management area as a fisheries management tool, particularly on positive effects such as increase of size and abundance on the target species *Concholepas concholepas* (Castilla 1996, 1999; Castilla and Fernandez 1999; Orensanz *et al.* 2001; Stotz 1997), and on some economic and social improvements to artisanal fishers (Barros and Aranguez 1993; Subsecretaría de Pesca 2004).

3.6.2 Key successes

- The increase in numbers of management areas requested by fishers organizations demonstrates that acceptance of the system within the artisanal fishers communities has been highly successful.
- The Chilean Management Area system emerged in response to the need for alternative solutions that would ensure sustainability of benthic fisheries resources after their severe overexploitation by the end of the 1980s. Artisanal fishers themselves realised the need to change exploitation practices and introduce access regulations for optimized resource use. The results and effects of these access regulations and exclusion of human impact on coastal ecosystems have influenced artisanal fishers in Chile and strengthened their acceptance of the AMEBR concept.
- Shifting from common property fisheries (characterized by a lack of property rights and economic over-exploitation) to exclusive use right in the Chilean coastal fisheries has created a sense of ownership and responsibility for the management of the resource.
- During this process fishers learnt to acquire new skills for managing the fisheries resources, while the authorities delegated certain responsibilities and found new collaborative ways of working with the resource users.
- The management areas allow for improved interaction between the fishers, the management authorities and the scientific community. The system is participatory and transparent enough to build and reinforce trust between the different stakeholders.

3.6.3 Challenges

- The main challenge of the system is to ensure enforcement of the management regulations. Involving the fishers in managing the resource aims at reducing the need for external control, implying the commitment of fishers to control illegal practices themselves in order to increase their benefits.
- Current regulations, however, focus only on the biological and technical aspects of the fishery exploitation, while economic considerations, which are crucial to understanding the fishers' strategic behaviour, are largely ignored. The Chilean Fisheries and Aquaculture Law, for example, do not inquire about norms and internal regulations used by the community to guarantee the compliance of the management plan. Fishing associations need to take into account the potential problems associated with self-regulation prior to being granted full user rights (Villena and Chavez 2005).
- The new co-management regime of the fishery did not empower fishers in advance to enable them to manage the resource effectively. Today there is a clear need for capacity building in the implementation of the management and exploitation plans, equipping the fishers with better tools for the management of the resources.

- Research, and especially studies that relate these areas to broader conservation objectives or to the status of the resources at the national scale are lacking. There is also a need for interdisciplinary research, considering biological, social and economic factors to develop an improved understanding of the various determinants of success in use rights arrangements.

3.6.4 Lessons learnt

- Establishment and administration of the AMEBRs promote and strengthen the development of fishers unions that are then linked with both government institutions in charge, and with the scientific community.
- AMEBRs can have a high educational value, as they allow for direct interaction between scientists, managers and users. Targeted capacity building, however, still needs to be made (see above).
- The AMEBRs provide an interesting opportunity for implementing different fishery management experiments. A synthesis of lessons learnt and comparison of effectiveness of the different management schemes would be needed to provide a basis for structural improvement of the system. A comprehensive evaluation of the system at a broader scale needs to be conducted.
- Surveillance, sanction and control are key elements for AMEBRs to work effectively, and need to be enforced by strengthening the control capacity of the relevant authorities.
- There is a need to conduct studies that relate these areas to broader conservation objectives or to the status of the resources at the national scale. There is a particular need for interdisciplinary research, considering biological, social and economic factors to develop an improved understanding of the various determinants of success in use rights arrangements.

3.7 Case study F: Community-managed coral reef sanctuaries in Bohol, central Philippines

This case study provides an illustration of nineteen no-take MPAs that are fully implemented, managed and enforced by local subsistence fishing communities across Danajon Bank in Bohol, in the central Visayas of the Philippines.

The no-take MPAs have been established, by the communities with the support of a non-government organisation and its local counterpart foundation. The first sanctuary, Handumon, was proposed in 1995 and enforcement commenced the same year. Reports of good experiences elsewhere in the country, and increasingly good reports in Bohol have prompted subsistence fishing communities to support the development of these areas.

3.7.1 Background

All MPAs are small in size and function as no-take marine sanctuaries, primarily protecting shallow, fringing reefs, seagrass beds and mangroves within the inshore coast of the Danajon Bank reef complex (FIGURE 8). At the periphery of the Camotes Sea, the Danajon Bank is a distinctive double barrier reef complex of reefs, inshore islands, seagrass beds and mangroves. The Danajon Bank reef complex comprises of a total area of 2 476 km^2 and is historically reported as the most habitat-rich fisheries ecosystem of the Central Visayas (Green *et al.* 2004). The Danajon Bank is suffering from declining fish stocks primarily because of overfishing, and increasingly critical habitat status due primarily to destructive fishing methods notably the use of trawls and dynamite. Reef conditions span the entire spectrum of high to low quality due to both environmental and human impacts. In addition, this region presently contains one of the highest recorded fisher numbers in the Central Visayas and the majority of these fishers are dependent on the fisheries for their livelihood and direct consumption. The fisheries of the region have changed drastically over the last several decades with CPUE declines associated with all fishing grounds (Green *et al.* 2004).

The reasons for the establishment of these sanctuaries were to promote rebuilding of marine life, for both conservation and economic purposes; to manage important local artisanal fisheries, such as the seahorse fishery (Martin-Smith *et al.* 2004), but also fisheries for demersal reef fish particularly rabbitfish and parrotfish; and to comply with national legislation that stipulates Municipalities must establish marine protected areas (MPAs).

The impacts of five of these small coral reef sanctuaries have been analysed in some detail. All five sanctuaries are small (< 1 km^2) spread through three municipalities, over a distance of approximately 40 km (see FIGURE 8), and comprise shallow coral reef habitat, but some include dense beds of the brown algae *Sargassum,* which may have been promoted by extensive coral destruction from dynamite fishing (Marcus *et al.* in press).

Legislation for the protection of coastal waters is very progressive in the Philippines. The National Integrated Protected Area System (NIPAS) Act (RA 7586), was enacted by Congress in 1992 to respond to the profound impact of human activities on all components of the natural environment in the Philippines (DENR, BFAR and DILG, 2001). Of greater relevance to the Bohol sanctuaries are the complementary Local Government Code 1991 (RA 1760) and the Philippines Fisheries Code 1998 (RA 8550), which provide municipalities, termed local government units (LGUs), with legal frameworks and mandates to manage their 15 km municipal waters and to establish MPAs. This is a relatively quick process requiring the passing of a municipal ordinance. To get an area protected under the NIPAS act requires either an executive action (Presidential Proclamation) or congressional action (house and senate bill). Under RA 7160, the LGUs can use their internal revenues to support coastal resource management initiatives including MPAs. They may even use these resources to build up their own capacities in Coastal Resource Management. These LGU-codified MPAs are fully protected no-take MPAs, locally referred to as *sanktwaryo (*sanctuaries). Under Philippine law, taking of any sort is not allowed in these sanctuaries.

The Bohol marine sanctuaries are legally gazetted through municipal ordinances and resolutions. Management plans for the five sanctuaries are included in coastal resource management plans produced by the Municipality in consultation with village management teams. Village natural resource management (NRM) plans may also include management plans for the sanctuary. The majority of the MPA management plans include goals that focus on the improvement of fisheries yields outside the sanctuary for food security and income. Activities have included participatory coastal resource assessment, on-site consultations, fulfilment of legal requirements, management council establishment, management plan formulation and community-based monitoring.

Encouraging compliance of sanctuaries involves a number of different steps: placing marker buoys and posts so that the sanctuary is clearly delineated; the building of a guard house in the sanctuary; and a patrol team established with a daily guard assigned to guard the sanctuary from the guard house, and this may be 24hr or at night only depending on the fishery. Finally, where there is good enforcement, patrols by boat are also conducted.

Legally, enforcement can commence as soon as a municipal ordinance or resolution is passed as it is the municipality who owns the municipal water (Fisheries Code of 1998). In reality local communities often take enforcement into their own hands before the ordinance is passed, and have some powers through formally delegated village police and fish wardens.

Starting in 1998, teams comprised of biologists, local fishers and volunteers have developed and conducted bi-annual surveys that now include visual census of fish abundance, seahorse surveys and quantitative benthic assessment. The long term monitoring programme tracks the effectiveness of MPAs in providing protection to coastal habitat, enhancing fish abundance and biomass, and conserving seahorse populations. Changes in eight MPAs are now surveyed using permanent transects inside and outside the MPAs, and at five distant control sites. The biophysical monitoring is reported to local MPA communities and municipal governments on an annual basis for their assessment of MPA success.

3.7.2 Key successes

- Strong and active community and fisher participation in all aspects from sanctuary site selection, management planning and monitoring has been a feature of most of the Bohol sanctuaries (Meeuwig *et al.* 2003) and this has meant communities feel a strong sense of ownership, responsibility and therefore generally comply with sanctuaries. Each of the villages associated with the five Bohol sanctuaries has a Peoples' Organisation (PO) which is involved in all aspects of sanctuary management. Community participation has and will continue to provide important insights with regard to interpretation of the monitoring data for adaptive management.
- Activities focused more on people than marine life in designing and planning MPAs, using community development specialists called Community Organisers (COs) to facilitate strong Peoples' Organisations, in partnership and with support from biologists.
- Technical and financial support with a strong presence on the ground has provided communities and local governments with help, encouragement and guidance, as well as technical input, training and funds (Project Seahorse).
- Analysis of monitoring data of reef fishes over seven years provides some convincing evidence of positive impacts of the sanctuaries though the results are complicated by natural variation. Positive impacts were, not surprisingly, primarily seen in the three sanctuaries (Handumon, Batasan and Asinan) that are well enforced. In these, the densities of groupers (Serranidae) and breams (Nemipteridae), key target species in the local fisheries, increased significantly in the sanctuaries compared to distant unprotected (control) sites. These density increases in the sanctuaries over time were also seen just outside the sanctuary boundary though at lower densities, providing some suggestion of spillover of these two fish groups. These positive impacts no doubt contribute to community acceptance of MPAs. A further point for acceptance might be the small size of the sanctuaries, so that spatial reduction in the overall fishing area is less significant, and easier to manage in logistical terms (Samoilys *et al.* 2006).
- A strong legislative framework to complement community management activities, with increasing financial allocation to MPAs was essential for the success of MPA implementation.
- Extensive awareness campaigns on the benefits of sanctuaries for improved fisheries and hence improved livelihoods, and activities such as cross-visits to well-established sanctuaries (e.g. Apo Island) have been an effective tool for building awareness and understanding.

3.7.3 Challenges

- Long-term financial sustainability is one of the key challenges that the Bohol sanctuaries face, because many of the sanctuaries have relied on external aid for financial support. To address this issue, recently drafted MPA ordinances now specify that the LGU should allocate funds from its annual budget for MPA management. With the codification of budget allocation, communities can now claim a yearly allocation from municipal governments.
- Technical capacity is still lacking at the village level and to some extent at the municipal level, given that guidance has largely been provided by outside partners in the past. Development of a local technical resource institution would be recommended.
- Another key challenge for the Bohol sanctuaries is compliance. Three of the five focal sanctuaries were found to be well enforced. Illegal fishing in the sanctuaries continues to be a problem: poor or non-existent enforcement in the other two may reflect a lack of resources by villagers to keep outside offenders out since village management teams often state that poachers are fishers from neighbouring villages. It may also reflect local social infrastructure – those MPAs that were well enforced are those with relatively strong POs.

- Monitoring of CPUE in the fisheries surrounding the MPAs started late in 2003 – well after sanctuaries were established, and therefore direct improvement in neighbouring fisheries cannot yet be empirically demonstrated.
- Government participation has been weak.
- Rapidly increasing local human populations negate many of the MPA benefits.

3.7.4 Lessons learnt

- Local fisher participation and consultation is important from the onset. It should continue during all stages of planning and implementation, with an emphasis on capacity building.
- Building capacity should target local communities, MPA managers, municipal government units, and MPA technical resource institutions.
- Accurate and regular monitoring of key fishery indicators (bio-physical, socio-economic and fisheries) is essential to demonstrate causal relationships between sanctuaries and fisheries. Local communities must be involved in this including the interpretation of monitoring data. A global analysis of key indicators relevant to these sanctuaries would be very helpful.
- The impacts of MPAs on different sectors of the community (poorest, inshore, women, children) need to be assessed and disproportionate efforts adapted.
- Adequate funding, logistics, and institutional support must be provided for ongoing enforcement by local communities and fisheries management agencies. Detailed measures of enforcement, compliance and community participation in sanctuaries are important to fully understand the factors that contribute to successful sanctuary management.
- Strengthen other fishery legislation such as gear restrictions and licensing needs to be put in place to complement, and be integrated with MPAs.
- The adaptive management cycle in which sanctuary plans are reviewed and revised based on analysis of monitoring data (bio-physical and socio-economic) needs to be put in place and supported (financially and technically).

3.8 Case study G: Incorporating MPAs into a set of existing fisheries management measures in Antarctic high seas areas

Experience in Antarctica provides a useful case study on recent progress and remaining challenges of developing marine protected area (MPA) systems within an existing regional fisheries management framework. At the same time it provides one of the very few concrete examples for establishing area-based measures in waters beyond national jurisdiction (i.e. on the high seas). This case study highlights the recent recognition by a regional fisheries management body that MPAs have considerable potential as a tool for use towards the implementation of an ecosystem-based approach to marine conservation and fisheries management, in an area that is characterized by a highly industrialized commercial fishery. This article largely references a recent article by Susie Grant (PARKS 2005).

3.8.1 Background

The Southern Ocean, bounded by the Antarctic Continent to the south and the Antarctic Polar Front to the north, comprises around 10 percent of the world's oceans. It is characterized by highly seasonal primary productivity leading to huge quantities of herbivore species such as copepods, salps, and euphausiids (especially the Antarctic krill). Their predators have been major target species for human exploitation historically and until today. The benthic fauna of Antarctica is highly adapted and species rich, with exceptional levels of endemism.

The Antarctic Treaty System (ATS) provides the basis for the protection of the marine ecosystem. Development of MPAs falls under the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), and the Antarctic Treaty and Protocol on Environmental Protection to the Antarctic Treaty (Madrid Protocol) (FIGURE 9). Both instruments have developed area-based measures for protection and management in marine areas.

The two main tools for area protection and management under the Madrid Protocol are: Antarctic Specially Protected Areas (ASPAs) and Antarctic Specially Managed Areas (ASMAs).

ASPAs correspond to IUCN Category I protected areas (Strict Nature Reserve), and require a permit for entry and other activities such as scientific study. There are currently six marine ASPAs (as well as nine terrestrial areas with small marine components), covering a total marine area of approximately 1 800 km^2, or 0.012 percent of the marine area south of 60° S. These are some of the few high seas MPAs currently in existence worldwide, however the majority are *ad hoc*, coastal areas of limited extent. None are located in areas in which there is any fishing activity, and none have been designated as "representative examples of major marine ecosystems" as required by the Madrid Protocol (Annex V, Article 3.2).

ASMAs correspond to IUCN Category IV protected areas (Habitat/Species Management). They are designed to help manage and co-ordinate activities based on a non-mandatory code of conduct for multiple uses. Three current ASMAs include marine components (although one of these has not yet been formally adopted), but this tool has the potential for much wider use to strengthen management and provide codes of conduct in areas of intensive use. These areas do not require a permit for entry.

CCAMLR is a pioneer of the ecosystem approach to fisheries management, aiming at the conservation and rational use of Antarctic marine living resources. These include populations of fin fish, molluscs, crustaceans and all other species of living organisms found south of the Antarctic Convergence (CCAMLR 2004, Article I, II). It has a wider conservation mandate than any other Regional Fisheries Management Organization (RFMO). A Commission and a Scientific Committee oversee implementation of the Convention.

The entire area covered by the Convention can be classified theoretically as an IUCN Category IV protected area (Habitat/Species Management), because of the level of overall management it provides: Conservation measures defined by CCAMLR include closed seasons, catch and effort limits for particular species, restrictions on the number of vessels permitted to fish in each season, gear restrictions, limits on by-catch of other fish species, and measures to mitigate the effects of fishing on associated and dependent species. CCAMLR also has a variety of area-based management tools that provide protection.

Amongst these area-based tools are Closed Areas for the purposes of scientific study or conservation, including special areas for protection and scientific study. Closed Areas have to date been implemented only on a species-specific basis, although two areas off the Antarctic Peninsula remain closed to all fin-fishing to allow stock recovery. Other Closed Areas include regions closed to fishing by species and season, and areas for protection of benthic habitats where fishing is prohibited in depths of less than 550 m. Areas may also be closed immediately once catch limits or by-catch limits for fish or seabirds have been reached (Figure 10).

Additional tools include geographically defined units used to assist with the implementation of fisheries management measures. Small Scale Research Units (SSRUs) are used to apply catch restrictions and research requirements for new and exploratory fisheries for toothfish (*Dissostichus* spp.), defining catch limits of zero (thus effectively closing the area to fishing for these species) in several locations. Small Scale Management Units (SSMUs) are used to facilitate management of the krill fishery, and aim to distribute fishing effort and reduce the potential for localized depletion of krill populations and impacts on land-based predators. No areas of fishing activity have been permanently closed to all types of living resource extraction.

The provisions and restrictions of individual area-based management measures applied here build a useful starting point for the development of MPA tools and implementation systems, whereas no MPA as such has been officially declared in Antarctic waters yet (areas have been declared due to their importance for science rather than conservation). The following describes recent progress towards rather than results from MPA effectiveness assessments.

3.8.2 Recent progress

Discussions on the development of MPAs within the CCAMLR context have recently advanced acceptance of conservation objectives into the fisheries management regime, and of fisheries no-take reserves: a workshop held in September 2005 identified specific conservation objectives for potential Antarctic MPAs, priorities for the types of areas to be considered for protection, and the types of scientific information required for the development of representative MPAs. The potential benefits of MPAs for biodiversity conservation, minimization of impacts of harvesting on non-target species, and protection (including restoration) of stocks and life history stages of target species were noted by CCAMLR Members. The positive workshop outcomes furthermore indicate an increasing willingness by CCAMLR Members to take action towards developing and testing new approaches for establishing MPAs that further the objectives of CCAMLR.

3.8.3 Challenges and lessons learnt

- There is a need for interaction and coordination between the two ATS instruments on the development of marine protected area strategies. Parties to the Antarctic Treaty and the Madrid Protocol do not have the authority to manage harvesting of marine living resources however with CCAMLR’s approval it can designate ASPAs that would restrict marine living resource harvesting (no ASPAs have yet been designated where this is the case). Further interaction and coordination between the two instruments could include the development of networks of protected areas to achieve both fisheries and biodiversity conservation objectives, and the designation of representative MPAs throughout the Southern Ocean.
- The CCAMLR area extends north of 60°S, thus covering a much larger area than the Antarctic Treaty and the Madrid Protocol. ASPAs and ASMAs cannot be applied in the entire area north of 60°S. There is a need to develop a strategic approach to MPA design and implementation throughout the CCAMLR area, and any regime for protection of the marine environment should be harmonized with measures already taken under the Antarctic Treaty and the Madrid Protocol.
- Although progress is being made, long-term biological data on the ecosystem and its functions is still very sparse. More information is needed with which to identify areas for protection.
- Year-round enforcement of the regulations established remains a challenge in the Antarctic environment.
- Although CCAMLR has designated Closed Areas to support its precautionary approach to managing fin-fisheries, these have not been established for broader purposes relating to MPAs.
- Recent CCAMLR discussions and decisions also have relevance for high seas marine protected area development worldwide: there is potential for concepts and models currently developed by CCAMLR to be used for high seas development elsewhere, and to appropriately apply them in relation to other management measures, particularly for fisheries. The concept of MPAs established under fisheries management frameworks (such as CCAMLR) but within a wider conservation context (such as that provided by the Antarctic Treaty with the Madrid Protocol) may be particularly applicable for high seas MPAs worldwide.

- Priorities for future work on MPA development within the CCAMLR context include wide consultation with appropriate interest groups and stakeholders, and the development of flexible decision-making and review procedures. To achieve maximum benefits, MPAs must be implemented within, and contribute to, the wider framework of sustainable fisheries management.

3.9 Discussion of the case studies

The case studies described throughout this paper illustrate different success features which MPAs can provide for achieving fisheries management objectives, as well as their challenges and limitations. Given the variety in scope, ecosystems, social, economic, ecological and governance context of the MPAs covered, and not least availability of supporting data and information, the first point they make is that there is no standard recipe for identifying their individual role and determining their set up.

A common feature that reappears throughout is the idea of developing MPAs that complement existing fisheries management regimes, and vice versa, and towards implementation of an ecosystem-based approach to both conservation and fisheries management. Recent advances have been made in Antarctica of developing MPAs in high seas areas where multiple-state industrial fisheries are regulated through existing fisheries management regimes.

The stakeholder process of designating no-take MPAs in the Channel Islands emphasises the importance of integrating reserve design and science with the fisheries management system. A cost-intensive process that included a large array of user groups from different sectors has been put in place for this reason. Given the wealth of lessons learnt, this case study focuses entirely on stakeholder processes.

Several of the other case studies also highlight the need for full participation and ownership by local stakeholder groups to make MPAs work and achieve sustainable fisheries objectives. While the Philippines case study provides an illustration of nineteen small-scale no-take MPAs that are fully implemented, managed and enforced by local subsistence fishing communities (villages), a series of collaborative management areas are established by user-groups in Tanzania in combination with a long-term fisheries monitoring programme.

Careful monitoring of the fisheries and their associated bio-physical and socio-economic context in and around MPAs is also documented in other cases, and should ideally lead to adaptations in MPA management if changing states are documented. The Great Barrier Reef Marine Park provides an example of where such adaptive management is practiced at the scale of a large multiple-use MPA. It is zoned to allow for differing human activities, including limited fishing and no-take areas, to an extent that ensures a healthy condition of the overall ecosystem.

The case study from Banc d’Arguin National Park shows how fisheries management objectives may be successively integrated into MPAs with primary conservation objectives, even if conservation objectives have been long established and conditions for efficient monitoring and enforcement are difficult. Full integration of the residential communities and their traditional resource use patterns inside an MPA is a key characteristic of this case, as is the role of the large-scale MPA for protecting critical life stages of commercially important fish species.

A crucial issue for all the case studies presented is that legal tools for MPA management be embedded within existing legal frameworks, and that new tools also be developed. Granting territorial use rights to local fisher communities in Chilean near shore zones has led to a rapidly increasing number of management areas for sustainable exploitation of benthic resources in Chile. A clear sense of local ownership could thus be established that led to overall improved conditions for fisheries management.

MPAs are emerging as a significant tool in the toolbox of fisheries management options (e.g. Martin-Smith *et al.* 2004). They can complement other fisheries management options and provide an additional safety net or insurance policy in case other options fail (Guénette *et al.* 1998; Russ 2002), or even an opportunity for other restrictions to be less severe.

The following section will present key elements, or 'messages', that have been extracted from the presented case studies for consideration and further discussion during this workshop.

4. RECOMMENDATIONS FOR TECHNICAL GUIDELINES AND FUTURE DIRECTIONS IN MPAs FOR FISHERIES MANAGEMENT

4.1 Key elements for consideration and recommendations

This section provides a set of recommendations and 'ingredients' for consideration when developing technical guidelines focused on MPAs as a tool for fisheries management. Given the wealth of lessons and recommendations resulting from MPA experiences globally, this listing does not seek to be exhaustive. It rather provides a set of 'conventional' experiences that can be complemented with more innovative approaches, such as vertically zoned, migrating or rotating MPAs, for example. It is recommended that the FAO consultative workshop improves, expands and agrees on this list on the basis of further information and reviews available (e.g. DEFRA 2006 for North Sea and Northeast Atlantic; Bernstein *et al*. 2004 for MPAs in United States waters; e.g. Simard and Lundin 2005). Further research and testing is needed, and the paper concludes with a brief discussion of the most pressing needs.

4.2 The MPA planning and designation process

As fisheries management agencies are moving towards applying the ecosystem approach to fisheries, classical fisheries management tools need to be adapted to take a more holistic approach and consider the ecosystem as a whole. The use of MPAs as a spatial management tool is becoming more common, but such use need to be integrated in an array of measures to ensure the sustainable use of marine resources and biodiversity (IUCN 2004).

As stated before, Marine Protected Areas can have different levels of protections, they can be no-take areas, or multiple use MPA where regulations are stricter than in the surrounding environment. The MPA can also be a combination of several zones.

4.2.1 Well defined goals and objectives

MPA goals and objectives need to be clearly defined when the MPA is in the planning stage. The specific role of the MPA in fisheries management needs to be captured in these objectives. The goals and objectives identified for an MPA determine criteria for its design as well as approaches for evaluating its effectiveness in achieving its goals and objectives.

Many MPAs are established with primary biodiversity conservation objectives, but they can also have significant benefits to fisheries, which are often not recognized or articulated by the conservation community.

Fisheries managers as well as conservation managers should take advantage of such MPAs and, where relevant, strive to ensure that they do also capture defined fisheries management objectives in their plans and design. On the other hand, MPA management should be realistic and critical to what stock enhancement can be achieved by the MPA, and where other, complementary fisheries management measures are likely to be more effective. There is abundant evidence that area closures for fisheries can also benefit benthic biodiversity and enhance habitat complexity (e.g. Sweeting and Polunin 2005). An individually adapted combination of tools seems thus to be the most practical way to go.

MPAs that have fisheries management objectives in addition to conservation objectives can help to bridge the gap between conservation and fisheries and in some cases address conflicts between competing users. They may also provide opportunities to create synergies and interactions between the practitioners, users and management authorities.

4.2.2 Full stakeholder involvement

Successful performance of MPAs in fisheries management requires that stakeholders recognize and agree to the need for this more inclusive approach to fisheries management. The engagement of stakeholders in MPA design and management is critical and needs to start from the very beginning at the conceptual/design phase of the MPA and continue throughout the review, evaluation and adaptive management cycle.

Representatives from all stakeholder groups need to be involved regardless of who is the driving force behind the MPA, whether government, community group, or other. All stakeholders likely to be affected by the MPA setting need to be consulted, and engaged into the MPA planning, implementation, monitoring and assessment process. Special attention must be given to address conflicts between competing users.

The mechanisms for consulting and engaging stakeholders will vary greatly from one situation to another, and need to be considered on a case-by-case basis. Advisory committees or coordination committees are common mechanisms and can comprise representatives from as broad a base of stakeholders as is relevant. If this step is ignored, or only partially considered due to financial or management constraints, the chances of opposition and resistance are greater. For an MPA to be successful local stakeholder support must be guaranteed, otherwise they are likely to undermine the whole process. Experiences also show that when the stakeholders, particularly fishers, are involved in the design and management of the MPA, they are more likely to comply with the MPA regulations, consequently reducing enforcement challenges.

Direct interaction between scientists, managers and users is particularly important in the monitoring, evaluation and adaptive management cycle (see below), but also more broadly to ensure stakeholder relations are cordial and that trust is built and maintained. This takes time and effort, trial and error, but will be important to prevent a breakdown of relations between stakeholders which can undo all the management on the ground. It is of key importance that stakeholders both within and beyond MPA boundaries are included. A fully open debate on the appropriate application of MPAs is often necessary to avoid public distrust and political manipulation that has recently dogged fisheries scientists and managers (Kaiser 2004).

4.2.3 Building capacity, education and communication

As governance concerns and financial constraints encourage the use of co-management models for MPA, there are new needs to build capacity in other stakeholders such as fishers and local communities.

Stakeholders' interactions are improved when each can appreciate each other's use of the MPA, and understand the ecosystem, the fisheries, the socio-economic constraints, etc. With the increasing number and broadening range of stakeholders, the potential differences in ability to participate in management also increase. Management agencies need to facilitate capacity building to empower all stakeholders to effectively play their role in the management of the MPA.

The Implementation of an ecosystem approach to fisheries and the use of MPAs as a fisheries management tool may involve changes in the responsibilities and priorities of management agencies and this might require appropriate training to staff affected by these changes. This might include enhancing knowledge and understanding of fisheries measures and objectives by MPA managers, and conservation and biodiversity considerations for fisheries officials.

Technical training in monitoring, evaluation and adaptive management is particularly helpful to local resource users and managers in developing countries and needs to be done on a regular basis. Training programmes and long term funding support need to be generated so that capacity can continue to be built in an inter-disciplinary way.

4.3 The legal and institutional frameworks

4.3.1 Enforcement

Illegal, unreported and unregulated (IUU) fishing is one of the most significant challenges to fisheries managers.

The experiences illustrated in the case studies above show that MPA offer an opportunity to reduce enforcement challenges, in cases where the stakeholder engagement is strong and particularly when enforcement is done by the local communities that benefit from the MPA.

Most large scale MPAs have particular challenges when it comes to control and surveillance functions to ensure compliance with the MPA regulations. This problem might require the use (and in certain cases development) of new and appropriate technologies such as vessel monitoring systems. The costs of such investment can be reduced when such measures are integrated in wider fisheries management tools required at a national/regional scale.

4.3.2 Harmonizing MPAs with other fisheries management legislation and existing legal frameworks

The choice of the legislation that would regulate the management of the future MPA is of crucial importance. The creation and management of an MPA, however, sometimes uses various existing pieces of legislation, each regulating one activity or use. In such cases, it is important to consider harmonization of these overlapping regulations.

The legislation(s) governing MPA management should also be easily amendable by additional arrangements without the involvement of too complex a legislative procedure in order to integrate the evolving management of existing and future human activities.

4.3.3 Institutional frameworks

The application of an ecosystem approach to fisheries implies a need for institutions to ensure coordination, consultation and cooperation, including joint decision-making, between fisheries management agencies and agencies managing other activities that might have interaction with Fisheries (FAO 2003).

One of the challenges will be promoting and strengthening synergies between fishery legislation and environment/conservation legislation. In many countries fisheries management responsibility is within one Ministry (e.g. of Agriculture) whereas environmental management with a more conservation/protection focus comes under another Ministry (e.g. Environment), although institutional responsibilities vary and sometimes overlap.

Ensuring coordination and consultative mechanisms between different agencies with relevant interests is essential and should be made in a formal manner. Ensuring transparency and dissemination of the information is also another important point that needs to be considered when establishing institutional frameworks.

Research that assesses the relative merits of different governance systems for MPAs in different cultural, political and socio-economic situations would be very useful for developing guidelines for legal frameworks for MPAs. On a regional scale, this could, for example, include examining the potential of inter-governmental commissions and similar governance units. The guidance proposed by FAO (2003) is a very useful first step that could be built upon to develop guidelines for legal frameworks for MPAs.

4.4 Sustaining MPA benefits

4.4.1 Monitoring and evaluation

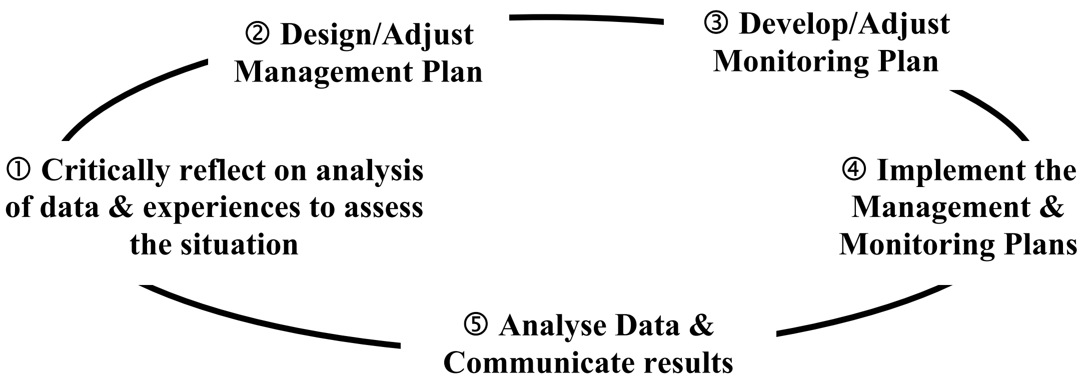
Careful monitoring of the fisheries and their associated bio-physical and socio-economic context in and around the MPA must be put in place. This needs to be done before and after MPA establishment if MPA effects are to be assessed, and the predominating gap in before-and-after change impact analysis (BACI) needs to be addressed (see Sweeting and Polunin 2005). The importance of monitoring and assessment is generally well recognized, although MPA managers often fail to seek suitable advice and expertise to put the right monitoring programme in place. A number of factors must be considered including resources, technical capacity and the long term sustainability of the programme, since the latter is crucial. For example, an MPA might be established with financial support from a particular donor. However, donors rarely want to fund long term monitoring programmes. Therefore such programmes need to be considered during financial sustainability assessments and built into local MPA budgets (often government funds), or supported through engaging with long-term partners, such as universities.

Choosing suitable indicators is integral to an effective monitoring programme. Indicators need to be specific to the objectives of the MPA, relevant to the resource managers, measurable (in terms of cost, logistics and replication), sensitive to change, and responsive within a reasonable time period (Pabari *et al.* 2005). Deciding on suitable indicators may require research (see Future Research section below), and certainly requires input from relevant experts.

4.4.2 Adaptive management

Although the concept of adaptive management is now well documented, it is regrettably still rare to find it being used properly. Adaptive management "*incorporates research into conservation action*. Specifically, *it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn"* (Salafsky *et al.* 2002).

Effective adaptive management requires managers to complete all steps in the cycle illustrated below (taken from Pabari *et al.* 2005):



This adaptive management cycle needs to be incorporated into the MPA management plan, supported by monitoring and data analysis. One of the steps that is often not given due consideration is critical reflection on the results of the data analysis. This should also involve consultation with stakeholders to verify interpretations of the results are plausible and practically applicable in the respective socio-economic context. In this way recommendations for management changes, where needed, are based on critical assessment and collaboration. Options for management change need to be a formal part of the MPA's management plan – e.g. to be reviewed every three years.

There is a need and demand for new innovative approaches to fisheries management and appropriate combinations of established tools and new approaches (FAO Code of Conduct 1995; FAO 2005). Continuously adaptive and participatory management processes with the broadest possible array of stakeholders will be needed to best assess and validate such approaches (Agardy *et al.* 2003; Carr and Raimondi 1999). This is even more important in the face of rapidly changing climate conditions that affect species compositions and habitats as well as fish stocks.

4.4.3 Financial sustainability

One of the major limitations in effective MPA implementation is sustaining funding in time. Funding mechanisms need to be set in place early in the design of an MPA, with long term sustainability in mind. Often, MPA plans are over-ambitious and consequently not realized due to inadequate funding. Priorities, for example for enforcement and monitoring, need to be considered and a regular source of funds identified. If this is through local or national government, the merits of the MPA often need to be justified. Management of fisheries and the link with peoples' livelihoods may be a better message to send to the government than biodiversity conservation alone.

Revenue generation, e.g. from fishing levies, cost sharing among stakeholders and other fund generating ideas, needs to be put in place at the start of the MPA. A wide range of funding options exists, and they will vary widely from country to country and between fisheries. Generally, three sources of funding are available: government, donors, and self-generating activities. The following mechanisms for financial sustainability can be considered: (i) cost effective implementation; (ii) revenue collection from use of the MPA and the ecosystem services it provides (fisheries, tourism, etc); (iii) equitable revenue sharing that reinforces local management efforts; (iv) precautionary instruments that provide safety nets; and (v) sharing of revenue between MPAs (Ruitenbeek *et al.* 2005).

4.5 Ecological considerations – some aspects

4.5.1 Habitat protection and restoration

It is logically evident, but often difficult to quantify the benefits that healthy (protected) habitats have for certain fisheries (Sweeting and Polunin 2005). MPAs which ban fishing gear with high impact on benthic features (such as towed gears) clearly protect seafloor habitats. A recent series of case study reviews from Northeast Atlantic temperate waters (DEFRA 2006) describe that area closures, if combined with effort removal, generally lead to increases in associated fauna, habitat complexity and increased survival in fish species. MPAs thus play a role in preventing damage by fishing gear especially to biogenic, slow growth-recovery habitats (as e.g. maerl beds, deepwater corals, sponge communities). In contrast, habitats subject to frequent natural disturbance are unlikely to benefit to the same extent.

4.5.2 Spawning and nursery site protection

MPAs can provide protection to vital breeding and nursery areas of important fishery species, and although these species may range well beyond the MPA boundaries, these critical life history stages remain protected at a time when they are particularly vulnerable and easy to exploit. The Mauritania and Australia case studies illustrate these benefits. Other examples include the protection of spawning aggregation sites. Many species migrate predictably to certain sites where they congregate in large numbers to spawn. Protection of these sites is vital, particularly if the species is subjected to heavy commercial fishing pressure (Sadovy and Domeier 2005). The Nassau grouper, *Epinephelus striatus,* in the Caribbean provides a clear example of this. The species was fished to the brink of extinction because spawning aggregations were specifically targeted by commercial fisheries (Sadovy 1993). Eventually several fisheries collapsed. Some have never recovered, such as those in Cuba and Bermuda, while others have only very recently been protected, such as in Belize. In the Cayman Islands, management has been in place for a number of years and the aggregations although reduced, still exist (Sadovy 1999). The existence of spawning aggregation sites needs to be determined early in the establishment of the MPA so that zoning of the MPA can take these sites into consideration.

4.5.3 Impact on biodiversity and fisheries

In general, several studies confirm that the establishment of Marine Protected Areas has led to increases in density, biomass, individual size, and diversity in nearly all fish functional groups (Halpern 2003). Various studies in Mediterranean MPAs attest to higher abundances of the most vulnerable fished species in comparison with adjacent fished areas, a greater total number of individual fishes in general, and fish of greater average sizes in the MPA than outside it (Francour *et al.* 2001).

MPA establishment can also lead to a “cascade effect”, as the protection regulations can lead to increases in top-predator populations (often target fisheries resources) provoking changes in predation interactions involving species at different trophic levels (Steneck 1998). The cascade effect as a direct consequence of protection was first proposed for a Chilean MPA (Moreno *et al.* 1984).

Marine reserves or MPAs generally aim to increase biodiversity or enhance a fisheries resource by removing or reducing exploitation pressure. One should not expect increases in all species following reserve designation, as each species’ response depends on various factors such as the level of exploitation, life-history characteristics, potential for replenishment from surrounding areas, and abundance of predators and prey. Pinnegard *et al.* (2000) reviewed research at 21 MPAs, and documented 39 cases of “trophic cascades”, in which the presence of primary carnivores had suppressed herbivores, and so increasing plant abundance.

The ecological interactions that play out within an MPA (and in relation with its surroundings) can yield unexpected results, and need to be taken into account when designing the MPA and setting its management options.

In summary, it is recommended that these technical guidelines for using MPAs are combined with the information gained from tracking the benefits of MPAs for different fisheries (see below) into a Toolkit for using MPAs for fisheries management. Such a Toolkit would provide fisheries managers with a hands-on reference tool with clear steps, guidelines, reference sources and contacts. A similar Toolkit has been developed for MPA managers in the Western Indian Ocean (IUCN 2004), but this encompasses all aspects of MPAs. Having a Toolkit that addresses fisheries specifically could be a very useful tool.

4.6 Future directions in MPA research

4.6.1 Indicators for MPA success

It is critical that indicators for measuring the effectiveness of MPAs as a fishery management tool are developed, and these have to be based on empirical assessment. Criteria for selecting suitable indicators are discussed in the section above. All too frequently inappropriate indicators are selected and the opportunity to monitor MPA impacts will be lost. Small scale, multi-species fisheries with multiple gear/vessel types and landing sites, typical of tropical coastal waters in developing countries (Munro and Williams 1985; Wright and Hill 1993), are particularly hard to measure precisely and therefore need to be very carefully tested to detect MPA effects for these types of fisheries. It is highly recommended as a first step that a global meta-analysis of datasets around the world on priority fisheries be conducted to determine suitable indicators. These can then be tested as new MPAs are established and trialed for particular fisheries.

In addition to developing suitable indicators based on sound science, monitoring design and data analysis protocols need to be defined for MPAs and associated fisheries. Often monitoring occurs, but data analysis is limited or absent. Analysis, evaluation and adaptive management cycles need to be put in place and this can be challenging where resources and capacity are limited (but see Pabari *et al.* 2005). Research that addresses these gaps would be extremely useful and the protocols developed could be incorporated in a Toolkit for MPA fisheries management (see section above on guidelines).

4.6.2 Track the benefits of MPAs for different species/fisheries worldwide

It would be hugely beneficial if an organization such as FAO were to track and analyze fisheries management successes over a period of time, say for the next five years, and to record where MPAs have been used, and to what extent, in conjunction with other fisheries management tools. This could be assimilated into a database of information from which fishery or species specific recommendations could be derived. For example, if demersal coral reef fisheries around the world are seen to be more sustainable when MPAs are involved, then one can recommend MPAs as one key tool for the management of such fisheries. Where MPAs show no benefits to a specific fishery after thorough checking, emphasis needs to be put on more suitable fisheries management tools instead. The database would enable the relative merits of MPAs for managing pelagic fisheries to be assessed, and ultimately could determine criteria for fisheries that are best suited to be covered by area-based management.

4.6.3 Fisheries models

Incorporating area-based input controls (MPAs) into fisheries models will give fisheries researchers the opportunity to assess the relative merits of MPAs among the suite of tools employed in managing a fishery. This approach has started (CEFAS 2005; Guénette *et al.* 1998; Stefansson and Rosenberg 2005) but needs to expand to cover the wide range of fisheries being managed by MPAs. Such models can quantify the merits of different fishery management options and these can then be presented to fishers and the options discussed. For example, it may transpire that for a particular fishery, an area restriction or closure is in fact less restrictive to a fisher than an effort or gear control throughout the fisher's range of operation. Although either option may be sufficient for sound fishery management, the area restriction may suit the fisher better, and without the model such scenarios may not have been apparent.

Scientific uncertainty and a persisting lack of empirical data on larger, mobile marine organisms in the open ocean is another constraint. Some fish stocks may be too mobile for site-specific approaches (Kenchington *et al.* 2003). Yet the applicability of area-based ecosystem management in the open ocean context is beginning to take hold, particularly as scientists are learning more about the importance of ocean 'hotspots' such as convergence zones and above benthic features like seamounts. Norse *et al.* (2005) note that a modelling study of Mediterranean hake (*Merluccius merluccius*) led Apostolaki *et al.* (2002) to conclude that "yield and spawning stock biomass benefits can be obtained through the use of a marine reserve even for highly mobile fish and underexploited fisheries." Wherever the mobility of adults is high, reserves have often been discounted as an effective management tool in the past. But even for highly migratory species such as swordfish or tunas, MPAs that protect nursery areas or vulnerable population bottlenecks may be effective management tools (NRC 2001). Such modelling approaches need to be continued to assess the applicability of MPAs for highly mobile species.

Models can furthermore usefully assess the case-to-case applicability of new MPA approaches such as vertical zoning schemes of an MPA, and the benthic-pelagic coupling to determine the most suitable form of zoning. So far, there are MPAs which only cover the seabed (determined useful for e.g. hot vents and cold seeps), while other MPAs apply a vertical 'buffer zone' to include the above water column in the protection scheme. Designating vertical MPA categories, such as applied in Tasmanian seamount reserves (FIGURE 1; AXYS 2003), thus needs to consider not only the seamount habitat itself, but also some migratory pelagic species of commercial value that tend to congregate above them. Given the likeliness that more vertically zoned MPAs may be established within the coming years, it is thus necessary that the benthic-pelagic coupling of the specific feature is studied in detail and that the zoning structure be adapted to the results from these studies.

4.6.4 Assessing suitability of MPAs for different fisheries

The effectiveness of MPAs for the large number of fisheries that have not yet employed area based controls such as various cold water/deep water demersal fisheries, open water pelagic fisheries, fisheries based on highly migratory species and others, needs to be properly assessed (FAO 2005; Hilborn *et al.* 2003; Kaiser 2004; McManus 2004; Agardy *et al.* 2003; Lubchenco *et al.* 2003; Jones 2002).

Research directed at assessing MPA effectiveness for fisheries management requires (i) suitable designs before and after MPA implementation; (ii) adequate replication and controls, (iii) suitably sensitive indicators defined and tested; (iv) criteria for MPA success defined; and (v) long-term evaluations and monitoring. Practically, such research tends to use a suite of fishery variables as the MPA is implemented, and through analysis suitable indicators among the variables become apparent. Such indicators may range from female spawning biomass, average fish size, egg production, yield per recruit, etc. Indicators can inform researchers and managers whether the MPA is equally effective, less effective, or more effective than other conventional management options, and analyses will quantify the relative merits of different management options. It is only through this sort of rigorous research and analysis that we will know how useful MPAs are across the broad spectrum of fisheries. Models are particularly useful for examining various scenarios, and varying the different management options including MPA type and size (e.g. Atlantic cod, Polachek 1990; prawns, Die and Watson 1992; reef fishes, DeMartini 1993; surf zone South African Fishes, Attwood and Bennett 1995).

For those fisheries that are relatively well understood in an MPA context, such as coral reef fisheries, there are still several gaps. The link between MPAs and improved livelihoods of coastal people dependent on marine resources is an area that requires quantification. Research is also needed to assess MPAs for tropical fisheries of other ecosystems such as seagrass beds and sand/mud substrates.

An ecosystem based research approach is also needed to understand the broader ecological impacts of fishing (see COMPASS 2004; Murawski 2000) in order to assess if and how various MPA types can be used to control negative habitat impacts from fishing. Another area that requires research is MPA size. Several modelling and fish movement studies have asked this question, though certainly not across the spectrum of fisheries, and the answers are likely to be fishery or species specific. This research should not only consider ecological factors but also social factors and the behaviour of fishers or the dynamics of the fleet.

4.6.5 Legal frameworks

It would be very useful to assess the relative merits of different governance systems for MPAs in different cultural, political and socio-economic situations. A global analysis might reveal interesting models from which guidelines for suitable, integrated legal frameworks for MPAs and fisheries management tools could be developed in particular contexts.

4.6.6 Addressing financial constraints

Availability of financial resources also remains a constraint for inventorying, managing and monitoring the effectiveness of MPAs to meet fisheries objectives. Some argue that the amounts needed to achieve major marine conservation goals worldwide are less than what is spent on fishing subsidies and would have profitable returns (Balmford *et al.* 2004). Economic valuation of marine ecosystems to date has focused almost entirely on easily quantifiable terms such as commercial fisheries and tourism. It is increasingly recognized that additional aspects need to be considered, such as exploitation of corals, mangroves and shells, 'ecosystem services', possible future uses, and values irrespective of use (cultural, aesthetic, scientific, bequest and heritage significance) (Salm *et al.* 2000). Further research along these lines could support identification and definition of the role of MPAs, and in turn identify sources of funding for MPAs.

4.6.7 Socio-economic impacts

Socio-economic studies of MPAs lag behind the biological and natural resource studies. MPAs, particularly as a fisheries management tool, would be more robust and effectively managed if their design could address in some ways the driving forces for over-exploitation of the resources. More studies on the socio-economic aspects of MPA could also help set incentives for their establishment and compliance with the regulations.

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ANNEX I: TABLES AND FIGURES

Table 2. Overview of the selected case studies and their key characteristics. Cases were selected to cover a wide range of different ecosystems, fisheries and reserve types, and come from varying socio-economic and institutional contexts.

Case Study	Location	Region	Ecosystem Type	Fisheries Type	Reserve Type	IUCN Category	Socio-econ Context'	Instit. Responsibility
A	**Channel Islands, California, USA**	North America	Temperate Coastal and Deeper Waters	Commercial, Recreational	Marine Reserves in State Waters	I	Multiple users across scales, science-based consensus-finding	Variety of state and federal jurisdictions, U.S. Coast Guard
B	**Tanga, Tanzania**	Eastern Africa	Tropical Coral Reef	Small-scale artisanal subsistence	Collaborative Management Areas	/=	Development from village-owned to user-based approach	Govt, Local Communities
C	**Banc d'Arguin, Mauritania**	West Africa	Coastal waters near upwelling area	Small-scale artisanal (formerly subsistence), Industrial	National Park, Ramsar and World Heritage Site	II	Resident population of trad. fishers, external fishing pressures	Park authority, Government (PM), (national research institute)
D	**Great Barrier Reef, Australia**	Oceania	Tropical to Temperate Coastal Waters	Recreational + Commercial	Large-scale, Zoned Multiple-use MPA	I - VI	Public, multiple user based approach	Government
E	**Nearshore Coastline, Chile**	Latin America	Upwelling Continental Shelf	Artisanal + Commercial	Areas for Management and Exploitation of Benthic Resources	VI	User-based exploitation system, govt supported	Fisher's associations, Govt, CPPS
F	**Bohol, Philippines**	Southeast Asia	Tropical Coral Reef	Subsistence	Small Scale Community-based MPAs	VI	Village-owned (monitoring) approach	Local Communities
G	**Antarctica, incl. high seas**	Antarctica	Polar Ocean	Commercial, Industrial	ASPA, ASMA, CCAMLR Closed Areas, Small-scale Research and Mgt. Units	I - IV	High seas areas of international use	Reg. Fish. Mgt. Organisation, Antarctic Treaty & Env. Protection Protocol

Table 3a. Main features of closed reefs in Tanga region. *Italics = reefs that are no longer closed*

Collaborative Management Area Name	Closure Area Name	Area km^2	Percentage of total CMA	Date closed	Date opened	Length of closure	Planned length of closure
Boma-Mahandakini	Bunju	2.0	1.4%	2001		4y	8y
Deep Sea Boma	Chundo/ Kiroba	10.0	2.7%	2000		5y	5y, but reviewed every 2y
Mwarongo-Sahare	Kipwani	1.5	0.8%	2000		5y	Reviewed every 2y
Mtang'ata	*Kitanga*	1.0		*1997*	*1998*	1yr	
	Upangu	4.25		*1997*	*1998*	1 yr	
	Makome (Kigombe)	2.5	4.7%	2001		4y	5y, but reviewed every 2y
	Shenguwe	2.0		2001		4y	5y, but reviewed every 2y
Boza-Sange	Dambwe	5.5	2.5%	1998		7y	Permanent, but reviewed at intervals
Mkwaja	Maziwe	4.5		1975		20y	Permanent
	Fungu Buyuni			2005			Permanent

Table 3b. Annual Estimates of Catch/Value by District in Tanga region, 2002-2004 (*source: Anderson 2004*).

District	Year	Annual Estimate of Catch (MT)	Annual Estimate of Value (Tsh)	Annual Estimate of Value (USD*)
Muheza	2002	1 016	527 192 239	483 663
Muheza	2003	639	377 365 104	346 207
Muheza	2004	676	481 237 536	441 502
Pangani	2002	1 760	579 271 330	531 442
Pangani	2003	1 329	426 303 171	391 104
Pangani	2004	941	344 601 172	316 148
Tanga	2002	4 190	2 365 675 317	2 170 344
Tanga	2003	5 912	2 514 534 532	2 306 912
Tanga	2004	4 571	1 767 872 393	1 612 901
Total	2002	6 966	3 472 138 886	3 185 448
Total	2003	7 880	3 318 202 807	3 044 222
Total	2004	6 188	2 593 711 101	2 379 551

*Tsh1090:1USD

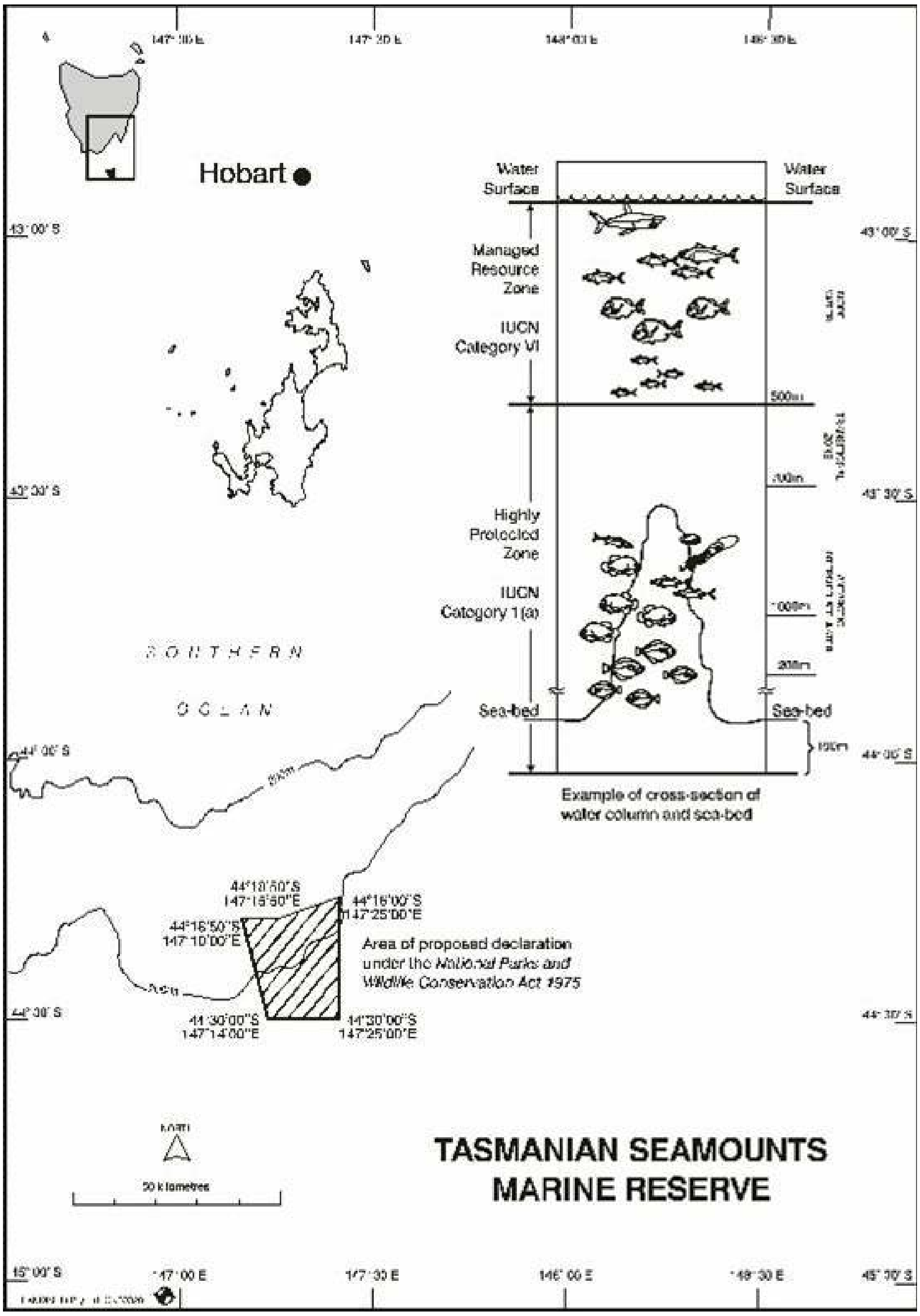


Figure 1. Tasmanian Seamounts Marine Reserve showing reserve location and vertical zoning by IUCN category.

Source: Environment Australia – Department of Environment and Heritage (http://www.pac.dfo-mpo.gc.ca/oceans/Bowie/bowie_appx_m%20(tasmn)_e.htm)

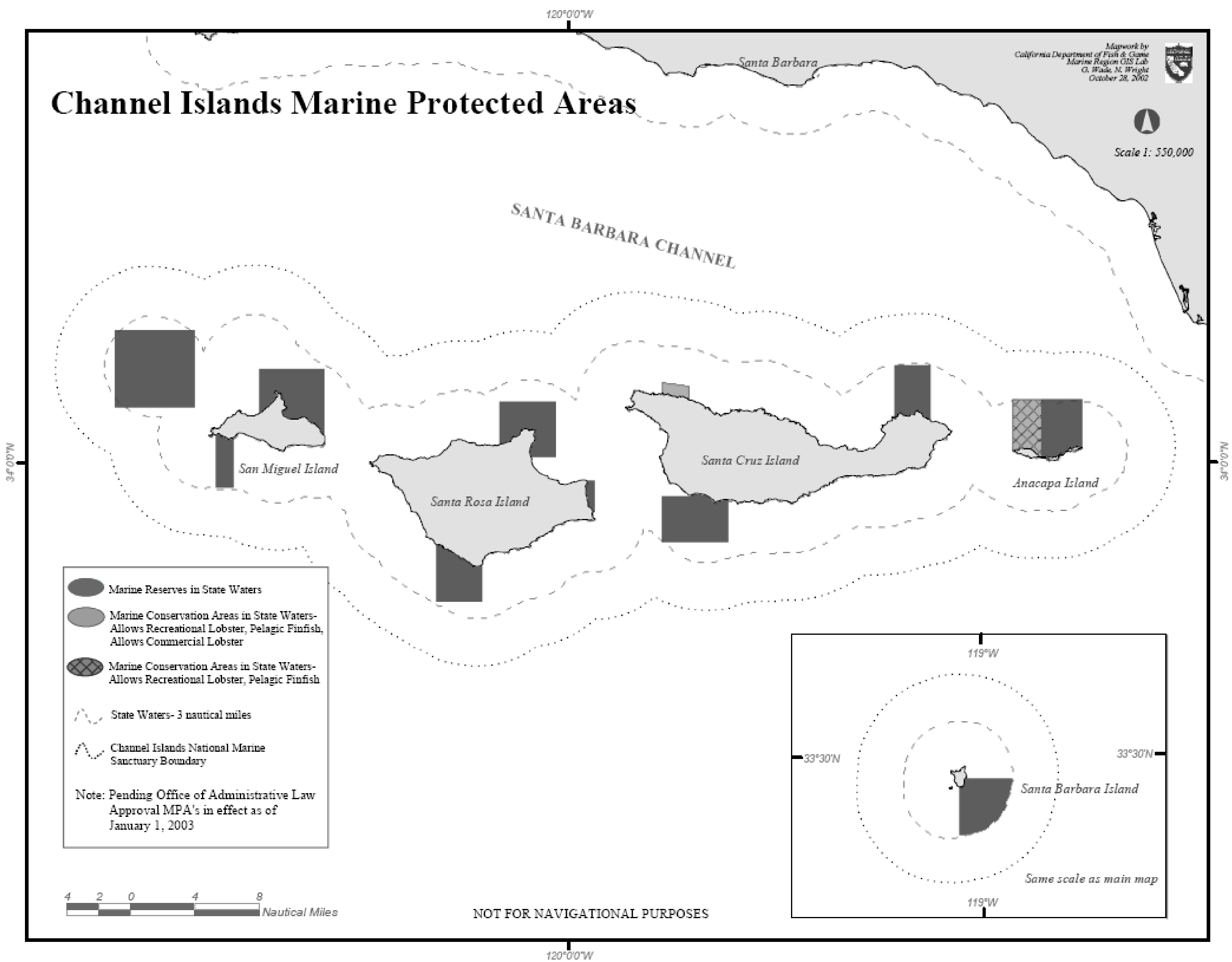


Figure 2. Map of the Channel Islands Marine Protected Areas.
Source: California Department for Fish and Game, Marine Region(http://www.dfg.ca.gov/mrd/channel_islands/index.html

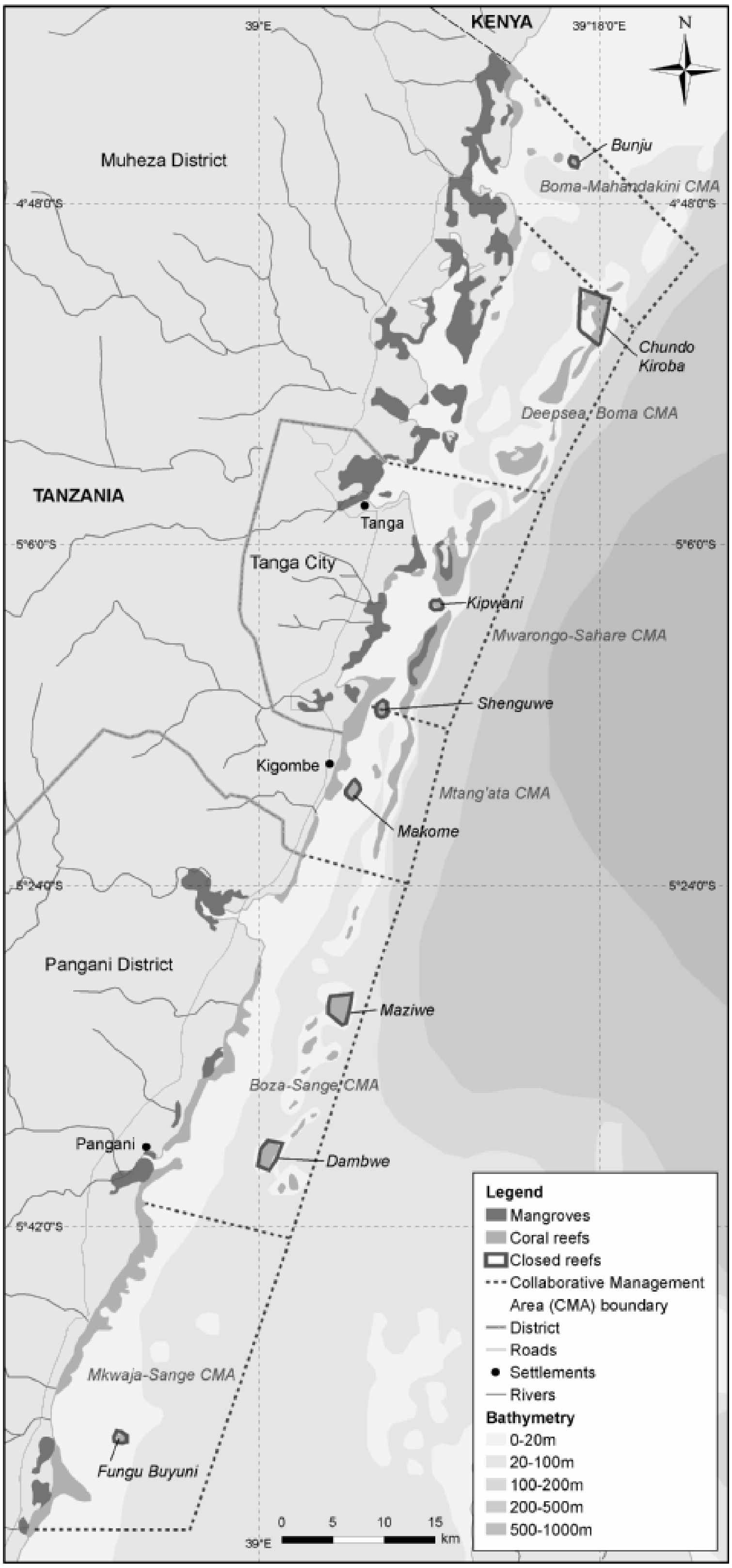
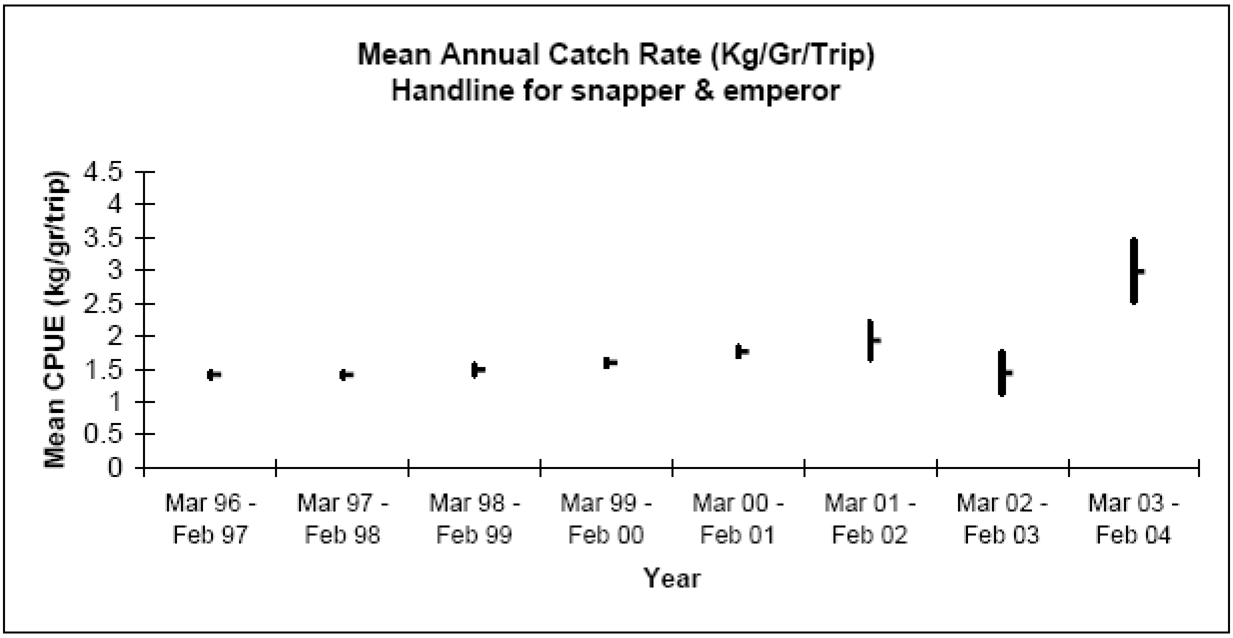


Figure 3. Map of the Tanga Collaborative Management Areas and key ecosystem and socio-economic features.



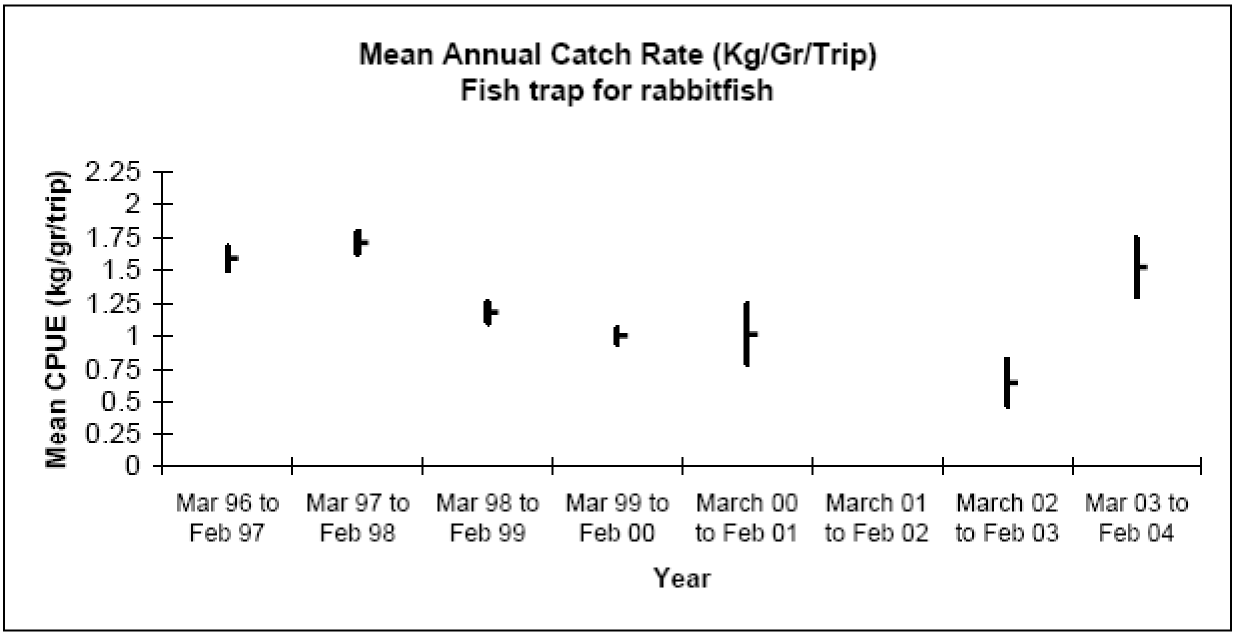


Figure 4a/b. Annual catch rates of the hook and line fishery for snapper and emperor and mean annual catch rate (CPUE) for rabbitfish trap fishery in Tanga.

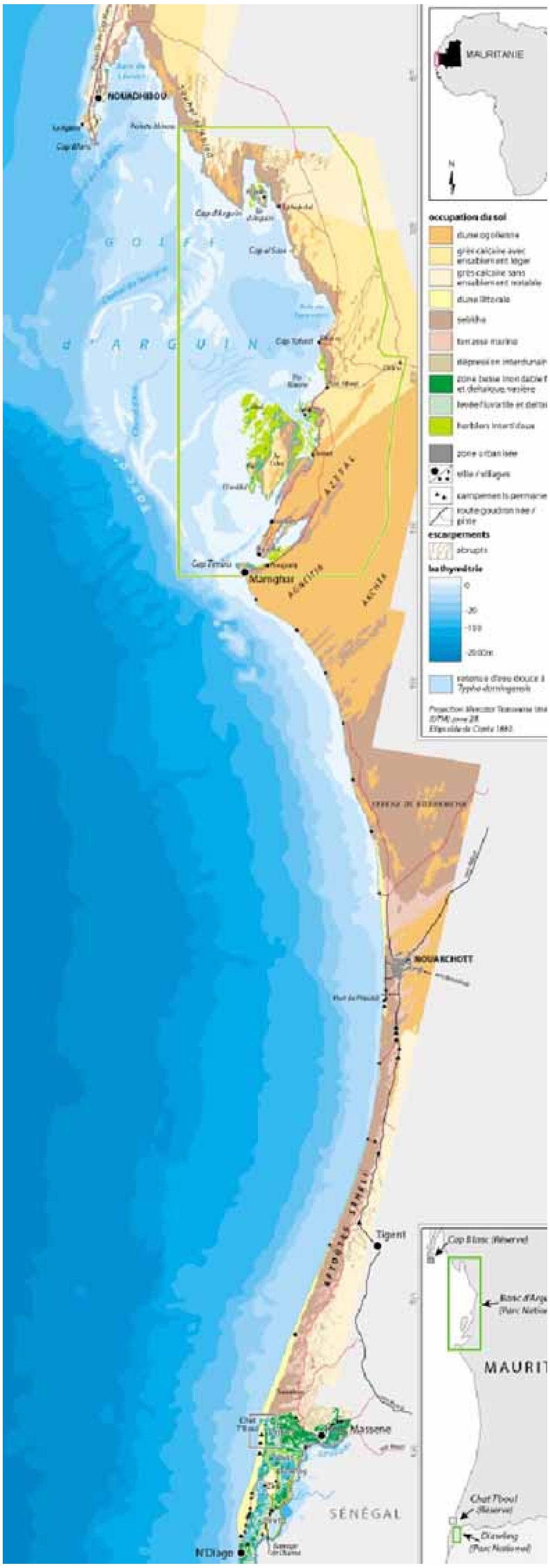


Figure 5. **Mauritanian coastline with the main ecological habitat and socio-economic features. The boundaries of the Park National du Banc d'Arguin are indicated by the fine green line.**

Source: Projet PALM, Programme Régional Côtier et Marin de l'Afrique de l'Ouest.

Figure 6. Great Barrier Reef Marine Park zoned management areas, in 2005.

Source: Great Barrier Reef Marine Park Authority

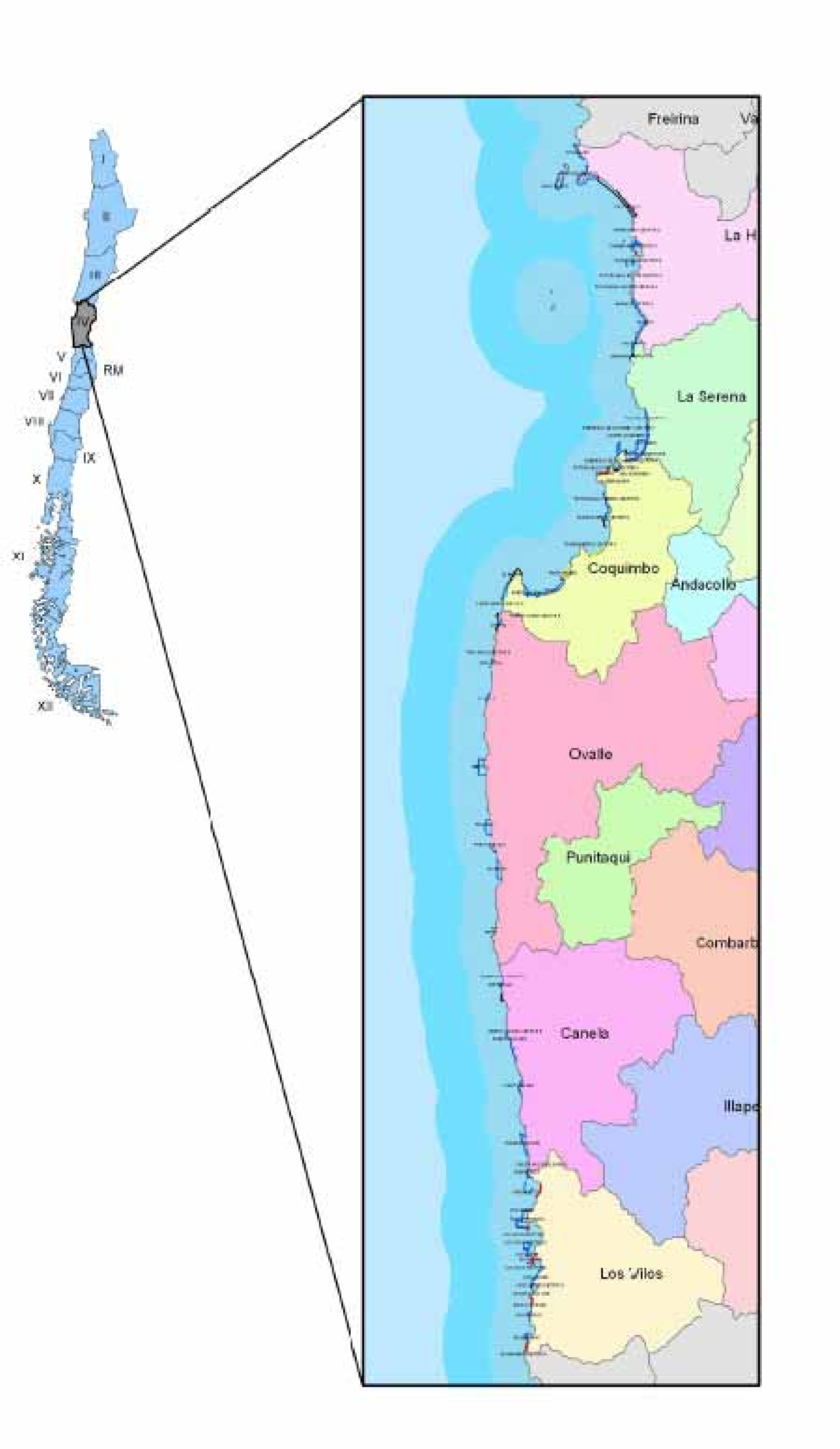


Figure 7. Location of AMEBR management areas in the IV region off the Chilean coastline, as per June 2005.

Source: Subpesca

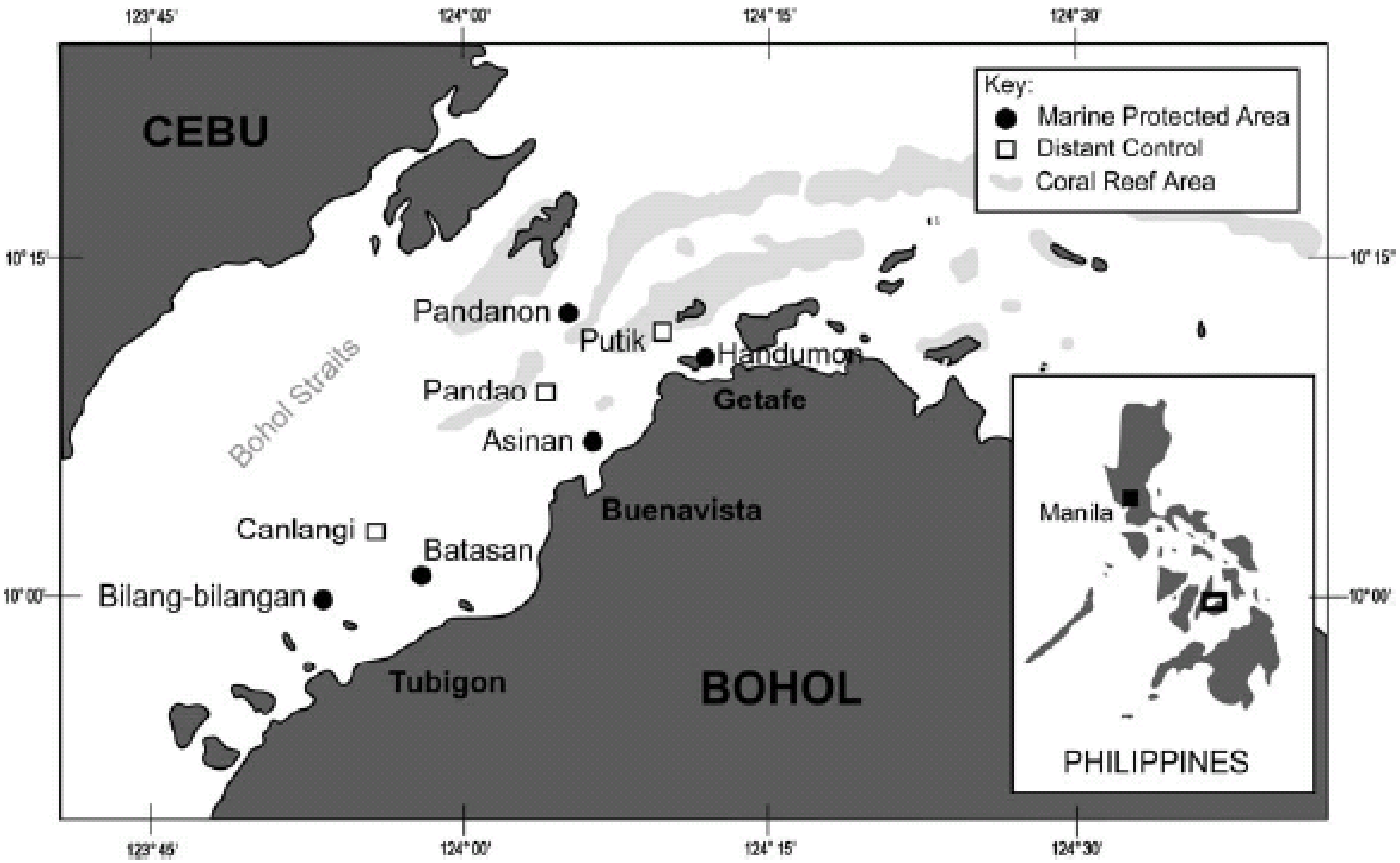


Figure 8. Map of Bohol, central Philippines, indicating location of reserve sites and municipalities.

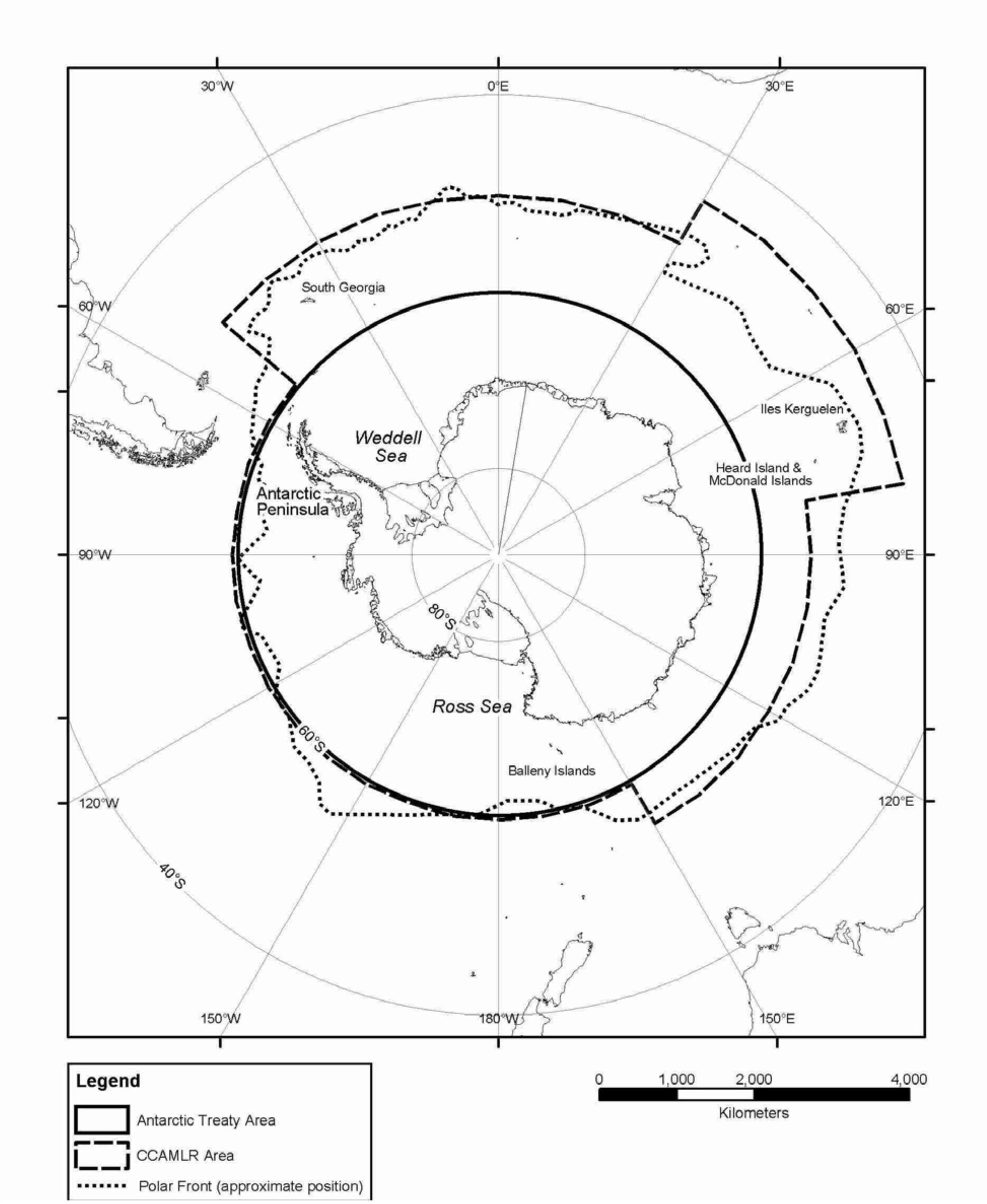


Figure 9. Map of Antarctica and the Southern Ocean showing the boundaries of the Antarctic Treaty Area and the CCAMLR Area, and the approximate position of the Polar Front.

Source: Susie Grant

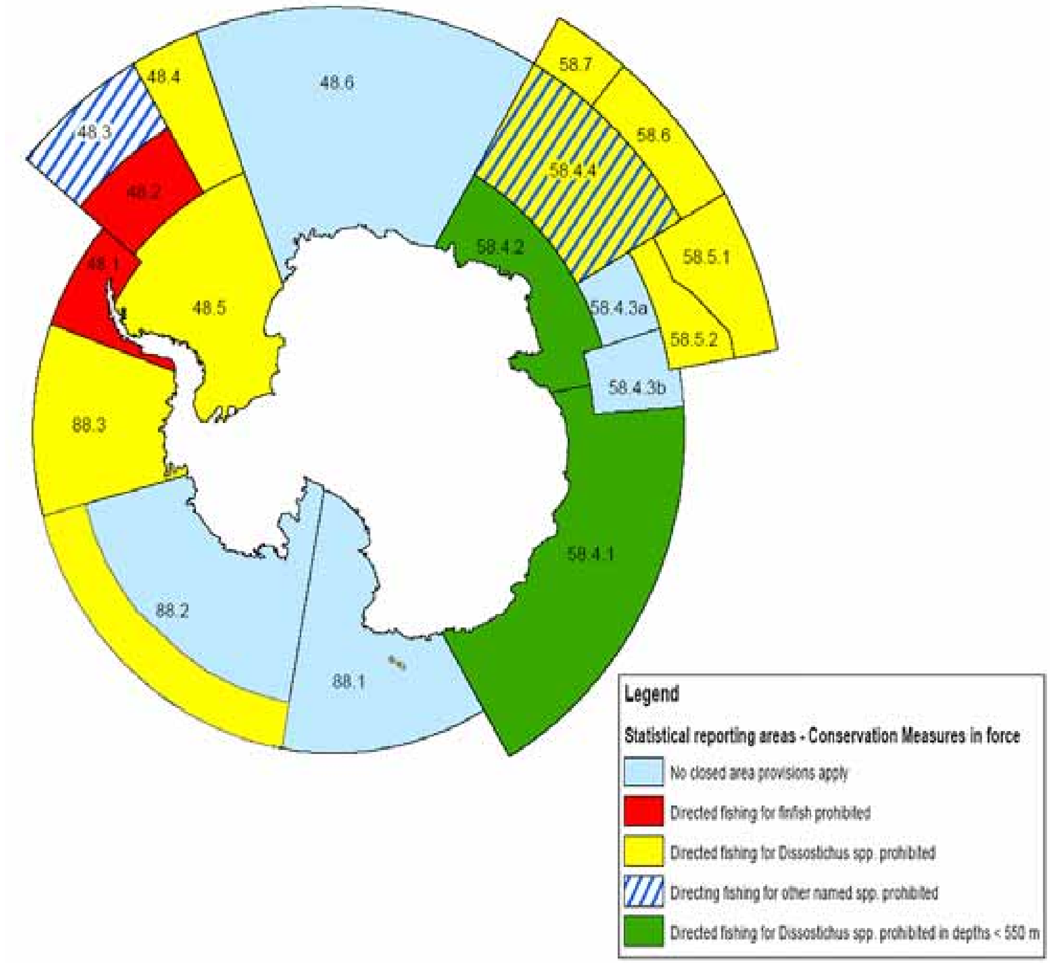


Figure 10. **Map of the Antarctic area-based conservation measures in place (statistical reporting areas).**

Source: Susie Grant

ANNEX 2: ABSTRACTS FROM REFERENCES LITERATURE

Agardy, T., Bridgewater, P., Crosby, MP., Day, J., Dayton, PK., Kenchington, R., Laffoley, D., McConney, P., Murray, PA., Parks, JE. & Peau, L. (2003) Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conservation: Marine & Freshwater Ecosystems* 13, 353-367.

1. While conservationists, resource managers, scientists and coastal planners have recognized the broad applicability of marine protected areas (MPAs), they are often implemented without a firm understanding of the conservation science} both ecological and socio-economic} underlying marine protection. The rush to implement MPAs has set the stage for paradoxical differences of opinions in the marine conservation community.
2. The enthusiastic prescription of simplistic solutions to marine conservation problems risks polarization of interests and ultimately threatens bona fide progress in marine conservation. The blanket assignment and advocacy of empirically unsubstantiated rules of thumb in marine protection creates potentially dangerous targets for conservation science.
3. Clarity of definition, systematic testing of assumptions, and adaptive application of diverse MPA management approaches are needed so that the appropriate mix of various management tools can be utilized, depending upon specific goals and conditions. Scientists have a professional and ethical duty to map out those paths that are most likely to lead to improved resource management and understanding of the natural world, including the human element, whether or not they are convenient, politically correct or publicly magnetic.
4. The use of MPAs as a vehicle for promoting long-term conservation and sustainable use of marine biodiversity is in need of focus, and both philosophical and applied tune ups. A new paradigm arising out of integrated, multi-disciplinary science, management and education/outreach efforts must be adopted to help promote flexible, diverse and effective MPA management strategies. Given scientific uncertainties, MPAs should be designed so one can learn from their application and adjust their management strategies as needed, in the true spirit of adaptive management.
5. It is critical for the conservation community to examine why honest differences of opinion regarding MPAs have emerged, and recognize that inflexible attitudes and positions are potentially dangerous. We therefore discuss several questions } heretofore taken as implicit assumptions: (a) what are MPAs, (b) what purpose do MPAs serve, (c) are no-take MPAs the only legitimate MPAs, (d) should a single closed area target be set for all MPAs, and (e) how should policymakers and conservation communities deal with scientific uncertainty?

Allison, G.W.; Lubchenco, J. & Carr, MH. (1998) Marine reserves are necessary but not sufficient for marine conservation. *Ecological Applications* 8, S879-S892.

The intensity of human pressure on marine systems has lead to the push for stronger marine conservation efforts. Recently, marine reserves have become one highly advocated form of marine conservation and the number of newly designated reserves has increased dramatically. Reserves will be essential for conservation efforts because they can provide unique protection for critical areas, they can provide a spatial escape for intensely exploited species, and they can potentially act as buffers against some management miscalculations and unforeseen or unusual conditions. Reserve design and effectiveness can be dramatically improved by better use of existing scientific understanding. Reserves are insufficient protection alone, however, because they are not isolated from all critical impacts. Communities residing within marine reserves are strongly influenced by the highly variable conditions of the water masses that continuously flow through them. To a much greater degree than in terrestrial systems, the scales of fundamental processes, such as population replenishment, are often much larger than reserves can encompass. Further, for some important threats, such as contamination by chemicals, they offer no protection. Therefore, without adequate protection of species and ecosystems outside reserves, effectiveness of reserves will be severely compromised. We outline conditions under which reserves are likely to be effective, provide some guidelines to increase their conservation potential, and suggest some research priorities to fill critical information gaps. We strongly support vastly increasing the number and size of marine reserves; at the same time, strong conservation efforts outside reserves must complement this effort. To date, most reserve design and site selection has involved little scientific justification. It must begin to do so to increase the likelihood of attaining their conservation objectives.

Attwood, C.G. & Bennett, B.A. (1995) Modelling the effect of marine reserves on the recreational shore-fishery of the south-western Cape, South Africa. *S. Afr. J. Mar. Sci.* 16, 227-240.
Abstract not available

AXYS Environmental Consulting Ltd. (2003) Management direction for the Bowie seamount MPA: links between conservation, research, and fishing. Report prepared for WWF Canada, Pacific Region, 72 pp.
Abstract not available

Balmford, B.; Gravestock, P; Hockley, N.; McClean, C. & Roberts, C.M. (2004) The worldwide costs of marine protected areas. *Proceedings of the National Academy of Sciences* 101, 9694-9697.
Declines in marine harvests, wildlife, and habitats have prompted calls at both the 2002 World Summit on Sustainable Development and the 2003 World Parks Congress for the establishment of a global system of marine protected areas (MPAs). MPAs that restrict fishing and other human activities conserve habitats and populations and, by exporting biomass, may sustain or increase yields of nearby fisheries. Here we provide an estimate of the costs of a global MPA network, based on a survey of the running costs of 83 MPAs worldwide. Annual running costs per unit area spanned six orders of magnitude, and were higher in MPAs that were smaller, closer to coasts, and in high-cost, developed countries. Models extrapolating these findings suggest that a global MPA network meeting the World Parks Congress target of conserving 20–30% of the world's seas might cost between $5 billion and $19 billion annually to run and would probably create around one million jobs. Although substantial, gross network costs are less than current government expenditures on harmful subsidies to industrial fisheries. They also ignore potential private gains from improved fisheries and tourism and are dwarfed by likely social gains from increasing the sustainability of fisheries and securing vital ecosystem services.

Barros, R. & Aranguez, R. (1993) La Experiencia de los Pescadores Artesanales de Caleta Quintay en el Manejo de Recurso Bentónicos, in Escuela de Ciencias del Mar, Universidad Católica de Valparaíso y Servicio Nacional de Pesca (eds) Taller Áreas de Manejo, Valparaíso, Chile.
Abstract not available

Bernstein, B.; Iudicello, S.; & Stringer, C. (2004) Lessons learned from recent marine protected area designations in the United States. A Report to the National Marine Protected Areas Center NOAA by the National Fisheries Conservation Center. http://www.mpa.gov/information_tools/lessons_learned_table.html
In the United States and around the globe, governmental agencies use marine protected areas (MPAs) as a tool to manage human impacts in ecologically and culturally sensitive areas. Defined in the U.S. as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (E.O. 13158, Federal Register, 2000), MPAs are designated through various processes that attempt – some more successfully than others – to merge the prerogatives of often disparate stakeholder groups with the physical needs of complex ecological systems.
This report is a study of six separate and distinct efforts to designate MPAs in the United States. Based on the assumption that within their unique details lie lessons that can be broadly applied to other efforts, the case studies were carefully selected to represent diverse geographic areas and a spectrum of social, political, and ecological complexity. The assumption was correct. Through review of the written record and numerous interviews with those intimately involved in and affected by the six MPA designation processes, patterns emerged that formed the basis for important, broadly applicable lessons.

The six case studies that form the analytical basis of this report, illustrated in Figure 1, are:

- •The attempt to designate a National Marine Sanctuary in the Northwest Straits and the related establishment of Bottomfish Recovery Zones in San Juan County, Washington
- • The designation of the Channel Islands Marine Reserves off the Coast of Santa Barbara, California
- • Phase I of the establishment of marine reserves under California's state-wide Marine Life Protection Act:
- • The creation of the Tortugas Ecological Reserve in the Florida Keys
- • Grouper Closures off the coast of Florida in the Gulf of Mexico
- • The establishment of the Carl N. Schuster Horseshoe Crab Reserve in Delaware Bay.

Bohnsack, JA. (1998) Application of marine reserves to reef fisheries management. *Australian Journal of Ecology* 23, 298-304.

Establishing permanent 'no-take' marine reserves, areas where fishing and all other extractive activities are prohibited, is an attractive but under-utilized tool for fisheries management. Marine reserves could potentially deal with many fishery problems that are not effectively addressed by other traditional management measures; they also offer numerous social, economic, and scientific benefits not directly related to fisheries. Limited but growing research has shown beneficial biological and economic effects of marine reserves on fisheries. More research is needed, especially at larger scales, to determine the ideal marine reserve size, number and location necessary to optimize fisheries productivity and resource conservation. Sufficient evidence is available to justify the expanded use of marine reserves in an adaptive approach to fisheries management.

Castilla, J.C. (1996) The Chilean dived-invertebrate resources: Fishery, Collapses, Stock Rebuilding and the Role of Coastal Management Areas and National Parks. Second World Fisheries Congress, 28 July-2 August, Brisbaine, Australia.

Abstract not available

Castilla, J.C. (1999) Coastal marine communities: trends and perspectives from human exclusion experiments, *Trends in Ecology and Evolution* 14: 280-28.

Abstract not available

Castilla, J. C. & Fernández, M. (1999) Coastal marine community-ecosystem approaches in invertebrate multispecies management: "take" and "no-take" areas network and territorial use rights in fisheries (TURFs). In Proceedings of the "Norway/UN conference on the Ecosystem approach for sustainable use of biological diversity". Trondheim, Norway, 6-10 Sep. 1999. Pp.137-142.

Abstract not available

Carr, MH. & Raimondi, PT. (1999) Marine Protected Areas as a precautionary approach to management. *CalCOFI Rep* 40, 71-76.

Various sources of uncertainty have greatly impeded the effectiveness of traditional fisheries management to assure acceptable levels of sustainability of fisheries and species populations. Marine protected areas are receiving increasing consideration and show potential as a means of contributing to the sustainability of populations and guarding against fishery failures. Marine protected areas take advantage of the open population structure that characterizes most exploited benthic marine species by considering the pelagic dispersal of propagules and the patchy distribution of benthic habitat. Because protected areas have only recently been considered for west coast fisheries, because poorly designed reserves may be useless and possibly detrimental, and because optimal design criteria are not yet understood, incorporating the evaluation of empirically derived design criteria into the final implementation of protected area networks (i.e., adaptive management) is the only prudent approach.

Carr, MH. (2000) MPAs: challenges and opportunities for understanding and conserving coastal marine ecosystems. *Environmental conservation* 27, 106-109.

The term 'marine protected area' (MPA) refers to areas in which human activities that cause reductions in populations either directly through exploitation or indirectly through habitat alteration are eliminated or greatly reduced. This spatially explicit approach to managing human impacts has many potential ecological and socio-economic benefits that can alleviate some of the problems fundamental to conventional management practices and can therefore complement, but is unlikely to supplant, the conventional practices (Allison *et al*. 1998; Bohnsack 1998, Lauck *et al*. 1998; Hastings & Botsford 1999; Murray *et al*. 1999). Five reviews in this number of *Environmental Conservation* summarize the main issues relevant to MPAs in the Western Mediterranean, our understanding of their ecological and management consequences, and our knowledge of the ecological and socio-economic processes that determine their effectiveness for fisheries management and conservation (Badalamenti *et al*. 2000; García Charton *et al*. 2000; Pinnegar *et al*. 2000; Planes *et al*. 2000; Sánchez Lizaso *et al*. 2000). The reviews identify three issues of key importance to the development and success of MPAs for conservation and management. First, MPAs hold strong promise for management and conservation objectives, but the historical pattern of haphazard design, implementation, enforcement and evaluation has often produced equivocal and sometimes contradicting evidence for both their ecological effects and their effectiveness at achieving their intended objectives. Second, our understanding of many of the critical population and community processes that bear greatly on the consequences of this approach (e.g. dispersal, recruitment, direct and indirect effects of competition and predation) suffers from a lack of strong empirical studies and a comprehensive theoretical framework. Third, the global growth of interest in MPAs and concern for rapid development of organized systems of MPAs is great. Taken together, these three issues identify an urgent need for a well-developed theoretical framework, more rigorous empirical studies motivated and directed by theory, and actual implementation of systems of MPAs that will allow for proper evaluation and an evolution toward optimal design.

Centre for Environment, Fisheries & Aquaculture Science (CEFAS). 2005. *Investigations into closed area management of the North Sea cod*. Report for United Kingdom Department for Environment, Food and Rural Affairs SFCD15. 98 pp.

Executive summary see http://www.defra.gov.uk/fish/science/index.htm

Convention for the Conservation of Antarctic Marine Living Resources (CAMLR) (2004) SC-CAMLR-XXIII Report. CCAMLR: Hobart Australia, 680 pp.

Abstract not available

Communication Partnership for Science and Sea (COMPASS) (2004) Synthesis of marine reserve science as it relates to fisheries management. COMPASS, USA, 27 pp.

Marine reserves are being widely considered around the world as a tool to fulfil both conservation and fisheries management objectives. Although the use of reserves to achieve biodiversity and ecosystem conservation goals is widely accepted, their potential role in fisheries management is controversial. This controversy is embedded in and complicated by an emerging shift within fisheries management from a focus on single species and optimum yield to a more holistic, ecosystem-based approach to fisheries management (Botsford et al. 1997, NMFS 1999, NRC 1999, Link 2002).

This paper synthesizes existing information from the natural sciences about marine reserves to inform a discussion about whether and how marine reserve science can be incorporated into fisheries management. It is intended solely to provide background data for this conference, without drawing conclusions about any areas of scientific disagreement. Thus, this paper narrowly focuses on scientific aspects of the possible roles of marine reserves in fisheries management by reviewing the following topics:

1. Definitions – What are marine reserves and how do they differ from other forms of area-based management?
2. Empirical evidence – What is known about marine reserve performance?
3. Theoretical insights – What can be inferred about marine reserve performance, especially in contrast with conventional methods of effort control, based on modelling studies?

4. Design considerations – Generally, what is known regarding design criteria for marine reserves?
5. Scientific uncertainties – What types of uncertainty can be addressed by new research and what are some additional, inevitable uncertainties?
The information contained in this document summarizes key findings and the kinds of evidence that are available for assessing or predicting the effects of reserves on fisheries. The evidence is necessarily global in scope because the use of marine reserves and marine protected areas for fisheries management in US waters has been limited. For recent comprehensive reviews of the use of marine reserves and/or marine protected areas for fisheries, see Ward et al. 2001, Russ 2002, and Gell and Roberts 2003 (empirical studies) as well as Gerber et al. 2003 (theoretical studies).

7th Conference of Parties on the Convention of Biological Diversity (CBD COP 7) (2004) Thematic problems of work: Review, further elaboration and refinement of the elaborated programme of work on marine and coastal biodiversity. CBD COP 7, Kuala Lumpur, Malaysia, 44 pp.
1. The present document contains the elaborated programme of work on marine and coastal biological diversity, which has been produced in response to recommendations VIII/3 A-D of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). In recommendation VIII/3 A, SBSTTA stressed that the programme elements of the programme of work still corresponds to global priorities, and although much progress has been made, the programme of work has not yet been fully implemented. Therefore, SBSTTA recommended that the Conference of the Parties extend the time period of the programme of work by an additional six years, and that an elaboration of the programme of work be undertaken by the Executive Secretary in accordance with paragraph 2 of recommendation VIII/3 A for the consideration of the Conference of the Parties at its seventh meeting.

Department for Environment Food and Rural Affairs (2006) The potential role of Marine Protected Areas (MPAs) for fisheries management purposes: Fisheries Directorate's summary of the main conclusions emerging from three desk studies. 5 pp.
Abstract not available

DeMartini, E.E. 1993. Modeling the potential of fishery reserves for managing Pacific coral reef fishes. *Fish. Bull.* 91, 414-427.
Abstract not available

Die, D.J. & Watson, R.A. 1992. A per-recruit simulation model for evaluating spatial closures in an Australian penaeid fishery. *Aquat. Living Resour.* 5, 145-153.
Abstract not available

Fernandes, L. Day, J., Lewis, A., Slegers, S., Kerrigan, B., Breen, D., Cameron, D., Jago, B., Hall, J., Lowe, D., Innes, J., Tanzer, J., Chadwick, V., Thompson, L., Gorman, K., Simmons, M., Barnett, B., Sampson, K., De'ath, G., Mapstone, B., Marsh, H., Possingham, H., Ball, I., Ward, T., Dobbs, K., Aumend, J., Slater, D. and K. Stapleton (2005) Establishing representative no-take areas in the Great Barrier Reef: large-scale implementation of theory on marine protected areas. *Conservation Biology,* 1733–1744.
The Great Barrier Reef Marine Park, an area almost the size of Japan, has a new network of no-take areas that significantly improves the protection of biodiversity. The new marine park zoning implements, in a quantitative manner, many of the theoretical design principles discussed in the literature. For example, the new network of no-take areas has at least 20% protection per "bioregion," minimum levels of protection for all known habitats and special or unique features, and minimum sizes for no-take areas of at least 10 or 20 km across at the smallest diameter. Overall, more than 33% of the Great Barrier Reef Marine Park is now in no-take areas (previously 4.5%). The steps taken leading to this outcome were to clarify to the interested public why the existing level of protection was inadequate; detail the conservation objectives of establishing new notake areas; work with relevant and independent experts to define, and contribute to, the best scientific process to deliver on the objectives; describe the biodiversity (e.g., map bioregions); define operational principles needed to achieve the objectives; invite community input on all of the above; gather and layer the data gathered in round-

table discussions; report the degree of achievement of principles for various options of no-take areas; and determine how to address negative impacts. Some of the key success factors in this case have global relevance and include focusing initial communication on the problem to be addressed; applying the precautionary principle; using independent experts; facilitating input to decision making; conducting extensive and participatory consultation; having an existing marine park that encompassed much of the ecosystem; having legislative power under federal law; developing high-level support; ensuring agency priority and ownership; and being able to address the issue of displaced fishers.

FAO (1995) Code of conduct for responsible fisheries. FAO Fisheries Department. Rome, Italy, 41 pp.
Fisheries, including aquaculture, provide a vital source of food, employment, recreation, trade and economic well being for people throughout the world, both for present and future generations and should therefore be conducted in a responsible manner. This Code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code recognises the nutritional, economic, social, environmental and cultural importance of fisheries, and the interests of all those concerned with the fishery sector. The Code takes into account the biological characteristics of the resources and their environment and the interests of consumers and other users. States and all those involved in fisheries are encouraged to apply the Code and give effect to it.

FAO (1997) Technical guidelines for responsible fisheries. FAO, Rome, Italy, 82 pp.
These Guidelines have been produced to support the implementation of Article 7 of the Code of Conduct for Responsible Fisheries, with some reference to Article 12. They are addressed primarily to the decision-makers within fisheries management authorities and other interest groups, including fishing companies, fishers' organizations, concerned non-governmental organizations and others. The Guidelines provide a background to the need for fisheries management and an introduction to the activities encompassed by fisheries management. They introduce the major constraints experienced in fisheries and fisheries management and some of the fundamental concepts related to these. Biological, environmental, technological, socio-cultural and economic constraints and concepts are examined. Information is fundamental to responsible fisheries management and these Guidelines put emphasis on the range of data required for informed decision-making and examine aspects of the collection and interpretation of these data. Data are discussed in terms of three suggested scales in fisheries management: fisheries policy and development planning, formulation of management plans and implementation of management action. The range of possible management actions is outlined. This includes technical measures, such as gear restrictions, and more direct approaches in the form of direct catch limitation or effort limitation. The problems associated with open access fisheries are explained and comments made on the means to limit access and obstacles which may be encountered in this process. Finally, the Guidelines examine the management process. This section covers the process of agreeing on a management plan for a fishery, including the need for consultation and, where appropriate, cooperative decision-making. The need for periodic review of management plans is stressed. The importance of an effective legal framework, institutional and administrative structures and monitoring control and surveillance are described.

FAO (2003) Fisheries Report No. 699. FAO, Rome, Italy, 27 pp.
The Advisory Committee on Fisheries Research (ACFR) held its fourth session in Rome from 10 to 13 December 2002.
The Committee reviewed its achievements during its last three sessions; provided guidance for operationalizing the time-bound fisheries goals in the Plan of Implementation of the World Summit on Sustainable Development (WSSD) 2002; identified priority emerging issues of international character in fisheries and aquaculture; and elaborated the plan of work for the Committee (2003 - 2004).
As in the past, the Committee extended its deliberation to include the manner in which scientific research could contribute to the development of fisheries policies with particular emphasis on questions of food security and poverty alleviation. In this regard the Committee, *inter alia:*
Welcomed the attention and prominence given by WSSD 2002 to fisheries issues;

Provided detailed guidance on how to operationalize the time-bound goals in fisheries of WSSD 2002 in the context of responsible fisheries;
Recommended that FAO play a key facilitating role in support of national, regional and international efforts towards implementation of the planned targets of WSSD 2002 and indicated how this could be done;
Reiterated that small-scale fisheries had generally received less research attention relative to other sectors than merited by their relative contribution to nutrition, food security, sustainable livelihoods and poverty alleviation;
Welcomed the inclusion of small-scale fisheries as a stand-alone agenda item of the Twenty-fifth Session of COFI;
Recommended the establishment of an ACFR Working Party on Small-scale Marine Fisheries to elaborate a draft research agenda and undertake an evaluation of the role and importance of these fisheries and also outline ways in which the transition to responsible fisheries can be facilitated, bearing in mind the developing paradigm of the Ecosystem Approach to Fisheries (EAF);
Recommended that priority be given to case studies to determine the impacts of trade and trade measures (either liberation on trade barriers) on conservation and livelihoods, particularly for small-scale fisheries in developing countries;
Recognized that the goals of WSSD 2002 and the promotion of responsible fisheries management and sound aquaculture development were constrained by lack of appropriate human capacity to accommodate the new approaches to fisheries issues and fisheries management, and therefore designated the building of human capacity as its next “mega-priority cross-cutting issue”;
Recommended that the idea for the development of a human capacity building strategy for fisheries should be highlighted by the Fisheries Department at the Twenty-fifth Session of COFI and indicated the process by which such a strategy could be established.

FAO (a) Committee on Fisheries (FAO COFI) (2005) Marine Protected Areas and Fisheries. COFI/2005/8. FAO, Rome, Italy, 4 pp.

Protected areas (and reserves) in which extractive activities are strictly controlled (or banned) have been conventionally used for the protection of aquatic biodiversity, critical habitats, or endangered species. An increase of their use is foreseen as a consequence of their establishment and development being called for in the Convention for Biological Diversity and the World Summit on Sustainable Development (WSSD) plan of Implementation. Marine Protected Areas (MPAs) and reserves are also being advocated as a fisheries management instrument. MPAs have a number of potentially useful properties for fisheries but a number of limitations too have drawbacks if not properly designed. Experience on the impacts of MPAs in fisheries is still scarce but slowly building up. Their performance in relation to fisheries resources and livelihoods depends greatly on the type of resources requiring protection and the situation of the fisheries exploiting them. More experimentation is needed before definitive statements can be made about the potential role of MPAs in fisheries management under different circumstances. Experimental MPAs need to be established through a strongly participatory process involving the main stakeholders.

Garcia, SM. & Grainger, RJR. (2005) Gloom and doom? The future of marine capture fisheries. *Philosophical Transactions of the Royal Society* 360, 21-46.

Predicting global fisheries is a high-order challenge but predictions have been made and updates are needed. Past forecasts, present trends and perspectives of key parameters of the fisheries—including potential harvest, state of stocks, supply and demand, trade, fishing technology and governance—are reviewed in detail, as the basis for new forecasts and forecasting performance assessment. The future of marine capture fisheries will be conditioned by the political, social and economic evolution of the world within which they operate. Consequently, recent global scenarios for the future world are reviewed, with the emphasis on fisheries. The main driving forces (e.g. global economic development, demography, environment, public awareness, information technology, energy, ethics) including aquaculture are described. Outlooks are provided for each aspect of the fishery sector. The conclusion puts these elements in perspective and offers the authors’ personal interpretation of the possible future pathway of fisheries, the uncertainty about it and the still unanswered questions of direct relevance in shaping that future.

Garcia, SM. & Cochrane KL. (2005) The ecosystem approach to fisheries management. In: World Fisheries and Aquaculture Atlas, 3rd edition. FAO, Rome, Italy, 2005. [Z:\html\govern\capture\ecosysmng\default.htm]

Abstract not available

Gell, FR. & Roberts, CM. (2003) The fishery effects of marine reserves and fishery closures. WWF, Washington DC, USA, 90 pp.

Marine reserves, areas permanently closed to all fishing, are frequently proposed as a tool for managing fisheries. Fishery benefits claimed for reserves include increases in spawning stock size, animal body size, and reproductive output of exploited species. Reserves are predicted to augment catches through export of offspring to fishing grounds, and spillover of juveniles and adults from reserves to fisheries. Protection of stocks and development of extended age structures of populations in reserves are argued to offer insurance against environmental variability and management failure. Models also suggest reserves will reduce year-to-year variability in catches, and offer greater simplicity of management and enforcement. Reserves are predicted to lead to habitat recovery from fishing disturbance which can also enhance benefits to fisheries. Extensive field research confirms many of these predictions. Reserves worldwide have led to increases in abundance, body size, biomass and reproductive output of exploited species. Such measures often increase many times over, sometimes by an order of magnitude or more. Population build up is usually rapid with effects detectable within 2-3 years of protection. Increases are often sustained over extended periods, particularly for longer-lived species and for measures of habitat recovery. Reserves have benefited species from a wide taxonomic spectrum that covers most economically important taxa, including many species of fish, crustaceans, molluscs and echinoderms.

Encouraged by these results, many countries and states have embarked upon initiatives to establish networks of marine reserves. However, reserves remain highly controversial among fishers and fishing industry bodies who argue that fishery benefits remain unproven. In the last three years there has been rapid growth in the number of cases where fisheries have been shown to benefit from reserves. In this report, we critically analyze this body of evidence, drawing upon studies of reserves and fishery closures. Fishery managers have long used fishery closures, areas temporarily closed to fishing for one or more species or to specific fishing gears. They are employed to help rebuild depleted stocks, reduce gear conflicts, protect vulnerable life stages of exploited species or protect sensitive habitats from damaging gears. Such areas can tell us much about the potential effects of marine reserves.

Fishery benefits from reserves and fishery closures typically develop quickly, in most cases within five years of their creation. Perhaps the most persuasive evidence of fishery effects of reserves comes from changing fishing patterns. In most places where well-respected reserves or fishery closures exist, fishers tend to move their fishing activities closer to their boundaries. Fishing-the-line, as it is called, allows fishers to benefit from spillover of animals from reserves to fishing grounds. There are now well-documented cases of spillover from more than a dozen countries and including a wide range of species. It is more technically demanding to prove fishery enhancement through export of offspring on ocean currents. Existing reserves are generally small, making it hard to detect increased recruitment to fisheries at a regional scale. However, there are now several cases in which export of eggs and larvae have been confirmed, including dramatic enhancement of scallop fisheries in Georges Bank and clam fisheries in Fiji. Small reserves have worked well and repeatedly produce local benefits. However, regional fisheries enhancement will require more extensive networks of reserves. Some of the most convincing success stories come from places in which between 10 and 35% of fishing grounds have been protected. In several cases there is evidence that yields with reserves have risen to higher levels than prior to protection, despite a reduction in the area of fishing grounds. In other cases, smaller reserves have stabilized catches from intensively exploited fisheries or slowed existing rates of decline.

We describe experiences that prove that success of marine reserves is not contingent on habitat type, geographical location, the kind of fishery involved, or the technological sophistication of management. Reserve benefits are not restricted to habitats like coral reefs, or to artisanal fisheries, as some critics claim. Fishery benefits have been demonstrated from reserves established in tropical, warm- and cold-temperate waters, and in many habitats, including coral reefs, rocky reefs, kelp forests, seagrass beds,

mangroves, estuaries, soft sediments, continental shelves and deep sea. Reserves and fishery closures have worked well for a wide range of fisheries, spanning recreational fisheries, artisanal fisheries like those of coral reefs, through small-scale nearshore fisheries for species like lobsters, up to industrial-scale fisheries for animals like flatfish and scallops.
They have worked across a similarly broad spectrum of management sophistication, from self-policing by committed fishers, through warden patrols to satellite monitoring of distant fishing activities. We now have strong evidence that with the support of local communities, marine reserves offer a highly effective management tool. However, reserves will only rarely be adequate as a stand-alone management approach, although we describe cases where they have worked in the absence of other measures. They will be most effective when implemented as part of a package of limits on fishing effort, designed to protect exploited species and their habitats

Gerber, LR. Botsford, LW., Hastings, A., Possingham, HP., Gaines, SD., Palumbi, SR. & Andelman, S. (2003) Population models for marine reserve design: A retrospective and prospective synthesis. *Ecological Applications* 13, S47-S64.
We synthesize results from existing models of marine reserves to identify key theoretical issues that appear to be well understood as well as issues in need of further exploration. Models of marine reserves are relatively new in the scientific literature; 31 of the 33 modelling papers we reviewed were published after 1990. These models have focused primarily on questions concerning fishery management at the expense of other objectives such as conservation, scientific understanding, recreation, and education and tourism. Roughly one third of the models analyze effects on cohorts while the remaining models have some form of complete population dynamics. Few models explicitly include larval dispersal. In a fisheries context, the primary conclusion drawn by many of the complete population models is that reserves increase yield when populations would otherwise be overfished. A second conclusion, resulting primarily from single cohort models is that reserves will provide fewer benefits for species with greater adult rates of movement. An important aspect of reserve design in need of further analysis and greater understanding is the interaction between dispersal and the spatial configuration of reserves. Other outstanding issues include the effects of: (1) particular forms of density-dependence, (2) multispecies interactions, (3) fisher behaviour and (4) effects of concentrated fishing on habitat. Model results indicate that marine reserves could play a beneficial role in the protection of marine systems against overfishing. However, additional modelling and analysis will greatly improve prospects for a better understanding of the potential of marine reserves for conserving biodiversity.

Grant, S.M. (in print) Challenges of Marine Protected Area Development in Antarctica. In: *PARKS*, Vol 15.3: High Seas Marine Protected Areas. IUCN, Gland, Switzerland. X pp.
Recent experience in Antarctica provides a useful case study on the challenges of developing marine protected area (MPA) systems on the high seas. This article provides an overview of the legal framework in which Antarctic MPAs can be designated, the protected areas existing within that framework, and the shortcomings of the current designations. The challenges facing MPA development in Antarctica include the sparseness of biological data with which to identify areas for protection, the need for decisions to be made within a consensus-based system of international governance, and the problem of enforcement. Further challenges include the need for co-ordination of protected area strategies between the different instruments of the Antarctic Treaty System, and with global recommendations on the development of high seas MPAs. Approaches being taken to address these challenges include recent work by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to identify specific conservation objectives for MPAs, priorities for the types of areas to be considered for protection, and the types of scientific information required. Finally, this paper offers some recommendations on how lessons learned in Antarctica might be applied in the establishment of high seas marine protected areas elsewhere.

Green, S.J.; Flores, J.O.; Dizon-Corrales, J.Q.; Martinez, R.T.; Nunal, D.R.M.; Armada, N.B. & White, A.T.. (2004) The fisheries of Central Visayas, Philippines: Status and trends. Coastal Resource Management Project of the Department of Environment and Natural Resources and the Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, Cebu City, Philippines, 159pp.
Abstract not available

Guénette, S., Lauck, T. & Clark, C. (1998) Marine reserves : From Beverton and Holt to the present. *Reviews Fish Biology & Fisheries*, 8, 251-272.
Abstract not available

Halpern, BS. (2002) The impact of marine reserves: Do reserves work and does reserve size matter? *Ecological Applications* 13, S117-S137.
Marine reserves are becoming a popular tool for marine conservation and resource management worldwide. In the past, reserves have been created with little understanding of how they actually affect the areas they are intended to protect. A few recent reviews have evaluated how reserves in general affect the density and biomass of organisms within them, but little work has been done to assess temporal patterns of these impacts. Here we review 112 independent measurements of 80 reserves to show that the higher average values of density, biomass, average organism size, and diversity inside reserves (relative to controls) reach mean levels within a short (1–3 y) period of time and that the values are subsequently consistent across reserves of all ages (up to 40 y). Therefore, biological responses inside marine reserves appear to develop quickly and last through time. This result should facilitate their use in the management of marine resources.

Halpern, BS. & Warner, RR. (2003) Marine reserves have rapid and lasting effects. *Ecology Letters* 5, 361-366.
Marine reserves are quickly gaining popularity as a management option for marine conservation, fisheries, and other human uses of the oceans. Despite the popularity of marine reserves as a management tool, few reserves appear to have been created or designed with an understanding of how reserves affect biological factors or how reserves can be designed to meet biological goals more effectively (e.g., attaining sustainable fish populations). This shortcoming occurs in part because the many studies that have examined the impacts of reserves on marine organisms remain isolated examples or anecdotes; the results of these many studies have not yet been synthesized. Here, I review the empirical work and discuss the theoretical literature to assess the impacts of marine reserves on several biological measures (density, biomass, size of organisms, and diversity), paying particular attention to the role reserve size has in determining those impacts. The results of 89 separate studies show that, on average, with the exception of invertebrate biomass and size, values for all four biological measures are significantly higher inside reserves compared to outside (or after reserve establishment vs. before) when evaluated for both the overall communities and by each functional group within these communities (carnivorous fishes, herbivorous fishes, planktivorous fishes/invertebrate eaters, and invertebrates). Surprisingly, results also show that the relative impacts of reserves, such as the proportional differences in density or biomass, are independent of reserve size, suggesting that the effects of marine reserves increase directly rather than proportionally with the size of a reserve. However, equal relative differences in biological measures between small and large reserves nearly always translate into greater absolute differences for larger reserves, and so larger reserves may be necessary to meet the goals set for marine reserves. The quality of the data in the reviewed studies varied greatly. To improve data quality in the future, whenever possible, studies should take measurements before and after the creation of a reserve, replicate sampling, and include a suite of representative species. Despite the variable quality of the data, the results from this review suggest that nearly any marine habitat can benefit from the implementation of a reserve. Success of a marine reserve, however, will always be judged against the expectations for that reserve, and so we must keep in mind the goals of a reserve in its design, management, and evaluation.

Hilborn, R., Branch, TA., Ernst, B., Magnusson, A., Minte-Vera, CV., Scheuerell, MD. & Valero, JL. (2003) State of the world's fisheries. *Annual Review of Environmental Resources* 28, 359–399.

The total world catch from marine and freshwater wild stocks has peaked and may be slightly declining. There appear to be few significant resources to be developed, and the majority of the world’s fish stocks are intensively exploited. Many marine ecosystems have been profoundly changed by fishing and other human activities. Although most of the world’s major fisheries continue to produce substantial sustainable yield, a number have been severely overfished, and many more stocks appear to be heading toward depletion. The world’s fisheries continue to be heavily subsidized, which encourages overfishing and provides society with a small fraction of the potential economic benefits. In most of the world’s fisheries there is a “race for fish” in which boats compete to catch the fish before a quota is achieved or the fish are caught by someone else. The race for fish leads to economic inefficiency, poor quality product, and pressure to extract every fish for short-term gain. A number of countries have instituted alternative management practices that eliminate the race for fish and encourage economic efficiency, use lower exploitation rates that deliberately do not attempt to maximize biological yield, and encourage reduced fishing costs and increased value of products. In fisheries where this transition has taken place, we see the potential for future sustainability, but in those fisheries where the race for fish continues, we anticipate further declines in abundance, further loss of jobs and fishing communities, and potential structural change to marine ecosystems.

Hilborn, R., Stokes, K., Maguire, J-J., Smith, T., Botsford, LW., Mangel, M., Orensanz, J., Parma, A., Rice, J., Bell, J., Cochrane, KL., Garcia, S., Hall, SJ., Kirkwood, GP., Sainsbury, K., Stefansson, G. & Walters, C. (2004) When can marine reserves improve fisheries management? *Ocean & Coastal Management* 47, 197-205.

Marine reserves are a promising tool for fisheries management and conservation of biodiversity, but they are not a panacea for fisheries management problems. For fisheries that target highly mobile single species with little or no by-catch or habitat impact, marine reserves provide few benefits compared to conventional fishery management tools. For fisheries that are multi-species or on more sedentary stocks, or for which broader ecological impacts of fishing are an issue, marine reserves have some potential advantages. Their successful use requires a case-by-case understanding of the spatial structure of impacted fisheries, ecosystems and human communities. Marine reserves, together with other fishery management tools, can help achieve broad fishery and biodiversity objectives, but their use will require careful planning and evaluation. Mistakes will be made, and without planning, monitoring and evaluation, we will not learn what worked, what did not, and why. If marine reserves are implemented without case by case evaluation and appropriate monitoring programs, there is a risk of unfulfilled expectations, the creation of disincentives, and a loss of credibility of what potentially is a valuable management tool.

Hutchings, JA. (2000) Collapse and recovery of marine fishes. *Nature* 406, 882-885.

Over-exploitation and subsequent collapse of marine fishes has focused attention on the ability of affected populations to recover to former abundance levels and on the degree to which their persistence is threatened by extinction. Although potential for recovery has been assessed indirectly, actual changes in population size following long-term declines have not been examined empirically. Here I show that there is very little evidence for rapid recovery from prolonged declines, in contrast to the perception that marine fishes are highly resilient to large population reductions. With the possible exception of herring and related species that mature early in life and are fished with highly selective equipment, my analysis of 90 stocks reveals that many gadids (for example, cod, haddock) and other non-clupeids (for example, flatfishes) have experienced little, if any, recovery as much as 15 years after 45?99% reductions in reproductive biomass. Although the effects of overfishing on single species may generally be reversible, the actual time required for recovery appears to be considerable. To exempt marine fishes from existing criteria used to assign extinction risk would be inconsistent with precautionary approaches to fisheries management and the conservation of marine biodiversity.

Hutchings, JA. (2001) Influence of population decline, fishing and spawner variability on the recovery of marine fishes. ***Journal of Fish Biology*** **59, 306-322.**
Abstract not available.

Hyrenbach, K.D; Forney, K.A. & Dayton, P.K. (2000) Marine protected areas and ocean basin management. ***Aquatic conservation: Marine and Freshwater Ecosystems*****. 10: 437 – 458.**
1. All reserve designs must be guided by an understanding of natural history and habitat variability.
2. Differences in scale and predictability set aside highly dynamic pelagic systems from terrestrial and nearshore ecosystems, where wildlife reserves were first implemented. Yet, as in static systems, many pelagic species use predictable habitats to breed and forage. Marine protected areas (MPAs) could be designed to protect these foraging and breeding aggregations.
3. Understanding the physical mechanisms that influence the formation and persistence of these aggregations is essential in order to define and implement pelagic protected areas. We classify pelagic habitats according to their dynamics and predictability into three categories: static, persistent and ephemeral features.
4. While traditional designs are effective in static habitats, many important pelagic habitats are neither fixed nor predictable. Thus, pelagic protected areas will require dynamic boundaries and extensive buffers.
5. In addition, the protection of far-ranging pelagic vertebrates will require dynamic MPAs defined by the extent and location of large-scale oceanographic features.
6. Recent technological advances and our ability to implement large-scale conservation actions will facilitate the implementation of pelagic protected areas.
7. The establishment of pelagic MPAs should include enforcement, research and monitoring programmes to evaluate design effectiveness.
8. Ultimately, society will need a holistic management scheme for entire ocean basins. Such overarching management will rely on many innovative tools, including the judicious use of pelagic MPAs.

IUCN – The World Conservation Union (2004) Managing marine protected areas: A Toolkit for the Western Indian Ocean. IUCN Eastern African Regional Programme, Nairobi, Kenya. xii+172 pp.
Abstract not available.

Jones, PJS. (2002) Marine protected area strategies: issues, divergences and the search for middle ground. ***Reviews in Fish Biology & Fisheries*** **11, 197-216.**
There has been a dramatic increase in recent years in the number of papers, reports, etc., which have been published concerning Marine Protected Areas (MPAs). This overview of the objectives, selection, design and management of MPAs aims to provide a basis for discussion regarding possible ways forward by identifying emerging issues, convergences and divergences. Whilst the attributes of the marine environment may limit the effectiveness of site-specific initiatives such as MPAs, it is argued that it would be defeatist in the extreme to abandon MPAs in the face of these limitations. Ten key objectives for MPAs are discussed, including that of harvest refugia, and it is argued that whilst these objectives may be justifiable from a preservationist perspective, they may be objected to from a resource exploitation perspective. MPAs generate both internal (between uses) and basic (between use and conservation) conflicts, and it is argued that these conflicts may be exacerbated when scientific arguments for MPAs are motivated by preservationist concerns. It is reported that a minority of MPAs are achieving their management objectives, and that for the majority insufficient information was available for such effectiveness evaluations. Structure and process-oriented perspectives on marine conservation are discussed. It is argued that there are two divergent stances concerning optimal MPA management approaches: top-down, characterized as being government-led and science-based, with a greater emphasis on set-aside; and bottom-up, characterized as being community-based and science-guided, with a greater emphasis on multiple-use. Given the divergent values of different stakeholders, the high degree of scientific uncertainty, and the high marine resource management decision stakes, it

is concluded that a key challenge is to adopt a "middle-ground" approach which combines top-down and bottom-up approaches, and which is consistent with the post-normal scientific approach.

Kaiser, MJ. (2004) Marine Protected Areas: The importance of being earnest. ***Aquatic Conservation: Marine & Freshwater Ecosystems*** **14, 635-638.**
Abstract not available

Kathiresan, K. & Rajendran N. 2005. Coastal mangrove forests mitigated tsunami. ***Estuarine Coastal and Shelf Science*** **65: 601-606.**
A study conducted after the 26th of December 2004 tsunami in 18 coastal hamlets along the south-east coast of India reiterates the importance of coastal mangrove vegetations and location characteristics of human inhabitation to protect lives and wealth from the fury of tsunami. The tsunami caused human death and loss of wealth and these decreased with the area of coastal vegetation, distance and elevation of human inhabitation from the sea. Human inhabitation should be encouraged more than 1 km from the shoreline in elevated places, behind dense mangroves and or other coastal vegetation. Some plant species, suitable to grow in between human inhabitation and the sea for coastal protection, are suggested.

Kelleher, G. (1999) Guidelines for Marine Protected Areas. IUCN, Gland, Switzerland, 107 pp.
Marine Protected Areas (MPAs) are essential to conserve the biodiversity of the oceans and to maintain productivity, especially of fish stocks. Yet at present there are too few MPAs and not many of them are effectively managed. These guidelines set out the various steps a country should take to establish an effective network of MPAs. IUCN has defined an MPA as "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". There are two ways of establishing MPA systems: either as many relatively small sites, each strictly protected, or as a few large multiple-use areas which contain strictly protected areas within them. To conserve biodiversity, both approaches should occur within an effective programme of ecosystem management covering the marine ecosystem and the land areas that affect it. From the accumulated technical experience in this field, there is one general lesson which can be drawn. A crucial attribute of an MPA manager is integrity. Some managers have made the mistake of believing that they can fool some of the people some, or even all, of the time. The result is a breakdown in trust. The manager may appear to win a series of battles but in fact the eventual outcome is failure. Another key lesson is that time spent in preparation is an essential investment that will be repaid many times over. Proponents of MPAs have to show demonstrable benefits for stakeholders, and this takes time and diplomacy. Box 1 lists other lessons from experience in establishing and managing MPAs in various situations around the world. The Guidelines set out the following steps, each being the subject of a separate chapter:
1. Placing MPAs in their wider context. The high degree of linkage between land and adjoining sea, and the inter-connectivity of the oceans, require that MPAs be integrated into management regimes that deal with all human activities that affect marine life. Thus MPAs should be integrated with other policies for land use and use of the sea. It is also desirable for countries to make use of international agreements, notably UNCLOS and CBD. More international support is needed for MPAs and more attempts should be made to establish MPAs on the High Seas.
2. Developing the legal framework. In most countries, a key step will be to establish the legislation needed. This may either be enabling legislation, which allows the administration or communities to establish individual MPAs, or specific legislation establishing an MPA, usually as a large multiple-use area. The various requirements for the legislation are outlined, though the needs and context will differ from one country to another.
3. Working with relevant sectors. Many sectors of human activity affect the coast and the sea, and it is vital for those planning an MPA to work with these sectors from the earliest opportunity. Tourism often has most to gain from an MPA and can generate the greatest economic activity from it. Fisheries is the other key sector, and one with which it is most important to cooperate. Other relevant sectors include aquaculture, coastal development, agriculture, forestry, industry, defence and science.

4. Making partnerships with communities and other stakeholders. MPA management should understand the local communities that will be affected by the MPA and identify potential partners. It must listen to the many interests and seek ways to involve them as participants in resource management. It is recommended to build management partnerships using the collaborative management model, which is outlined in greater detail in Annex 1.
5. Selecting the sites for MPAs. Choosing the location and extent of MPAs involves a different emphasis to that of terrestrial protected areas. In many parts of the world, local people depend greatly on the services and resources provided by natural terrestrial areas. However, the dependence on marine areas tends to be even greater. Some forms of fishing can occur in large areas without threatening the conservation objectives of the MPA because they do not involve habitat modification. This makes it feasible to balance conservation and the needs of local people. Weight needs to be given to events outside the MPA that might affect it, such as pollution. Following these principles, the guidelines propose a rigorous set of criteria for site selection that have been applied in many countries over the past few years.
6. Planning and managing the MPA. Management should be responsive and adaptive, working with local interests in a way that builds support for the conservation objectives. To achieve this, managers should adopt a systems approach, use interdisciplinary teams and follow a clear sequence of decision-making. Most MPA management is about managing human activities, so this must be at the heart of the approach. Suggested contents for a management plan are provided in Annex 2.
7. Zoning, in which various areas are allocated for various uses. This is usually the best way of ensuring strict protection of a core zone as part of a larger, multiple-use area. The stages involved in preparing a zoning plan are outlined in Annex 3.
8. Planning for financial sustainability. Lack of funds is a critical problem for many MPAs. Managers therefore need the freedom to raise funds in as many ways as possible, such as user fees, donations and environment funds, and to retain those funds for management of the MPA. External donors are advised to extend the aid period for protected area projects, so as to help achieve financial sustainability.
9. Ensuring research, monitoring, evaluation and review. Research and monitoring should be firmly orientated to solving management issues. Guidance is given on the planning and development of a monitoring and research programme, with its different emphases in the planning and the implementation phase of the MPA. Most important of all is to use the results of research and monitoring to evaluate and if necessary reorient management.

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http://www.deh.gov.au/coasts/mpa/wpc/benefits/pubs/benefits-mpas.pdf

Kerr, AM.; Baird, AH.; Campbell, SJ. 2006. Comments on „Coastal mangrove forests mitigated" by K. Kathiresan and N. Rajendran [Estuar. Coast. Shelf Sci. 65 (2005) 601-606]. ***Estuarine Coastal and Shelf Science*** **67: 539-541.**
Abstract not available

Lauck, T., Clark, CW., Mangel, M. & Munro, GR. (1998) Implementing the precautionary principle in fisheries management through marine reserves. ***Ecological Applications*** **8, S72-S78.**
Abstract not available

Lubchenco, J., Palumbi, SR., Gaines, SD. & Andelman, S. (2003) Plugging a hole in the ocean: The emerging science of marine reserves. ***Ecological Applications*** **13, S3-S7.**
Rapid and radical degradation of the world's oceans is triggering increasing calls for more effective approaches to protect, maintain, and restore marine ecosystems (Allison et al. 1998, Murray et al. 1999, NRC 1999a, 2000a). A broad spectrum of land and ocean-based activities, coupled with continued growth of the human population and migration to coastal areas, is driving unanticipated, unprecedented, and complex changes in the chemistry (Committee on Environment and Natural Resources 2000, NRC 2000b, Boesch et al. 2001), physical structure (Lubchenco et al. 1995, Watling

and Norse 1998), biology and ecological functioning (Lubchenco et al. 1995, Vitousek et al. 1997, Botsford et al. 1997, Watling and Norse 1998, NRC 1999b, NMFS 1999, FAO 2000, Hutchings 2000, Carlton 2001, Jackson et al. 2001) of oceans worldwide. Symptoms of complex and fundamental alterations to marine ecosystems abound, including increases in: coral bleaching, zones of hypoxic or anoxic water, abrupt changes in species composition, habitat degradation, invasive species, harmful algal blooms, marine epidemics, mass mortalities, and fisheries collapses (Botsford et al. 1997, Vitousek et al. 1997, Harvell et al. 1999, NRC 1999b, 2000a). Fishing practices, coastal development, land-based chemical and nutrient pollution, energy practices, aquaculture, land use and land transformation, water use and shipping practices combine to alter the structure and functioning of marine ecosystems globally (Lubchenco et al. 1995). Fundamental alterations to ecosystem structure include changes in species diversity; population abundance, size structure, sex ratios, and behaviour; habitat structure; trophic dynamics; biogeochemistry; biological interactions; and more. These changes in turn affect the functioning of marine ecosystems and the consequent provision of goods and services (Lubchenco et al. 1995, Peterson and Lubchenco 1997). As both the value and vulnerability of marine ecosystems become more broadly recognized, there is an urgent search for effective mechanisms to prevent or reverse widespread declines and to protect, maintain, and restore ocean ecosystems. Fully protected marine reserves are an emerging tool for marine conservation and management. Defined as ‘‘areas of the ocean completely protected from all extractive and destructive activities,’’ fully protected marine reserves (hereafter, simply ‘‘marine reserves’’) have explicit prohibitions against fishing and the removal or disturbance of any living or nonliving marine resource, except as necessary for monitoring or research to evaluate reserve effectiveness.

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Mapstone, B.D.; Davies, C.R.; Little, L.R.; Punt, A.E.; Smith, A.D.M; Pantus, F.; Lou, D.C.; Williams, A.J.; Jones, A.; Ayling, A.M.; Russ, G.R. & McDonald, A.D. 2004. The Effects of Line Fishing on the Great Barrier Reef and Evaluations of Alternative Potential Management Strategies. *CRC Reef Research Centre, Technical Report No 52.* CRC Reef Research Centre, Townsville, Australia.
The effects of reef line fishing on the productivity of targeted species and its impacts on other reef species on the Great Barrier Reef (GBR) have been poorly understood. Understanding the distribution, intensity, and effects of reef line fishing is essential for successful management of both fishing and other recreational and commercial activities in the GBR region, as well as for conservation of the GBR ecosystem.
The GBR Reef Line Fishery (RLF) comprises socially and economically important commercial, charter, and recreational fishing sectors. The fishery has been undergoing some change over the last decade, particularly manifest as considerable increases in effort and catch in the commercial fishery since 1995. These changes probably arise from several events, including changing management arrangements in other fisheries, the introduction of Dugong Protection Areas in in-shore areas, the process of reviewing management arrangements for the Reef Line Fishery and the development of lucrative export markets for live reef fish for consumption. Collectively, these influences have resulted in nearly 50% increase in commercial effort and 40% increase in catch since 1996. There also is potential for increased recreational fishing pressure along the GBR coast simply because of population growth and increased tourism. Management arrangements for the Coral Reef Fin Fish Fishery are now under review, with new management arrangements likely to regulate commercial effort in the fishery explicitly.
Conservation management of the GBR Marine Park also is undergoing significant change. The current zoning system is being substantially upgraded with the development of a comprehensive, adequate and representative system of no-take areas for biodiversity conservation of the GBR ecosystem – the Representative Areas Program. This revision is likely to increase the area of the GBR closed to reef line fishing. Realising the minimum regime of 20% of all GBR bioregions being ‘no-take’ will inevitably result in significant increases in the amount of coral reef habitat closed to the Reef Line Fishery in some areas. These factors, combined with limited historical information about the fishery or

its main target species, present significant problems for planning appropriate management strategies of the fishery and the GBR World Heritage Area.

These factors, combined with limited historical information about the fishery or its main target species, present significant problems for the development of appropriate management strategies for the fishery and the GBR World Heritage Area. In this research, we have quantified some of the primary impacts of the RLF on targeted stocks and assessed secondary impacts on other components of the GBR ecosystem. We have assessed experimentally the degree to which area closure strategies are likely to have ameliorated those impacts. Finally, we evaluated the prospects for alternative mixes of strategies for conservation and fishery management in the region to realise the objectives of diverse stakeholders.

Surveys of areas that had been open and closed to fishing for over a decade showed that the two main target species of the RLF, the common coral trout and the red throat emperor, were significantly more abundant, larger and older in areas zoned Marine National Park 'B' (and so closed to fishing) than in adjacent General Use areas that have always been open to fishing. The magnitude of these differences varied regionally, from near-zero around Lizard Island to several-fold for some population characteristics in the southern regions of the GBR. The pattern in apparent 'effectiveness' of past closures matched closely patterns in the amount of fishing effort and catch and underlying patterns in the abundances of several harvest and non-harvest species. We present circumstantial arguments that this regional variation in the apparent 'effectiveness' of Marine Protected Areas is likely to reflect long-standing regional variations in the amounts of fishing and its impacts outside closed areas, rather than wholesale subversion of zoning strategies by high levels of poaching. That is, the lack of contrast between open and closed areas in the Lizard Region probably arises because the open areas are lightly fished, whereas the strong contrasts in the other regions arises because of relatively heavy fishing in the open areas in those regions.

Experimental manipulations of reef zoning status and fishing effort verified that fishing on reefs that had been closed historically reduced the abundances of target species on those reefs to levels similar to surrounding open reefs. In the absence of prior data with which to compare open and closed reefs before zoning was implemented, these manipulations provide the most convincing evidence that the Marine Park zoning strategies have been effective in protecting sub-populations of the fishery resource from the impacts of harvest. The protection of such refuges, with sufficient compliance, thus has the potential to sustain high biomass of reproductively mature populations of harvested species in spite of an active fishery on the GBR.

Indirect effects of line fishing on non-harvest fish were less conspicuous. Whilst differences existed between open and closed reefs in abundances of the prey of targeted species, the nature of the patterns varied regionally, through time and with species or species group. In some situations the patterns in abundance suggested that removal of a key predator (coral trout) by fishing might have allowed populations of some prey to grow on fished reefs, but the evidence was neither uniform nor convincing.

We have evaluated prospectively the relative merits for managers and stakeholders of alternative strategies for effort management and area closure on the GBR. We based these evaluations on a set of simulation models ('ELFSim') for the population dynamics and harvest of common coral trout on the GBR. The population dynamics model is spatially structured, depicting nearly 4000 reef-associated populations of coral trout inter-connected via larval dispersal. The reef-associated, post-settlement populations are age, size and sex structured and we allow for variation in most of the key demographic parameters, such as natural mortality, growth, recruitment, etc. The harvest model predicts the allocation of fishing effort over the GBR by three fishing fleets, parameterised with historical catch and effort data to represent the commercial, charter and recreational sectors of the RLF.

Objectives for the future status of coral trout populations and for the RLF were developed by a diverse set of stakeholders in the fishery and the GBR World Heritage Area, in association with the Reef Line Fishery Management Advisory Committee (ReefMAC). Contributing stakeholders included state and federal managers, commercial, charter and recreational fishers, conservation organisations, and researchers. Stakeholder objectives included preserving near-virgin biomass of coral trout on reefs closed to fishing, ensuring satisfactory levels of populations available for harvest, maintaining economically viable commercial catch rates and recreationally rewarding recreational catches of coral trout, and minimising variation in harvests from year to year. Quantitative articulations of these and other objectives were derived and agreed with stakeholders, together with associated performance indicators.

The same set of stakeholders advised on the mix of potential strategies to be considered for achieving their respective objectives. We were asked to compare the efficacy of three levels of fishing effort, ranging from half of 1996 levels to 1½ times 1996 levels, and three levels of area closure, ranging from current closures to nearly three times current closures. The outputs from these Management Strategy Evaluations provide comparative assessments of the likelihood that each of the stakeholder objectives will be met by each combination of effort control and area closure strategy. The results are not intended to prescribe which strategy mix should be adopted, but to provide a basis for stakeholders to negotiate such an outcome based on the degree to which different combinations of strategies meet their needs.

Harvest-related objectives (e.g., maintaining CPUE, increased chance of catching a large fish, preserving biomass available for harvest) were most likely to be achieved when effort was lowest under any area closure strategy, but were less likely to be achieved as increasing amounts of area were closed to fishing. The principle stock-conservation objective, represented by preserving the spawning biomass of the whole population, was most likely to be achieved by increasing the amount of area closure and was only relatively slightly impacted by increasing fishing effort within each area closure strategy.

Importantly, the observed increase in fishing effort in recent years is most likely to impact most negatively on the performance indicators for areas open to fishing, especially those reflecting what fishers would consider satisfactory performance of the fishery (e.g., catch rates and sizes of fish). The increase in area closures under the Representative Areas Program is likely to exacerbate the depreciation of fishery performance, but our results suggest that growth in fishing effort will be considerably more influential than changes in areas available to the fishery. Our results suggest that the currently elevated levels of effort (~1.5 time 1996 levels) will reduce significantly the prospects of fishers in all sectors realising their objectives in future years, irrespective of the inevitable increases in protected areas under the Representative Areas Program.

Reducing effort, conversely, is the strategy of those considered in our evaluations most likely to realise direct fisheries-related objectives. The conundrum in these results, however, is that the improved prospects from effort reduction would apply only to those fishers remaining in the fishery. We are unable to assess the magnitude of financial costs likely to be incurred by those fishers excluded through the effort reductions that would now be necessary to achieve the two lower effort scenarios we considered. Changing effort had relatively little impact on most performance indicators for closed areas, especially conservation of spawning biomass of coral trout within Marine Protected Areas, even allowing for low levels of infringement of closed areas. The most effective mechanism by which to increase total spawning stock biomass over the GBR domain, therefore, was increasing the area closed to fishing, presuming that compliance with those closures was relatively high.

It is important to note that the status of coral trout populations in areas open to fishing remained relatively robust under all strategies we considered. For example, even under the most 'adverse' scenario of maximum effort constrained to the smallest fishable area, spawning biomass (in the open areas) remained above 50% of virgin spawning biomass and biomass available for harvest (i.e., above the minimum legal size limit) remained above 30% of virgin available biomass. These statistics generally would be considered acceptable for a harvested stock. In large part, this is likely to be the consequence of the biologically precautionary minimum legal size limit on harvest of common coral trout, which ensures that most fish can spawn in at least one year before reaching harvestable size.

Sensitivity analyses for the simulations showed that the qualitative relationships among scenarios were robust to changes in model parameters. Accordingly, the conclusions about the relative merits of increasing or decreasing fishing effort or area closures are robust to most changes in model assumptions. It should be noted, however, that our evaluations relate only to the populations and harvest of common coral trout (*P. leopardus*). Though several other species harvested in the Reef Line Fishery are taxonomically close to *P. leopardus*, they are generally considered to be less abundant and longer lived than *P. leopardus* and their populations dynamics are perhaps less resilient to harvest than that of *P. leopardus*. Accordingly, conservative regulations for the harvest of these other species would be prudent at this stage.

This research has laid bare some of the inevitable trade-offs among different scenarios for managing the harvest of common coral trout by the RLF in the GBR World Heritage Area. Most importantly, the trade-offs have been assessed in relation to objectives and performance indicators specified by diverse stakeholders in the fishery and the World Heritage Area. We present the tradeoffs in ways that allow direct comparisons among disparate objectives, essentially providing a common currency for comparing performance across fundamentally different types of objectives. In so doing, we hope that the costs and benefits of different management options are more transparent to all stakeholders than might otherwise have been the case. We hope that such transparency aids in the negotiation of acceptable and effective future management arrangements for the Great Barrier Reef World Heritage Area and the Reef Line Fishery.

Marcus, J.E; Samoilys M.A.; Meeuwig, J.J.; Villongco, Z.A.D. & Vincent, A.C.J. (in press) Benthic status of near-shore fishing grounds in the central Philippines and associated seahorse densities. *Marine Pollution Bulletin*.

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Martin-Smith, K.M.; Samoilys, M.A.; Meeuwig, J.J. & Vincent, A.C.J. (2004) Collaborative development of management options for an artisanal fishery for seahorses in the central Philippines. *Ocean Coast. Manage*. 47:165-193.

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McClanahan, T. R., & Kaunda-Arara, B. (1996) Fishery recovery in a coral-reef marine park and its effect on the adjacent fishery. *Conservation Biology* 10:1187-1199.

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McClanahan, T. R. & Mangi, S. (2000) Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery. *Ecological Applications* 10:1792-1805.

Abstract not available

McClanahan, T.R.; Verheij, E. & Maina, J. (2006) Comparing the management effectiveness of a marine park and a multiple use collaborative management area in East Africa. *Aquatic Conservation: Marine and Freshwater Ecosystem* 16: 147-165.

Abstract not available

McManus, RE. (2004) Protecting some fish with no-take reserves is common sense. National Fisheries Conservation Center (NFCC): Ojai (USA), 1 p.

One evening you go to dinner with several people, including a local wildlife manager. During dinner the manager tells you that she is setting up a new protected area where no wildlife will be killed. She explains that where people kill wild animals, their numbers and sizes have decreased. Moreover, where there has been heavy hunting and other types of human activities, wild places have fewer kinds of animals and plants. To help remedy these problems, the manager explains, her agency will fully protect wildlife in a few carefully chosen areas administered by the government. Where this has been done elsewhere she notes, the animals and plants are more abundant and larger, and their habitats look more like they have in the past before they were disturbed by humans. One of your reactions might be to say, "this doesn't sound like rocket science to me, it would be logical to assume that when you protect wildlife, they do better." Most people agree with that conclusion. All of the scientists that I know who study protected areas have concluded the same thing, for both terrestrial ecosystems and marine ecosystems. Of course, the degree such management regimes are successful depends on a variety of factors regarding how they are designed and implemented, and how well external threats to the species are controlled. Nevertheless, the basic hypothesis that if you protect them they do better seems to be common sense and it is supported by scientific evidence.

Micheli, F. & Halpern, BS. (2005) Low functional redundancy in coastal marine assemblages. *Ecology Letters* 8, 391-400.

The relationship between species and functional diversity remains poorly understood for nearly all ecosystem types, yet determining this relationship is critically important for developing both a mechanistic understanding of community assembly and appropriate expectations and approaches to protecting and restoring biological communities. Here we use two distinct data sets, one from kelp forests in the Channel Islands, California, and one from a global synthesis of marine reserves, to directly test how variation in species diversity translates into changes in functional diversity. We find strong positive relationships between species and functional diversity, and increased functional diversity of fish assemblages coinciding with recovery of species diversity in marine reserves, independent of the method used for classifying species in functional groups. These results indicate that low levels of redundancy in functional species traits exist across a suite of marine systems, and that fishing tends to remove whole functional groups from coastal marine ecosystems.

Murawski, SA. (2000) Definitions of overfishing from an ecosystem perspective. *ICES Journal of Marine Science* 57, 649-658.

Ecosystem considerations may be incorporated into fisheries management by modifying existing overfishing paradigms or by developing new approaches to account for ecosystem structure and function in relation to harvesting. Although existing concepts of overfishing have a strong theoretical basis for evaluating policy choices and much practical use, they do not provide direct guidance on issues such as biodiversity, serial depletion, habitat degradation, and changes in the food web caused by fishing. There is, however, little basis for defining optimum fishing by using related metrics such as diversity indices, slopes of size or diversity spectra, or average trophic level of the catch, and these may produce ambiguous results. If ecosystem-based overfishing concepts are to assume a greater role in management, unambiguous, quantifiable, and predictive measures of ecosystem state and flux must be developed to index: (1) biomass and production by the ecosystem and relationships among its parts, (2) diversity at different levels of organization, (3) patterns of resource variability, and (4) social and economic benefits. Ecosystem considerations do not need to substitute for existing overfishing concepts. Instead, they should be used to evaluate and modify primary management guidance for important fisheries and species. In practice, they emphasize the need to manage fishing capacity, supported by broader use of technical measures such as marine protected areas and gear restrictions.

Murawski, S.; Rago, P. and Fogarty, M. (2004) Spillover Effects from Temperate Marine Protected Areas. In: Shipley, J. B. (ed) Aquatic protected areas as fisheries management tools. American Fisheries Society, 301 pp.

Abstract not available

National Fisheries Conservation Centre (NFCC) (2004) Integrating marine reserve science and fisheries management: NFCC consensus conference. NFCC: Long Beach (USA), 33 pp.

Objective

The objective of this Consensus Statement is to inform the fishery management, ecological research, and marine protected area management communities of the results of the NFCC Consensus Conference on Integrating Marine Reserve Science and Fisheries Management. The statement provides an objective examination and assessment of the information regarding potential biological, social, and economic consequences of marine reserves, their potential effectiveness as a fishery management tool in the U.S., the methods for integrating their application with existing U.S. fisheries management and how marine reserves might be designed, monitored and evaluated. In addition, the statement addresses sources and magnitudes of uncertainty associated with marine reserves and conventional management approaches, and recommends areas for further study.

Participants

The conference included scientists and policy experts representing the fields of biological oceanography, marine ecology, fish biology, population dynamics, stock assessment, fishery management, fishery economics, and marine environmental law. The conference's seven-member review panel was made up of scientists and policy experts not currently engaged in research or advocacy in the field of marine reserves. The conference's ten-member presentation panel was made up of scientists and policy experts that are currently engaged in research or advocacy in the field of marine reserves. In addition to conference panelists, an audience of about 100 fishers, scientists, and policy makers was observed and contributed comments.

Evidence

The Communication Partnership for Science and the Sea (COMPASS) at Oregon State University conducted the literature search for the planning committee and the consensus conference and prepared an extensive bibliography for the panel and conference audience. COMPASS staff also prepared abstracts and topic synthesesfor the panel with relevant citations from the literature.

Consensus Process

The panel, answering predefined questions, developed their conclusions based on the scientific evidence presented in open forum and the scientific literature. The panel composed a draft statement that was summarized and presented to the experts and the audience for comment. Thereafter, the panel resolved conflicting recommendations and released a summary of its revised statement at the end of the conference. The panel finalized the revisions after the conference. The draft statement was made available on the World Wide Web after panel revisions.

Conclusions

Marine reserves should be considered in the broader context of the development of ecosystem-based management in the U.S. From that perspective, marine reserves have clear application for meeting objectives for ecosystem conservation and protection of marine biodiversity in addition to whatever benefits they may have for achieving fishery management objectives. Furthermore, marine reserves are a category of area management options—including less restrictive and less permanent alternatives -that may be used in order to achieve ecosystem- or species based management objectives. With regard to fishery effects, studies of marine reserves and other area closures, most of which are from lower latitudes, have now shown that fishery target species have increased in abundance and expanded age structure within the closed area in a preponderance of cases (the so-called “reserve effect.”). This is particularly the case where the resource species are significantly overfished. Evidence for effects outside closed areas, either by movement of adults across the reserve boundaries (“spillover”) or larval “export” is more limited and effects on stocks within larger regions can only be deduced by models at this point. This is because of the limited size of existing reserves and inherent difficulties in measuring and interpreting such broader effects. In general, knowledge is sufficient to proceed with the design and evaluation of marine reserves and other marine protected areas and their incorporation into regional ecosystem-based management. More sophisticated modelling and analysis is required for better understanding of spatial movement rates, export of reproductive products, and adaptations by fishers. Marine reserves clearly offer some advantages for simultaneously incorporating habitat protection and maintenance of ecosystem structure and function within the protected area. They may offer some advantages for multi-species management and as a hedge against environmental surprise or management failure. Marine reserves are most likely to be an effective management tool for relatively sedentary species with broad larval dispersal, which are recruitment limited, and for mobile species with high site fidelity. They may also be effective for protecting rare habitats vulnerable to human disruption or in protecting aggregations of animals (e.g., when spawning), when exploited populations have been severely depleted, or where bycatch is high. Closed areas may also be useful in achieving broad demographic representation in spawning populations if large animals have limited movement potential relative to reserve boundaries, and when they can maintain populations of highly fecund, older females with strong reproductive potential. They may be more feasible to implement either when reduced yields have already restricted fishing activities and other management measures have been ineffective or when they address special needs within otherwise productive regions. Marine reserves and other protected areas should be integrated with existing and emerging management measures as part of a coherent ecosystem-based approach to management of commercial and recreational fisheries and should not be simply layered over existing regulations. Careful consideration of the effects on allocation of resources among users, displacement of fishing activity, the requirements for surveys and stock assessment, and the costs of monitoring and enforcement should be made in considering protected area options and design. The Panel found it difficult to limit its considerations to marine reserves as strictly defined, i.e. areas permanently protected from all extractive activities. We found that management actions need to be openly evaluated against stated goals and where goals are not being met changes in management must at least be considered. The design requirements for marine reserves depend heavily on the environmental context and specific management goals, including the overriding goal of sustainability and high yields of economically important species. Robust experimental design will be critical in order to determine the effects of displaced fishing pressures and enhancement effects on populations outside of reserves in before-after-control-impact assessments. We have been hampered in evaluating the use of marine reserves as a tool for fishery management by the lack of experiments explicitly designed to address reserve effects on fisheries. These explicit experiments are urgently needed. There are numerous uncertainties associated with our understanding both of important biological and socioeconomic processes and with monitoring, analysis, prediction, and implementation. Some important uncertainties for marine reserves include the degree of effective dispersion and reproductive seeding and the ability to resolve spatial and temporal interactions in monitoring and modelling. Further study is required on several key issues if closed areas are to assume a more important role in ecosystem approaches to fisheries management and biodiversity protection. These include high quality, synthetic bottom mapping with which to define vulnerable habitats that closed areas might best protect; study of dispersal rates; synthesis of effects of closures in northern temperate and boreal systems. Many authors have speculated that marine reserves offer more precaution against management and scientific uncertainty than traditional measures. At this point, this is an assertion, and no studies using common definitions and metrics of precaution have been conducted. Given the importance of this issue, there is a need to conduct such work, applying biology and social science, particularly as it relates to findings from existing marine closures.

National Research Council Committee on Ecosystem Management for Sustainable Marine Fisheries (NRC) (1999) Sustaining marine fisheries. NRC, USA, 184 pp.

Marine ecosystems are being perturbed by fishing and other human activities. Many marine fisheries are in decline, and the effects of fishing on other ecosystem goods and services are beginning to be understood and recognized. In recent years, global marine catches appear to have reached a plateau of about 84 million metric tons per year, although total fish production, which includes aquaculture, has continued to increase. In some cases, fisheries have been entirely closed, and in many others it takes increasing effort to maintain catch rates. Fishing is also an economically important international industry, with first-sale revenues of approximately $US 100 billion per year for all fishery products. (Farm-raised and freshwater fisheries account for approximately 25 percent by weight of all fishery products.) Globally, fishery products directly provided approximately 14 kg of food per person in 1996; approximately 28 percent of global fishery products was used for animal feed and other products that do not contribute directly to human food. Although in recent years total fish production has increased faster than the human population, the total from marine-capture fisheries has increased little if at all. To evaluate whether current marine-capture fisheries are sustainable, to determine to what degree marine ecosystems are affected by fishing, and to assess whether an ecosystem approach to fishery management can help achieve sustainability, the National Research Council's Ocean Studies Board established the Committee on Ecosystem Management for Sustainable Marine Fisheries. The committee was directed to "assess the current state of fisheries resources; the basis for success and failure in marine fisheries management (including the role of science); and the implications of fishery activities to ecosystem structure and function. Each activity [was to] be considered relative to sustaining populations of fish and other marine resources" (Statement of Task). This report is the product of the committee's study.

National Research Council Committee on Ecosystem Management for Sustainable Marine Fisheries (NRC) (2001) Marine Protected Areas: Tool for sustaining ocean ecosystem. NRC, USA, 288 pp.

Declining yields in many fisheries and the decay of treasured marine habitats such as coral reefs have heightened interest in establishing a comprehensive system of marine protected areas (MPAs) in the United States. MPAs, areas designated for special protection to enhance the management of marine resources, show promise as components of an ecosystem-based approach for conserving the ocean’s living assets. However, MPA proposals often raise significant controversy, especially the provisions for marine reserves—zones within an MPA where removal or disturbance of resources is prohibited, sometimes referred to as closed or "no-take" areas. Some of the opposition to MPAs lies in resistance to "fencing the sea," reflecting a long tradition of open access. This opposition continues despite compelling empirical evidence and strong theoretical arguments indicating the value of using reserves as a tool to improve fisheries management, to preserve habitat and biodiversity, and to enhance the esthetic and recreational value of marine areas. The controversy persists because we lack a scientific consensus on the optimal design and use of reserves and we have only limited experience in determining the costs and benefits relative to more conventional management approaches. The current decline in the health of the ocean's living resources, an indication of the inadequacy of conventional approaches, and the increasing level of threat have made it more urgent to evaluate how MPAs and reserves can be employed in the United States to solve some of the pressing problems in marine management.

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http://www.iucn.org/themes/wcpa/pubs/pdfs/PARKS/Parks_Jun98.pdf

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PARKS (in print) High Seas Marine Protected Areas. Vol 15.3. IUCN, Gland, Switzerland.

http://www.iucn.org/themes/wcpa/pubs/pdfs/PARKS/Parks_Jun98.pdf

Abstract not available.

Pinnegar, JK., Polunin, NVC., Francour, P., Badalamenti, F., Chemello, R., Harmelin-Viviens, M-L., Hereu, B., Milazzo, M., Zabala, M., D'Anna, G. & Pipitone, C. (2000) Trophic cascades in benthic marine ecosystems: lessons for fisheries and protected-area management. *Environmental Conservation* 27, 179-200.

An important principle of environmental science is that changes in single components of systems are likely to have consequences elsewhere in the same systems. In the sea, food web data are one of the few foundations for predicting such indirect effects, whether of fishery exploitation or following recovery in marine protected areas (MPAs). We review the available literature on one type of indirect interaction in benthic marine ecosystems, namely trophic cascades, which involve three or more trophic levels connected by predation. Because many indirect effects have been revealed through fishery exploitation, in some cases we include humans as trophic levels. Our purpose is to establish how widespread cascades might be, and infer how likely they are to affect the properties of communities following the implementation of MPAs or intensive resource exploitation. We review 39 documented cascades (eight of which include humans as a trophic level) from 21 locations around the world; all but two of the cascades are from shallow systems underlain by hard substrata (kelp forests, rocky subtidal, coral reefs and rocky intertidal). We argue that these systems are well represented because they are accessible and also amenable to the type of work that is necessary. Nineteen examples come from the central-eastern and north-eastern Pacific, while no well-substantiated benthic cascades have been reported from the NE, CE or SW Atlantic, the Southern Oceans, E Indian Ocean or NW Pacific. The absence of examples from those zones is probably due to lack of study. Sea urchins are very prominent in the subtidal examples, and gastropods, especially limpets, in the intertidal examples; we suggest that this may reflect their predation by fewer specialist predators than is the case with fishes, but also their conspicuousness to investigators. The variation in ecological resolution amongst studies, and in intensity of study amongst systems and regions, indicates that more cascades will likely be identified in due course. Broadening the concept of cascades to include pathogenic interactions would immediately increase the number of examples. The existing evidence is that cascade effects are to be expected when hard-substratum systems are subject to artisanal resource exploitation, but that the particular problems of macroalgal overgrowth on Caribbean reefs and the expansion of coralline barrens in the Mediterranean rocky-sublittoral will not be readily reversed in MPAs, probably because factors other than predation-based cascades have contributed to them in the first place. More cascade effects are likely to be found in the soft-substratum systems that are crucial to so many large-scale fisheries, when opportunities such as those of MPAs and fishing gradients become available for study of such systems, and the search is widened to less conspicuous focal organisms such as polychaetes and crustaceans.

Polacheck, T. (1990) Year around closed areas as a management tool. *Nat. Resour. Model.* 4, 327-354.

Abstract not available

République islamique de Mauritanie, Secrétariat général du Gouvernement. (2004) Document de synthèse du Plan d'aménagement et de gestion du Parc national du Banc d'Arguin. 2005-2009. 52 pp.

Abstract not available

Robinson, M.; Miller, C.; Hoeflinger, C.; & Walker, B. Problems and recommendations for using GIS to improve decision-making in California's Channel Islands marine reserves. *MPA News*, 7(5):4-5.

Abstract not available

Rowe, S. & Hutchings, JA. (2003) Mating systems and the conservation of commercially exploited marine fish. *Trends in Ecology & Evolution* 18, 567-572.

Unprecedented declines of marine fish have revealed our inability to predict the susceptibility of populations to collapse and their capacity for subsequent recovery. Lack of knowledge about the behaviour and ecology of exploited species has hindered our understanding of how exploitation influences the resistance of marine fish to catastrophic decline and their resilience thereafter. Based on available data, particularly on the Atlantic cod *Gadus morhua*, we argue that the breeding behaviour of marine fish is considerably more complex than was believed previously. Mate competition, mate choice and other components of mating systems can affect population growth rate deleteriously during and after periods of intense exploitation. There is a pressing need to incorporate knowledge of mating systems in population assessments, to undertake field research on spatial and temporal scales of reproduction, and to initiate laboratory manipulation experiments to test hypotheses about marine fish mating systems, Allee effects and correlates of individual reproductive success.

Ruitenbeek, J.; Hewawasam, I. & Ngoile, M. (2004) Blueprint 2050: Sustaining the Marine Environment in Mainland Tanzania and Zanzibar. The World Bank, Washington D.C., USA.
Abstract not available

Russ, G.R. (2002) Yet another review of marine reserves as reef fishery management tools. In*:* Sale, P.F. (ed) Coral reef fishes: dynamics and diversity in a complex ecosystem. Academic Press, New York, p 421-444.
Abstract not available

Russ GR. & Alcala AC. (2004) Marine reserve benefits local fisheries. *Ecological Applications* 14, 597-606.
The utility of no-take marine reserves as fisheries-management tools is controversial. It is hypothesized that marine reserves will help to sustain fisheries external to them by becoming net exporters of adults (the "spillover effect") and net exporters of propagules (the "recruitment effect"). Local fishery benefits from spillover will likely generate support from fishing communities for marine reserves. We used underwater visual census to show that biomass of Acanthuridae (surgeonfish) and Carangidae (jacks), two families of reef fish that account for 40–75% of the fishery yield from Apo Island, Philippines, tripled in a well-protected no-take reserve over 18 years (1983–2001). Biomass of these families did not change significantly over the same period at a site open to fishing. The reserve protected 10% of the total reef fishing area at the island. Outside the reserve, biomass of these families increased significantly closer to (200–250 m) than farther away from (250–500 m) the reserve boundary over time. We used published estimates of fishery catch and effort, and fisher interviews (creel surveys) to show that the total catch of Carangidae and Acanthuridae combined at Apo Island was significantly higher after (1985–2001) than before (1981) reserve establishment. Hook-and-line catch per unit effort (CPUE) at the island was 50% higher during 1998–2001 (reserve protected 16–19 years) than during 1981–1986 (pre-reserve and early phases of reserve protection). Total hook-and-line effort declined by 46% between 1986 and 1998–2001. Hook-and-line CPUE of Acanthuridae was significantly higher close to (within 200 m) than far from the reserve. CPUE of Carangidae was significantly higher away from the reserve, possibly reflecting a local oceanographic effect. The benefits of the reserve to local fisheries at the island were higher catch, increased catch rate, and a reduction in fishing effort. The fishery and tourism benefits generated by the reserve have enhanced the living standard of the fishing community.

Sadovy, Y. (1993) The Nassau grouper, endangered or just unlucky? *Reef Encounter* 13: 10-12.
Abstract not available

Sadovy, Y. (1999) The case of the disappearing grouper: Epinephelus striatus, the Nassau grouper, in the Caribbean and western Atlantic. Proc. 45th Gulf. Carib. Fish. Inst. Mexico, November 1992. 22 pp.
Abstract not available

Sadovy, Y.J. & Domeier, M.L. (2005) Are aggregation fisheries sustainable: reef fish fisheries as a case study? *Coral Reefs* 24, 254–262.
Abstract not available

Sainsbury, K. & Sumaila, UR. (2003) 'Incorporating ecosystem objectives into management of sustainable marine fisheries, including "best practice" reference points and use of marine protected areas' in M. Sinclair & G. Valdimarsson (eds) *Responsible fisheries in the marine ecosystem*. FAO: Rome (Italy), 343-361.

The broadening of fisheries management to include ecosystem-related objectives raises a potentially confusing range of possible issues for consideration in management decisions, in reporting and in assessing management performance. However, there are methods available and approaches to addressing the issues that are practical, accessible to stakeholder participation and scientifically assessable. Three broad and interrelated elements are described that allow ecosystem objectives to be practically and operationally incorporated into marine fisheries management systems.

Reporting and assessment of the whole management system against sustainability objectives

Three major points are developed and emphasized:

1. Indicators and reference points - and consequently performance measures – must relate explicitly to the high-level objectives of management.
2. The structure and focus of reports on sustainability must be derived transparently from the high-level objectives. A methodology for this is described that can be used in meetings with stakeholders to elucidate the issues, indicators and reference points, management response and the justification for decisions. It can include risk-based methods to help identify the relative importance of different issues.
3. Performance assessments must be of the management system as a whole, rather than solely on the merits of particular parts in isolation. An established methodology (management strategy evolution) is described that can be used to test quantitatively the likely performance of different management strategies in achieving ecosystem objectives. A management strategy in this context is a combination of monitoring, use of the monitoring data for assessment against reference points, identification of appropriate management measures and implementation of these measures. This methodology can be used to test any aspect of the strategy in the 'common currency' of the management objectives, and to identify the circumstances in which particular strategies are likely to perform well or fail. It has already been used in fisheries in relation to target species, important by-catch species, predator-prey dependencies and seabed habitats.

Indicators, reference points and performance measures for fisheries ecosystem objectives

There are many options available, and some recent summaries are identified. A set of target and limit reference points for fisheries ecosystem objectives are provided. These are based broadly on experience to date, and could be practically implemented in the short term. It is not claimed that these reference points are necessary or adequate to achieve sustainability for fisheries and marine ecosystems. Rather, they represent a practical and emerging 'best practice' means of operationally accommodating ecosystem-related objectives in fisheries management.

Use of marine protected areas to achieve ecosystem objectives in fisheries management

Fisheries have long used some forms of spatial management, such as closure of nursery areas to protect juvenile fish, but more recently there has been a focus on use of marine protected areas (MPASs) to achieve fishery objectives for the target species and the for the ecosystem generally.

MPAs hold promise as a rational and practical way of managing ocean resources to achieve fishery ecosystem objectives, although this promise should not be overstated. MPAs are best seen as part of a collection of management tools and measures, with a combination of on-reserve and off-reserve measures being used together to achieve sustainable fisheries and marine ecosystems. Several new technological developments are making their design and management more practical. These recent development are reviewed.

Salafsky, N.; Margoluis, R. & Redford, K. (2002) Adaptive Management: A Tool for Conservation Practitioners. Washington, D.C.: Biodiversity Support Program.

Abstract not available

Sale, PF., Cowen, RK., Danilowicz, BS., Jones, GP., Kritzer, JP., Lindeman, KC., Planes, S., Polunin, NVC., Russ, GR., Sadovy, YJ. & Steneck, S. (2005) Critical science gaps impede use of no-take fishery reserves. *Trends in Ecology and Evolution* 20, 74-80.

As well as serving valuable biodiversity conservation roles, functioning no-take fishery reserves protect a portion of the fishery stock as insurance against future overfishing. So long as there is adequate compliance by the fishing community, it is likely that they will also sustain and even enhance fishery yields in the surrounding area. However, there are significant gaps in scientific knowledge that must be filled if no-take reserves are to be used effectively as fishery management tools. Unfortunately, these gaps are being glossed over by some uncritical advocacy. Here, we review the science, identify the most crucial gaps, and suggest ways to fill them, so that a promising management tool can help meet the growing challenges faced by coastal marine fisheries.

Salm, RV., Clark, JR. & Siirila, E. (2000) Marine and coastal protected areas: a Guide for Planners and Managers. IUCN, Gland, Switzerland, 370 pp.

Approaches to planning and managing marine protected areas (MPAs) have evolved considerably since the first edition of this book was published in 1984. The original version arose from the Workshop on Managing Coastal and Marine Protected Areas, held in October 1982 during the World Congress on National Parks in Bali, Indonesia. A second edition was printed in 1989, with minor revisions. This second edition was exhausted several years ago, but demand for the book remained high. However, as so much has changed over the past 15 years, and so many new lessons have been learned, there is evident need for a major update. This Third Edition answers that demand. Even today, some 15 years later, the feedback we have received is that the book is a practical tool with an applied, "hands-on," viewpoint. This was the book's original intention and remains the main goal of this revision. It is still intended as a guide for people who find themselves with mandates to plan individual or national systems of marine protected areas (MPAs), or both, and need a philosophical context for marine protected areas along with some basic principles and approaches to establish them. Wherever possible, case studies are used to illustrate points or processes by "real world" examples. We would like to think that practitioners today will find this version as useful as our counterparts and colleagues did the original "Orange Book" during the past many years.

The book derives from many sources, including the 1982 Bali Workshop papers and summary reports of session chairs and rapporteurs. The participants of the workshop remain contributors to this version of the book. It is heartening to find how relevant these original outputs are today. But the field of conservation science and theory have evolved enormously over the past two decades, which has been a period of catch-up for marine protected areas with those on land. We have reached the point where one book can only introduce the huge body of thought and publications on theory, science and policy surrounding MPAs and the vast quantity of new practical experience (largely embodied in the gray literature). In revising this book, we have accessed some of the least accessible techniques and practices, many of which remain unpublished.

One new trend is important - the emphasis on community participation mechanisms. Also, there have been major advances in the last two decades on the challenge of sustainability of MPAs through innovative financing mechanisms, partnerships with the private sector and NGOs, and collaborative management between government and coastal communities. These advances have brought along with them new approaches for MPA establishment and management that are more participatory, involving communities through interaction and collaboration rather than prescription. While it has become popular to write about participatory and collaborative management, we are still testing and refining different approaches. We may need ten more years in most cases before we can separate reality from easy optimism and say that one or another approach is a real success. This applies especially to the emerging field of collaborative management—partnership between government and communities, NGOs and/or the private sector (especially those concerned with tourism). In the search for published material to use in the first edition of this book, it soon became apparent that relevant publications on planning and managing marine and coastal protected areas were scarce. There are more today. In the early 1980's, the MPA creation and management field was new and evolving with few tested practical tools and little to publish. As a result, the book drew heavily on personal experience and displayed a strong bias toward personal styles of approach. These days we are blessed with a wider variety of published materials and tools, but there still exists a deficit of tested, proven, practical results, particularly in collaborative management. So again, the personal experiences of the authors tend to influence the book.

This is a book for practitioners in tropical countries. It is meant to complement modern texts covering policy aspects of MPA selection and design by providing approaches and tools for everyday application at field sites. Until the modern theories are tried, tested, refined, proven, and generally absorbed into everyday practice, there will always be the need for approaches that get results on the ground. Given the urgency to act now and safeguard what we have before it is lost, we need to lock up what we can in conservation and to strive over the longer term for perfection. Practitioners who see their reefs being blasted apart, their mangroves being cut, their beaches and dunes eroding, their coastal wetlands being clogged with silt, or their MPA boundaries being ignored or encroached upon often make the same remark: "We need to do something now to safeguard what we have, based on the best available information." That "something" often means "We need to engage the stakeholders (communities, private sector, tourism industry, government) and work with them to achieve compliance with our programme and its objectives, and we need to do it fast." It is to this audience that we are attempting to cater: to give the practitioner in a tropical country some very basic approaches and tools to take those immediate first steps.

Samoilys, M.A.; Martin-Smith, K.M.; Giles, B.; Cabrera, B.; Anticamara, J.; Brunio, E.O. & Vincent, A.C.J. (2006) Fish responses over seven years in five coral reef sanctuaries in the central Philippines. Fisheries Centre Working Paper #2006-10. The University of British Columbia, Vancouver, Canada.

No-take marine reserves are increasingly promoted as a simple, precautionary measure to conserve biodiversity and sustain coral reef fisheries. However, rigorous empirical assessment of their effects has lagged behind theoretical studies. We surveyed changes in fish communities for seven years. Our transects were located within (Inside) five small reserves in the central Philippines, within a kilometre of their boundaries (Outside) and at three distant Control sites. We found significant differences between fish communities Inside and Outside the reserve only at the two sites with strictest compliance with fishing prohibition, while there were significant differences to distant Control sites in all cases. The strongest responses to reserve protection were found in predatory fishes (groupers and breams) and in butterflyfish. Other abundant fish families showed weak effects of protection. For all taxa analysed, we found significant effects of reserve Site and Site x Treatment interactions. The detection of fish responses to reserves is complicated by potential spillover effects, site-specific factors, particularly compliance, and the difficulty of identifying appropriate control areas.

Simard, F. & Lundin, C.G. (2005) Japanese fishing rights and biodiversity conservation. Summary paper submitted to the First International Marine Protected Areas Congress, Geelong, Australia, October 2005, 5 pp.

There exist many examples of fishing customary rights and tenures all around the world. The Japanese system is interesting mainly for two reasons: 1. it concerns a huge number of fishers grouped in fisheries cooperatives; 2. it is ancient and traditional however institutionalized during the reform of the Constitution in 1948. The system includes several management tools for the coastal zone around Japan, e.g. temporary and permanent closures, no-take zones, and other fisheries regulations. It is an example of strong local governance within a fairly centralized country. This paper looks into this fishing right as a management tool for local communities on a large scale and discusses the values of such systems for both biodiversity conservation and sustainable development.

Stefansson, G. and A.A. Rosenberg (2005) Combining control measures for managing fisheries under uncertainty: quotas, effort limitation and protected areas. Proceedings of the Royal Society: B. 360:133-146.

We consider combinations of three types of control measures for the management of fisheries when the input information for policy decisions is uncertain. The methods considered include effort controls, catch quotas and area closures. We simulated a hypothetical fishery loosely based on the Icelandic cod fishery, using a simple spatially explicit dynamic model. We compared the performance with respect to conserving the resource and economic return for each type of control measure alone and in combination. In general, combining more than one type of primary direct control on fishing provides a greater buffer to uncertainty than any single form of fishery control alone. Combining catch quota control with a large closed area is a most effective system for reducing the risk of stock collapse and maintaining both short and long-term economic performance. Effort controls can also be improved by adding closed areas to the management scheme. We recommend that multiple control methods be used wherever possible and that closed areas should be used to buffer uncertainty. To be effective, these closed areas must be large and exclude all principal gears to provide real protection from fishing mortality.

Stotz, W. (1997) Las áreas de manejo en la ley de pesca y acuicultura: primeras experiencias y evaluación de la utilidad de esta herramienta para el recurso loco. Estud. Oceanol. 16: 67-86 1997.

In north-central Chile the fisherfolk unions began to protect coastal areas at the end of 1990, one year before the management areas appeared in the Chilean fishery law as a new management tool. The areas were selected for the protection of the snail *Concholepas concholepas (`loco'),* whose fishery had been closed for several years, but nevertheless, was suffering an important illegal capture. The only management decision was to prohibit fishing in the areas. As a result, a rapid increase of the abundance of the "loco" was observed in the areas. Nevertheless, in the area that was first established, the abundance exceeded the carrying capacity before legal extraction was authorized. The "loco" population overexploited his prey species, and then emigrated from the area. The present general low abundance of 'locos", in the management areas, as well as in the historical fishing areas, are frustrating the expectations the fisherfolk unions had in this new management tool. Many of them are abandoning the care of their areas. The present paper analyses this experience and evaluates, in view of the characteristics of the life history of the species, the possibilities or utility of the areas as a management tool to favour fishery production of this resource. The basic conclusion is that production of *Concholepas concholepas* in the management areas depends largely on oceanographic processes, which occur at scales which are not controllable in restricted coastal areas. Thus, little can be done to improve production in management areas, but proper management would help to make an efficient and sustainable use of the natural production of the resource. Restricting the fishery exclusively to management areas, and protecting the rest of the coast, could be beneficial. General management of the resource has to take account of the natural spatial and temporal variability of the abundance and production of the snail and his prey species. Nevertheless, the importance of management areas goes beyond its only objective to improve or maintain production of the resource. Its establishment offers the unique opportunity to perform management experiments, with different treatments and proper controls, using the different areas. Thus, the areas will help to improve knowledge and experience on fishery management. Furthermore, the establishment and administration of the areas strengthen the organization of fisherfolk unions, and include an important educational value, for all the people involved: academics, administrators and fisherfolk. Finally, the development of management strategies, which not only include biological, but also legal, social and economic aspects, will be favoured.

Subsecretaría de Pesca. (2004) Análisis del desempeño económico de las áreas de manejo 2000–2002.

1. Introducción

En los inicios de la implementación del Régimen de Áreas de Manejo y

Explotación de Recursos Bentónicos (AMERB), muchas hipótesis se plantearon sobre las posibles fortalezas de tal medida, que afectarían en el tiempo, tanto al recurso como a los agentes directamente involucrados, los pescadores. Dentro de estas presunciones, se planteó: un aumento de los precios promedios de venta; aumento de la biomasa, tanto del recurso principal como del secundario; esto aparejado de un aumento de los ingresos del pescador; mayor capacidad de gestión de las organizaciones y aumento de las tallas de los recursos, entre otras. Ya hace más de diez años, que las áreas de manejo han venido desarrollándose, inicialmente, como pruebas pilotos o experimentales en algunas regiones, y a la fecha, como una medida adoptada por casi todas las organizaciones de pescadores artesanales a nivel nacional. Aunque la mayoría de las fortalezas planteadas en aquellos años, son reconocidas por los involucrados hoy en día y evaluadas a nivel organizacional, difícilmente se ha podido cuantificar algunas de éstas, desde un punto de vista de su aplicación a nivel nacional. Si bien aún es difícil evaluar dichas fortalezas, por la falta de información, se puede rescatar ciertos resultados de algunas de éstas, como el precio, la captura y por ende, del ingreso percibido. Por cuanto y tomando la información de los estudios de seguimiento, se tratará de determinar si tales fortalezas se han cumplido actualmente, al menos para el período de evaluación.

Sweeting, C.J. & Polunin, N.V.C. (2005) Marine Protected Areas for management of temperate North Atlantic Fisheries – lessons learned in MPA use for sustainable fisheries exploitation and stock recovery. A report to Defra. 64 pages.

http://www.defra.gov.uk/fish/science/index.htm

With most fish stocks in the NE Atlantic at historically low levels there is pressure for more effective fishery management practices. One approach involves marine protected areas (MPAs), spatially defined areas of sea or estuary, where populations are protected from human extractive impacts (particularly fishing and contingent habitat damage).

Exhaustive lists of potential benefits of MPAs are largely derived from small conservation-oriented MPAs in tropical coastal waters. Use of MPAs for sustainable exploitation of temperate fisheries however, requires knowledge of how MPAs function in a radically different setting. This report reviews scientific information on existing well-studied MPAs in the North Atlantic and draws the following conclusions.

A CRITICAL INFORMATION SHORTAGE EXISTS.

(1) The design of MPAs (e.g. size, shape, management and objectives) varies greatly, however the science is biased towards small inshore MPAs. Very few MPAs in the temperate North Atlantic are well-studied and for fewer still have fishery effects been considered, severely limiting detailed lessons that may be drawn, especially regarding effects of strong protection at the large scales (100s-10,000s km^2) required for temperate fisheries management.

THERE ARE POTENTIAL BENEFITS OF MPAS BUT NONE ARE GUARANTEED.

(2) Establishment of even small MPAs (<10km^2) can lead to increased habitat quality in most habitat types, (particularly greater structural complexity) where fishing methods that interact with the seabed are excluded. There are positive links between such quality and growth and survival of some juvenile fishes, however such fisheries benefits are unquantified. Many critical fish habitats (e.g. maerl, sea grass beds, salt marsh and rocky and Sabellaria reefs) have inherent conservation value, thus an opportunity exists for conservation-oriented MPAs, some of which may benefit local fisheries.

(3) Enhancement of shellfish populations (e.g. scallop and lobster) inside MPAs often occurs because adult mobility is limited and the MPA effectively protects a component of the stock. There is some evidence that such increases benefit surrounding fisheries through net export of juveniles and adults ['spillover'] and of eggs/ larvae. MPAs can contribute to management of shellfish stocks.

(4) Evidence for benefits to temperate finfish inside MPAs is inconsistent. Strongly protected MPAs can benefit site-attached species (e.g. wrasse, rockfish on rocky reefs) and mobile finfish stocks (e.g. cod, mackerel, plaice) will benefit where hydrodynamic or topographic isolation effectively increase larval return and reduced adult emigration, or where strong management significantly reduces fishing mortality. But these conditions look to be rare, and light protection in very large MPAs (10,000s km^2) is inadequate to accumulate biomass within.

(5) Spillover and larval export depend especially on biomass build-up inside MPAs which is not guaranteed. Spillover relies also on animal mobility, which in turn influences biomass build-up in MPAs. In virtually all cases where spillover occurred, effects were localised (invertebrates – scale of 10-100s m, finfish – 100s m to km). In no case examined has spillover compensated for loss of fishing area. Larval export depends also on current dispersal and data on it are rare, even for the well-studied tropical reef MPAs. The magnitude of the larval export role of MPAs can therefore scarcely be predicted, and finfish (e.g. cod, haddock) represent a stumbling block to uncritical MPA application.

MANY FACTORS MITIGATE MPA BENEFITS.

(6) The argument that MPAs are more politically robust than other forms of fisheries management is rejected. The notion that MPAs reduce conflicts among users is valid in some cases but not others. Many supposed MPA benefits (e.g. maintenance of diversity of fishing opportunities, reduced variation in fisheries yield) remain inadequately tested even for reefs, thus there is no sound basis for planning MPAs for them.

(7) With few exceptions, highly mobile species benefit only from MPAs of very large size. Yet protecting such areas is manifestly extremely difficult for economic and social reasons and extension of existing fisheries management measures may prove the most effective approach.

(8) MPAs are not isolated from wider conditions. As spatially defined static entities, MPAs are vulnerable to environmental changes, including altered spatial and temporal distributions of fish and

habitat, pollutants and eutrophication. MPAs are not the hedge against fisheries management failures that advocates suggest.
(9) Effects of fishing are assumed to be reversible, yet marine ecosystems can be fundamentally altered in structure by fishing such that return to pre-closure conditions is impossible. Recovery of stocks inside MPAs or enhancement outside MPAs can be influenced by the complex population structure ('metapopulation') of the species involved. Thus interruption of larval dispersal by hydrographical isolation or reduction of supply will mean some MPA objectives become unachievable. Additionally, where stocks have fallen below critical densities required for successful reproduction (ie. 'depensation'), recovery may be negligible.
(10) MPA success should be based on benefit/cost assessments of whole areas, both inside and out of the MPA. For strongly-protected MPAs, other additional fisheries management measures are essential (e.g. large fleet or quota reductions) to mitigate effects of displaced effort which unless reduced decrease MPA benefit and in extreme cases the MPA becomes detrimental overall. Other socio-economic considerations including the extent of compliance with MPA regulations and direct economic costs (e.g. fuel) compared to benefits (i.e. catch) must also be considered.
(11) No-take MPAs are not the only way forward for MPA-based management and strict adherence to rules of thumb (e.g. percentage of habitat to be protected) may be misguided. MPAs require tailoring to specific objectives and local biological, social and physical conditions. MPAs need to be designed on a case by case basis.
(12) Fishery science has been blamed for failures of fisheries management, but gaps in MPA science mean that for MPA management to avoid the perceived pitfalls of fisheries science, more research of a new kind is needed.
CONCLUSIONS
This report suggests that MPAs are not a cure-all of fisheries management, but, under the right conditions, MPAs are valuable tools for the preservation and enhancement of certain critical habitats and management of site-attached shellfish and finfish populations. In very specific situations, MPAs may benefit the mobile species which are socio-economically the most important, however all MPAs should be assessed for their merit on a case by case basis that accounts for both internal and external effects of MPA establishment. The strict closure of large open sea areas is unlikely to be a good management measure, and the fundamental shift in policy which this would require should encourage renewed consideration of other management measures which may provide a more optimal cost/benefit distribution, although this might be in combination with light or small MPAs. However, many of the costs and benefits of MPAs remain speculative due to a lack of research on what is a comparatively new tool for fisheries management. There is a critical need to remedy this information deficit if MPAs are to fulfil their full potential in the areas indicated with confidence.

Verheij, E.; Makoloweka, S. & Kalombo, H. (2004) Collaborative coastal management improves coral reefs and fisheries in Tanga, Tanzania. *Ocean and Coastal Management* 47: 309-320.
Abstract not available

Villena, M. G. & Chávez, C. A. (2005) On the enforcement of territorial use rights regulations: a game theoretic approach. *Economia*, Brasilia (DF), v.6, n.1, p.1–44, Jan / July 2005.
Territorial Use Rights (commonly known as TURFs in the literature) consists in the allocation of fishing rights to individuals and/or groups to fish in certain geographical locations. A requisite for these communities to be granted fishing rights is the formulation of a management and exploitation plan (MEP). While thus far the literature on TURFs has been centred on the biological and technical aspects of it, to our knowledge there is no work squarely dealing with the issue of enforcement of the MEP that the community, once granted the fishing use rights, have to comply with. We formally explore this issue from an economic perspective by formulating a static game of norm compliance in a regime of common property resource exploitation. The key characteristic of this game is a monitoring and sanctioning mechanism, where fishermen monitor and sanction one another. We found that in the absence of any endogenous regulation from the part of the fishing community, TURFs can not avoid the economic overexploitation of the fishery. We discuss the importance of economic incentives (and disincentives) in the formulation of endogenous regulations aimed at ensuring compliance of the MEP.

Our results on the Revista EconomiA July 2005 relevance of economic incentives in the context of a TURF regulation can also be used to highlight the importance of less conventional enforcement tools.

Willis, TJ., Millar, RB., Babcock, RC. & Tolimieri, N. (2003) Burdens of evidence and the benefits of marine reserves: putting Descartes before des horse? *Environmental Conservation* 30, 97-103.

An extensive literature has appeared since 1990 on the study of 'no-take' marine reserves and their potential to make significant contributions to the conservation and management of fisheries, especially in tropical environments (see Polunin 1990; Roberts & Polunin 1991; DeMartini 1993; Roberts 1997; Allison *et al.* 1998; Guénette *et al.* 1998). The literature describes many potential benefits of marine reserves to fisheries, including increases in spawner-biomass-per-recruit and increases in larval supply from protecting 'source' populations (Jennings 2000). The important word here is 'potential'. Some claims made by advocates of marine reserves might be regarded as optimistic, whereas critics of reserves might sometimes have been unduly harsh. Conservation goals for marine reserves are often poorly defined, and differences of opinion regarding the efficacy of reserves for fulfilling any of their stated goals can frequently be attributed to a lack of good information with which to predict their effects. Here, we critically examine the literature from 1990–2001 to determine (1) the relative effort put into empirical and theoretical approaches to predict reserve effects, and (2) the quality of empirical evidence available to support theoretical predictions. It is not the purpose of this article to single out particular studies for criticism (although this is sometimes inevitable to provide examples), nor to draw conclusions concerning the efficacy of marine reserves. Our purpose is to examine the science, rather than politics, of the field of 'marine reserves'. We examined the relevant peer-reviewed primary literature from 1990–2001 by searching the Current Contents and Science Citation Index (ISI) databases using the keywords 'marine reserve' found anywhere in a paper. Also included were papers that were not in the search databases but were cited in papers that were (these included refereed proceedings of symposia, but excluded book chapters and unpublished reports). Only studies that directly investigated the effects of reserves were included. Many articles that explored specific biological issues mentioned marine reserves incidentally in the discussion. These were removed from the analysis, as were those concerned solely with policy, management or advocacy. The remaining papers (*n* _ 205) were classified into three groups, namely empirical (presenting field data from existing reserves), theoretical (conceptual or numerical modelling studies) and review (including notes and ideas papers based on other literature). With few exceptions, empirical papers reported some positive impact of the marine reserve or reserves under study, so these were carefully examined to determine (1) the robustness of the survey design, and (2) the effect size.

Worm, B.; Sandow, M.; Oschlies, A.; Lotze, H.K. & Myers, R.A. (2005) Global Patterns of Predator Diversity in the Open Oceans, *Science*, Vol 309:1365-1369.

The open oceans comprise most of the biosphere, yet patterns and trends of species diversity there are enigmatic. Here, we derive worldwide patterns of tuna and billfish diversity over the past 50 years, revealing distinct subtropical ''hotspots'' that appeared to hold generally for other predators and zooplankton. Diversity was positively correlated with thermal fronts and dissolved oxygen and a nonlinear function of temperature (È25-C optimum). Diversity declined between 10 and 50% in all oceans, a trend that coincided with increased fishing pressure, superimposed on strong El Nin˜o–Southern Oscillation–driven variability across the Pacific. We conclude that predator diversity shows a predictable yet eroding pattern signaling ecosystem-wide changes linked to climate and fishing.

Wright, A. & Hill, L. (1993) Nearshore Marine Resources of the South Pacific. Forum Fisheries Agency, Honiara, Solomon Islands. XVI.

Abstract not available

BACKGROUND PAPER 2

BIOLOGICAL AND ECOLOGICAL CONSIDERATIONS IN THE DESIGN, IMPLEMENTATION AND SUCCESS OF MPAs[1]

by

Louis W. Botsford, Fiorenza Micheli and Ana M. Parma[2]

Summary points

1) While Marine Protected Areas (MPAs) have a long history, there has recently been increasing interest in implementing them as a tool for fishery management. This interest is driven in large measure by the observation that some 25 percent of world fisheries are over-exploited or recovering from over-exploitation. To aid decision makers in deciding whether implementing MPAs will improve their fisheries and marine ecosystems, and in selecting the best MPA designs, we review what is known about their ecological performance from empirical observations and modelling studies.

2) The answer to the question of whether species will benefit inside reserves is reasonably well known. Empirical evidence from 70 existing marine reserves indicates that 63 percent of them have higher densities inside them than outside, 90 percent have higher biomass, 80 percent have a larger mean size of individual fish, and 59 percent have greater taxonomic diversity. The higher biomasses are primarily in fished species, and the effect is stronger for species at higher trophic levels and for species with greater body size.

3) The answer to the question of how reserves will contribute to the fisheries outside reserve is less well understood. The species that attain higher biomass or abundance inside reserves could contribute to fisheries outside through larvae produced in reserves being transported out of them. However, there is little empirical evidence regarding the magnitude and extent of the contribution of larvae produced within reserves to recruitment outside reserves.

4) Fish whose juvenile and adult stages are highly mobile could also contribute to fisheries outside reserves by juvenile and adult movement to outside the MPAs. However, individuals spending a large amount of time outside reserves will be exposed to fishing outside the reserves, hence more mobile species will be less well protected by marine reserves. Although empirical comparisons among species with varying adult mobility show that less mobile species increase more in abundance inside reserves, in other cases such comparisons are confounded by the stronger influences of fishing intensity.

5) Empirical evidence indicates that catch and CPUE of mobile species can be higher near marine reserves than far away from them, but few studies have assessed the net gain in catch and CPUE due to marine reserves when the loss of fishing area to reserves is accounted for. These few studies yielded conflicting results on whether increased CPUE around MPAs compensates losses associated with closure of fishing grounds.

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[1] This paper was produced for the FAO Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations (12–14 June, 2006).

[2] The views expressed in this paper are solely those of the authors, Louis W. Botsford, Department of Wildlife, Fish and Conservation Biology, University of California, Davis, CA 95616 United States, Fiorenza Micheli, Hopkins Marine Station, Stanford University, Pacific Grove, CA 93950, United States, and Ana M. Parma, Centro Nacional Patagonico (CENPAT), 9120 Puerto Madryn, Argentina.

6) There are no empirical comparisons of increases in catch with reserves to the increases possible through a reduction in fishing effort. Modelling studies indicate that the yield possible through management by marine reserves is approximately equal to the yield possible through conventional management. This implies that reserve implementation will increase yield only for heavily fished species (empirical evidence in Bullet 2). Exceptions to this approximate equivalence include species with pre-dispersal density-dependence, species with ontogenetic migration (e.g. specific spawning areas) and species with a distinct source/sink structure. For species with pre-dispersal density dependence, models suggest that yield may be less with reserves than with conventional management, whereas the opposite is predicted for species with distinct source/sink structure, if MPAs can be designed to protect sources.

7) The question of how to choose the size and spacing of MPAs currently depends on modelling results because there is no empirical information available regarding the dependence of yield and sustainability on size and spacing of marine reserves. Modelling studies of the level of sustainability brought about by different size and spacing of reserves indicate that, when there is intense fishing: (1) single reserves will sustain species with larval dispersal distances less or equal to the linear dimension of the reserve, and (2) systems of many marine reserves will sustain species with larvae dispersing any distance, when the fraction of area covered in reserves is greater than the minimum fraction of lifetime egg production needed for replacement. The latter is a network effect. The reserve area required for sustainability is less when there is less fishing outside reserves.

8) Management by MPAs depends on different uncertainties than conventional fishery management. The significant uncertainties relevant to the design of marine reserves are the limited knowledge of larval dispersal patterns, a poor understanding of the minimal individual replacement (i.e. minimum Lifetime Egg Production or Spawning Potential Ratio) required for population sustainability, and indirect effects of protection in reserves through species interactions. Conventional fishery management shares a critical dependence on the last two elements, and has, in addition, considerable implementation uncertainty.

9) The decision as to whether to employ marine reserves for fishery management may be approached differently depending on the amount of ecological and socio-economic data available. For data-rich management environments, the ecological aspects of design and implementation of reserves can be approached through a modelling framework. Uncertainties can be identified and explored and performance of different reserve designs combined with other conventional management tactics can be compared under different scenarios that represent the existing uncertainty. Even in data-rich situations, major uncertainties remain (see bullets 3 and 8) and it is important that learning through monitoring is included in the implementation plans.

10) For data-poor management environments, rules of thumb from the modelling studies may be useful. The influences of management costs, practicality of implementation and enforcement, and uncertainties (bullet 8) on the decision of whether to implement reserves or conventional quota or effort management differ from the data-rich case. Reserves, probably in combination with some form of effort limitation, tend to be more advisable than catch quotas when many species are taken by the same gear and when the resource has a persistent spatial structure due to low mobility of the individuals (see bullet 4).

1. INTRODUCTION

Over the past several decades a substantial number of marine protected areas (MPAs) have been implemented throughout the world, and the creation of more has been recommended. MPAs have been created and are recommended both to improve fishery management as well as to preserve biodiversity. The former is motivated by the observation that some 24 percent of world fisheries are overfished, depleted or recovering (e.g. Garcia and Grainger 2005). As their use increases there is a need to establish guidelines for their design, implementation and evaluation. Here we provide the ecological/biological aspects of the scientific background required for those guidelines.

Design, implementation and evaluation of MPAs all rely on an understanding of how MPA performance depends on both MPA configuration and species life history characteristics. Because the use of MPAs is a form of spatial management, the important life history characteristics are the various kinds of movement over space, i.e. in the larval stage, as well as the juvenile and adult stages. Although spatial aspects of population dynamics have been addressed in some analyses of conventional fisheries (e.g. Beverton and Holt 1957), the fundamental dynamics are different enough that the intuition of a typical fishery analyst or manager may be inadequate to address the design of MPAs. Also, because performance in spatial management depends on different processes than conventional fisheries management, management with MPAs will need to deal with different sources of uncertainty.

The major components of performance of interest in this investigation of the use of MPAs in fishery management are persistence (or sustainability) and yield. These are the same two issues that form the central focus of the Food and Agriculture Organization of the United Nations' (FAO) guidelines for conventional fishery management, with population persistence typically associated with Limit Reference Points (LRPs) and yield typically involved in Target Reference Points (TRPs) (FAO 1995). MPAs created for the preservation of biodiversity also involve persistence as a goal, while possible resulting reductions in yield are treated as a cost. Persistence and yield are population level characteristics, while MPAs are typically viewed as a tool for ecosystem management. However, population persistence is important to ecosystem management also, since ecosystems cannot exist without persistent populations. We also address here, the way in which MPAs affect species differently, as well as how MPAs will affect community interactions between species.

To describe how performance depends on MPA configuration and location we first turn to direct empirical evidence. We describe several examples of observed performance of MPAs, as well as the existing major meta-analyses of MPA performance. Unfortunately, the lessons for MPA design and implementation from empirical evidence are limited. The difficult task of monitoring MPAs to compare the responses of yield and sustainability to MPA configuration and location over a range of species and life history characteristics is seldom undertaken. Information is usually limited to a comparison of biomass or abundance inside vs. outside the MPAs for a limited number of species. Therefore, after reviewing the existing empirical information, we also review the information available from modelling studies of how fished populations respond to the implementation of MPAs. In most cases the models involve an extension of conventional fishery modelling to add explicit movement and spatially heterogeneous fishing rates. Although these models extend the dynamics beyond what is supported by typical observations of MPAs, they increase our understanding of the spatial dynamics, and can increase our ability to focus on the important empirical gaps in our knowledge.

Both the empirical evidence regarding performance of MPAs and the population modelling results can be put in an accessible context by briefly reviewing what might be expected to occur when an MPA is implemented. Focusing on a single species initially and assuming that fishing effort is reduced to zero within the MPA, the initial effect inside the MPA would be a "filling-in" of the age or size structure, which would have been truncated by fishing. This would tend to increase abundance and biomass in the MPA, and the amount of that increase would be greater the more intense the fishing had been. The new value of fishing mortality rate F with the MPA would depend on the mobility of the fish occurring in the MPA, essentially on how much time they spent outside of the MPA. For species with little juvenile and adult movement, F would be close to zero. For mobile species, as the time spent outside the reserve increased, there would tend to be less protection in the reserve (greater F), but there could also be greater yield outside the reserve. The fishing mortality rate outside the reserve would also depend on the response of fishermen to the reserve, i.e. whether they continued to fish and simply shifted their effort outside the reserve (Smith and Wilen 2005).

An important, but more complex question would be whether we would expect recruitment to increase, both inside and outside the MPAs. We know that for fished populations that are assumed to be well-mixed over space, the equilibrium recruitment to a population is determined by a single stock-recruitment relationship (actually the (total egg)-recruitment relationship). The equilibrium recruitment is at the intersection of that curve with a straight line through the origin with slope 1/LEP, where LEP is lifetime egg production (Sissenwine and Shepherd 1987) (Fig. 1). From that relationship, we know that for moderate to low abundance, as LEP declines, recruitment declines and vice versa. The population ceases to persist (i.e. the equilibrium level is zero) when LEP is small enough that the slope of the straight line exceeds the slope of the egg-recruit function at the origin. This result is important because it means that for population sustainability we do not necessarily need to know the stock-recruitment relationship, we only need to know the point at which the LEP drops below a certain value. This aspect of this density-dependent population dynamics is similar to the lifetime reproduction, R_0, in density-independent population dynamics. Fisheries analysts have examined the question of how much spawning biomass per recruit is enough to sustain populations using conventional stock-recruitment relationships and have concluded that the fraction of LEP (FLEP) at which the population ceases to persist can be reasonably bounded, at least over taxa of similar species (Myers *et al.* 1999, 2002). A value of FLEP of 35-40 percent was originally proposed as a safe management target for maximizing productivity (Mace and Sissenwine 1993; Clark 1990). That value has been determined to be too small for some species (e.g. Ralston 2002).

The essential question when we shift from persistence of a single well-mixed population to a population distributed over space is how to interpret LEP in a spatial context, especially when an MPA is implemented. Since LEP is essentially a measure of the degree to which individuals are tending to replace themselves through reproduction, we need to reinterpret that replacement in a spatial context. In conventional fishery management we assume that the LEP of all eggs or larvae, that is their capacity to replace themselves, is independent of where they settle. But when MPAs are present, larvae may settle either inside or outside of an MPA. Those that settle inside will survive longer and produce more eggs in their lifetime than those that settle outside. To describe replacement in the case with MPAs then, for each location we need to know the fraction of larvae produced there that will settle in MPAs, and the fraction settling outside, and the LEP associated with each location. In addition, because we are concerned with replacement, we need to know the larval return produced at each settlement site (see Botsford and Hastings 2006 and Hastings and Botsford 2006 for further details). This modified concept of replacement suggests that we should expect abundance to tend to be greater when MPAs are larger or closer together. Furthermore, if the distance over which larvae disperse is shorter, we would expect recruitment to tend to be greater in the MPAs because fewer larvae will settle outside the MPAs thus leading to greater replacement.

This brief, qualitative description gives us some idea of what to expect from MPAs, but it also underscores some of the difficulties in attempting to understand the performance of MPAs solely from empirical evidence. Essentially, many mechanisms will tend to increase or decrease abundance in MPAs, hence any single observation of an MPA tells us little about the operative processes. Understanding enough about MPAs to design them on the basis of empirical information alone would require well-planned experimental design and extensive meta-analysis. The description above also points out the opportunities (needs) for a better quantitative understanding of the various processes involved. For the time being at least, those questions are being addressed through modelling.

Before reviewing what is known about the performance of MPAs, it is useful to summarize what we would want to know to design and implement them, as well as to monitor their performance. Much of the effort in the literature associated with MPAs has been focused on obtaining a *strategic* view of their performance, e.g. asking questions such as, how frequently does abundance increase when an MPA is implemented? As we see in the following sections, the answer is that abundance within a reserve increases in a large fraction of cases studied. Unfortunately the answer to that strategic question does not help us to design effective MPAs. An agency designing and implementing an MPA would want to maximize the chances that the MPA had a positive effect on the population or fishery or ecosystem of interest. Hence they would want to know which aspects of MPA design or species life history have determined whether they increase, and by how much. Thus, for the design and implementation of MPAs, there is a need to develop a *tactical* approach to marine reserve performance to complement the strategic results.

When the purpose of the MPAs is fishery management, the primary design goal is not just an increase in abundance inside the reserves, but rather an increase in the catch or sustainability of a fishery. The primary decisions to be made are what should the size and spacing of the MPAs be, where should they be located, and how should the management of the fishery outside the MPAs be changed. We therefore would like to know how the size, shape and location of MPAs, and the level of fishing outside MPAs would affect sustainability and yield of the fishery. Furthermore, the effect of the MPAs on fisheries is relevant even when the overall goal is just to conserve biodiversity. In that case sustainability (persistence) is the primary issue, and the effect on fishery yield may be a cost of MPA implementation.

2. EMPIRICAL OBSERVATIONS

This section reviews what is known about the effects of MPAs on populations, communities, and fisheries productivity, based on previous syntheses and individual case studies. Examination of empirical evidence will highlight: (1) general responses from protection in reserves; (2) reserve attributes, environmental characteristics, and life history correlates of differential responses among locations, ecosystem types, and species; and (3) remaining uncertainties about the types, magnitude, and directions of effects.

2.1 Population and community responses to protection in MPAs

A majority of empirical studies of marine reserves has compared populations or community measures before/after the establishment of reserves, or between reserves and adjacent locations with similar habitat characteristics. Review of 89 studies, including data from 70 reserves, showed that in a majority of studies (Fig. 2) no-take reserves host greater densities (63 percent of reserves), biomass (90 percent), mean sizes of organisms (80 percent), and taxonomic diversity (as species richness; 59 percent) compared to reference conditions (Halpern 2003). Only a minority of reserves had lower values for these biological variables, compared to reference conditions: 7 percent of reserves had lower densities, 2 percent had smaller organisms, and 10 percent had lower species diversity compared to reference conditions, whereas in no instances did reserves have lower biomass (Halpern 2003). Synthesis of quantitative results from 69 of these studies revealed that, on average, values of density, biomass, organism size, and species diversity were 91, 192, 31, and 23 percent greater in reserves, respectively (Fig. 3). While these studies include a variety of levels of replication and most frequently consist of spatial comparisons between reserves and adjacent fished areas, rather than before-after control-impact designs, the consistency of results across systems and types of study design suggests that results are robust. Although a systematic analysis of how results of each study may be influenced by the specific design and level of replication has not been conducted, meta-analytical techniques are designed to give greater weight to studies with higher and more balanced replication (e.g. lower sampling variance), thereby partly accounting for such hetereogeneity in the dataset.

Other meta-analyses, similarly utilizing comparisons between no-take reserves and reference conditions also highlighted differential responses to protection among taxonomic and functional groups. Mosquera *et al.* (2000) conducted a meta-analysis of species-level data extracted from 12 studies, for a total of 346 fish species from 56 families. Overall, fish abundances were over three times greater within reserves, however there was high between-species variability in responses, with a subset of fish families (7 of 19) showing significantly greater abundances in reserves, and thereby driving the overall density increase. In contrast, no statistically significant difference was detected in 11 families, and one (Gobidae, small-bodied, omnivorous benthic fishes typically not targeted by fishers) had significantly lower densities within reserves (Mosquera *et al.* 2000). Additional analyses indicated that much of this variation could be attributed to the fishery status of species, with only species targeted by fishing outside reserves showing significantly greater densities within the reserves, and no significant differences for non-target species. Moreover, the species' body size was also an important factor in determining variation in responses to protection, with species characterized by large maximum body sizes showing the strongest positive responses (reaching densities up to 33 times greater in reserves than in adjacent fished areas), and the magnitude of effects increasing with increasing body size (Mosquera *et al.* 2000). Because maximum body size is generally correlated with life history parameters such as age at maturity, growth, and reproductive output, this variable may be a surrogate for predicting recovery rates (Jennings *et al.* 1999; Jennings 2001).

Meta-analysis of additional studies (20 studies, from 31 different temperate and tropical locations) also found that only fished species exhibited significantly greater abundances in no-take reserves, whereas non-target species had similar abundances between reserves and reference fished areas (Micheli *et al.* 2004). These analyses indicated that different overall population increases in no-take reserves occurred for different levels and types of exploitation (Fig. 4): species that are primary fisheries targets, that are caught occasionally or as bycatch, and species targeted by the aquarium trade all showed significantly greater abundances in reserves, with similar average magnitudes of the effect of protection across these three exploitation groups (Micheli *et al.* 2004). Although all trophic groups except the omnivores had significantly greater abundances in no-take reserves, the largest increases were observed in species at the top of food webs (piscivores, with trophic levels >3.5) (Fig. 5). Piscivores accounted for 10-43 percent (av. 24.5 percent, N=10) of total fish biomass, as compared to 5-24 percent (av. 15.5 percent, N=10) outside reserves. A finer categorization of species into functional groups taking into account not only a species' trophic level, but also its maximum size and mobility showed that in addition to abundances and biomass increasing disproportionately for some trophic groups, protection in reserves results in overall greater functional diversity, with specific combinations of trophic levels, size and mobility represented only within protected areas, and not in the presence of fishing (Micheli and Halpern 2005).

Piscivorous fish were also the only group to show a significant, positive relationship with the duration of protection within no-take reserves, with magnitudes of responses increasing since time of establishment across different reserves (Micheli *et al.* 2004). Thus, in addition to fisheries status of species, a species trophic level and the age of reserves interacted in determining responses to protection, with evidence for a gradual build up of top predators biomass within reserves over decadal time frames (Micheli *et al.* 2004).

Trends from these spatial comparisons corroborated results of both spatial comparisons and long-term monitoring from specific locations. These case studies showed that large-bodied, long-lived top predators respond slowly to protection, and frequently do not show a levelling off of abundance and biomass even after decades of protection in no-take reserves (Russ 2002). Monitoring of Serranidae (grouper), Lethrinidae (emperors) and Lutjanidae (snapper) at both fished and unfished coral reef locations within Apo and Sumilon islands, in the southern Philippines, revealed significantly greater biomass within reserves after four years of protection (Russ *et al*. 2005). Over 18-year long monitoring of these locations, the relationship between predator biomass and duration of protection was exponential within reserves, and linear outside. Rates of biomass buildup were similar between these temporal monitoring and spatial comparisons among 15 reserves with varying durations of protection (Russ *et al.* 2005), except that significantly greater biomass within reserves was evident after a slightly longer duration of protection (six years) compared to results from long-term monitoring (four years).

Species other than top predators can also show lags in recovery, either because of slow population turnover or through indirect effects mediated through species interactions. For example, establishment of the Mombasa Marine National Park in Kenya was followed by increases in a sea-urchin predator, the wrasse *Chelinus trilobatus*, during the first three years (McClanahan 2000). However, sea urchin declines and recovery of benthic corals occurred after more than ten years, and coincided with later recovery of the triggerfish *Balistapus undulatus*, also a predator of sea urchins. Data from five fully protected Kenyan MPAs indicate that populations of *B. undulatus* showed positive trends in their abundances after over 30 years of protection (McClanahan 2000).

Rapid buildup of abundances and biomass documented at specific locations, (e.g. Caribbean coral reefs, Roberts 1995) and in meta-analyses of marine reserve studies (Halpern and Warner 2002), where significant increases occurred within 1-3 years of protection, appear to be driven by rapid responses of fished species with short generation times. Documented slower recovery of long-lived species and lags in responses through indirect effects (e.g. predator-prey and competitive interactions, or habitat recovery) lead to temporal changes in community composition and relative dominance by different species and trophic groups, with reserves moving through a series of transient states (e.g. McClanahan 2000; Shears and Babcock 2003; Micheli *et al.* 2004).

For long-lived species, a key mechanism in allowing for population recovery and possible contribution to adjacent fisheries is the effect of protection on age and size structure, in particular the increased survivorship of larger individuals. Because in most fish and invertebrates fecundity increases approximately cubically with length, older, larger individuals contribute disproportionately to reproductive output from the populations, producing quantities of gametes orders of magnitude greater than small reproductive individuals (Sadovy 1996 and Bohnsack 1998 describe the impact of this well known fact on marine reserves). Shifts in age and size structure towards larger size classes and older individuals have been commonly documented in marine reserves across multiple fish and invertebrate species and in different ecosystem types (e.g. Polunin and Roberts 1993; McClanahan and Kaunda-Aurara 1996; Russ and Alcala 1996; Wallace 1999; Paddack and Estes 2000; Mumby *et al.* 2006). Based on size-fecundity relationships, reproductive output has been estimated to be up to four times greater following reserve establishment (e.g. for Nassau grouper in the Exuma Cays Land and Sea Park, Bahamas, Sluka *et al.* 1997; or abalone in British Columbia, Wallace 1999; and for rockfish in central California, Paddack and Estes 2000).

As discussed earlier, a life history trait that is expected to influence species responses to protection in marine reserves is a species' mobility. A species with high mobility relative to reserve size would receive less protection than a more sedentary species. Empirical support of this prediction is scarce and contradictory. Fisher and Frank (2002) examined changes in community composition from a 31-year time series of abundances of over 70 fish species within a fishery closure and an adjacent reference area on the Scotian Shelf, Canada. A preliminary review of life history attributes for 16 species in this dataset indicated that different trajectories may be related to dispersal ability of the species. Species with benthic eggs, ovoviviparity, and small body size (i.e. species likely to have limited dispersal in the larval, juvenile or adult stages), tended to benefit from the fishery closure more than those with pelagic eggs or larger body sizes, (i.e. potentially greater dispersal abilities and home ranges, Fisher and Frank 2002).

In contrast, meta-analysis of responses to protection in species assigned to different adult mobility classes (sedentary or territorial, mobile, and highly mobile or migratory), failed to detect any overall differences in responses in relation to mobility (Micheli *et al.* 2004). In these analyses, the lack of an effect of species mobility on their responses to protection may be explained by the strong positive correlation between mobility and exploitation level among the species in this dataset (r=0.38, P=0.0001, N=920). Thus, mobile species tend to be subject to intense fishing pressure and the expected dependence of effects of protection on species mobility may be obscured by the counteracting dependence on exploitation level.

Larger reserves are expected to support higher population densities and more diverse communities. However, differences in densities (in terms of biomass and numbers), mean organism sizes, and species diversity were not correlated to reserve sizes across reserves ranging from 0.002 to 846 km^2 in surface areas (Halpern 2003). Micheli *et al.* (2004) also found that the magnitude of responses of different trophic groups to protection in reserves was uncorrelated to reserve size. Though not generally supported by these synthetic analyses, the prediction that effectiveness of reserves is size dependent is supported by a specific case study. Among four Tasmanian coastal reserves, the largest reserve (7 km^2) contained overall greater fish, abalone and lobster sizes, densities of large fish, macroalgal cover, and species diversity of algae, fish and invertebrates compared to adjacent fished sites (Edgar and Barrett 1999). In contrast, in three smaller reserves (~0.6 km^2), significant differences were found only for density and diversity of large fish in one reserve, and for macroalgal cover in another (Edgar and Barrett 1999). However, observations from the large reserve are unreplicated, the three smaller reserves have a total surface area of less than 2 km^2, and even the larger reserve is fairly small. This is also an issue with the meta-analyses discussed above, where half of the reserves in the dataset ranged 1-10 km^2 in size, and the median reserve size was 4 km^2 (e.g. Halpern 2003).

These results show that even small reserves lead to some biological responses. But data over a broad range of reserve sizes or local, replicated comparisons of reserves of varying sizes are not available to allow for empirical tests of the effects of reserve sizes and spacing on reserve effectiveness. To our knowledge, no empirical studies have disentangled a possible effect of reserve size from the local confounding of how species characterized by different mobility and habitat use may be affected by reserves of different sizes. Therefore, the result that the magnitude of responses to protection by individual species and sets of species is uncorrelated to reserve size (Halpern 2003; Micheli *et al.* 2004) should be interpreted with caution.

From this brief review of empirical reserve studies, some general trends emerge. Much information has been gathered on how frequently increases in some biological variables occur. These include abundances, biomass, sizes, and diversity. Although several reviews have highlighted that marine reserve studies frequently suffer from problems with experimental design, particularly a dearth of replicated, long-term before-after/control impact studies (e.g. Russ 2002; Sale *et al.* 2005; Willis *et al.* 2003) the consistency in the direction of responses observed across multiple studies (Halpern 2003; Mosquera *et al.* 2000; Micheli *et al.* 2004), and documentation of positive effects in studies using BACI designs (Halpern and Warner 2002; Willis *et al.* 2003) indicate that documentation of benefits inside reserves is robust. In contrast, fewer studies have focused on recruitment, mortality and growth rates, and spatial distribution of individuals, e.g. variables that are key to understanding how reserve establishment influences population dynamics both within and outside reserves. For example, large-scale comparisons of recruitment and post-settlement mortality of seabreams (*Diplodus* spp.) across Spanish, French and Italian marine reserves did not find increased or decreased recruitment and mortality rates within reserves (Macpherson *et al.* 1997). However, more studies are needed before general conclusions can be drawn. Also, relationships with potential correlates of responses, including some life history traits of species (e.g. life span, body size, and trophic level), and some characteristics of reserves (e.g. duration of protection and reserve size) have been examined. In contrast, no systematic analyses have been conducted of how other life-history traits (larval durations and dispersal potential, growth rates, recruitment periodicity) influence species responses.

Moreover, the basic questions of how many reserves should be established, how big they should be, and how they should be arranged relative to each other to re-build populations, restore communities, and sustain fisheries are still largely unanswered in the empirical literature. Detailed process-based studies are difficult and costly. Also, few opportunities to investigate the effects of networks of reserves exist, and most studies have been conducted on one or few reserves. The recent or proposed establishment of reserve networks (e.g. the re-zoning and expansion of the Great Barrier Reef Marine Park, to include 33 percent of coral reefs in no-take reserves; the protection of 19 percent of the Channel Islands National Marine Sanctuary state waters in multiple reserves; the proposed establishment of a network of up to 40 reserves in the Bahamas; and the ongoing designation of a reserve network in coastal California through the Marine Life Protection Act) will provide invaluable opportunities for such empirical assessments (see Channel Islands Marine Protected Area Monitoring Plan, *http://www.dfg.ca.gov/mrd/channel_islands/monitoring.html*).

2.2 Habitat quality and configuration in marine seascapes

An additional question in MPA design relates to where reserves should be established, and specifically what habitat or oceanographic features they should include. Habitat characteristics are key considerations in reserve design. While most reserve planning to date has proceeded in an ad hoc fashion (Pressey *et al.* 1993; Stewart *et al.* 2003), more systematic approaches to reserve design and conservation planning have been advanced recently in terrestrial systems and are being applied to marine systems. Networks of MPAs are currently being designed in a variety of marine settings (e.g. the Great Barrier Reef, Australia, GBRMPA 2004; the Channel Islands, California, Airame *et al.* 2003; and Baja California, Mexico, Sala *et al.* 2002) based on the objective of maximizing representation of habitat and species per unit of area protected within the network (Possingham *et al.* 2000). It is assumed that protection of representative components of the biodiversity of a region will maintain or restore the ecological functioning of the ecosystem as whole (Possingham *et al.* 2000). Under the principle of representativeness, an MPA network is designed so that it includes at least a minimum portion of each conservation target (e.g. habitats or populations) within the network. This translates to a goal of including at least one example or a minimum percentage of the available area of each habitat, community or population in the reserve network, under the constraint of minimizing the total area or cost of the network (Pressey *et al.* 1993).

A variety of computer-based mathematical algorithms that apply the above criteria to spatial data on the distribution of biological features have been developed for the selection of alternative networks of MPAs (Ferrier *et al.* 2000; Possingham *et al.* 2000). Such models often formulate this as a minimum representation problem and attempt to select the minimum area that will meet the conservation target (e.g. represent 35 percent of every habitat type) (Kirkpatrick 1983; Pressey *et al.* 1993; Leslie *et al.* 2003). Minimizing area (and/or boundary length) while maximizing representation is assumed to minimize opportunity costs (e.g. lost opportunities for fishing or other extraction within reserved areas) and costs associated with implementing, enforcing and monitoring the MPA network (Possingham *et al.* 2000).

Surprisingly, few empirical studies have explicitly addressed how habitat quality and heterogeneity influence the performance of established reserves. Habitat is known to affect productivity of fish and invertebrate stocks, and thus to be fundamentally important to fisheries production (Dayton *et al.* 1995). Mumby *et al.* (2004) showed that in Caribbean coral reefs, biomass of several species, including fisheries species, is more than doubled when reef habitat is adjacent to mangroves, and that the parrotfish *Scarus guacamaia*, the largest herbivorous fish in the Caribbean, is present only on reefs that are adjacent to mangroves. Thus, inclusion or proximity to nursery habitats may be a key determinant of the performance of reserves in maintaining populations and contributing to fisheries production. Although no direct tests of this hypothesis exist, empirical evidence from case studies indicates that: (1) habitat composition within reserves can be a good predictor of what species are positively affected through protection; (2) declining habitat quality within reserves can result in population declines despite protection from fishing; and (3) habitat composition and heterogeneity around reserves may influence rates of spillover from the reserve to adjacent areas.

In the San Diego-La Jolla ecological reserve, one the oldest marine reserve on the United States west coast (established in 1971), higher densities of large individuals of green abalone (*Haliotis fulgens*), red sea urchins (*Strongylocentrotus franciscanus*), vermillion rockfish (*Sebastes miniatus*), and sheephead (*Semicossyphus pulcher*) were in boulder-reef, kelp and submarine canyon habitats respectively, compared to similar habitat types outside the reserve (Parnell *et al.* 2005). For vermilion rockfish, the only large individuals in the La Jolla area were likely to be found in the canyon within the reserve, highlighting how inclusion of a diversity of habitat types is key to maintaining source populations of species with specific habitat requirements. Thus, protection in the reserve affected densities of multiple species associated with specific habitat types, even though only 0.8 percent of the kelp habitat and 11 percent of the boulder-reef habitat in the La Jolla area are included in the reserve. However, it is important to note that several fished species did not exhibit any response to the reserve, and in fact in most cases declined in the reserve, with the exception of a few sedentary species, suggesting that the reserve might be too small (~2.16 km2) to protect populations with intermediate or high mobility (Parnell *et al.* 2005).

A combination of bleaching, increased sedimentation from terrestrial run-off, and outbreaks of the coral predator *Acantaster planci*, the crown-of-thorn starfish, caused coral decline between 1996-2003 from an average 66 percent to less than 7 percent live coral cover in four marine reserves in Papua New Guinea (Jones *et al.* 2004). Coinciding with habitat degradation, 75 percent of fish species declined in abundance, and 50 percent to half of their original abundance, despite continued protection in reserves. The occurrence and magnitude of decline was correlated to the dependence of a species' juveniles on coral as recruitment substrate, thereby linking habitat quality to population declines (Jones *et al.* 2004). In contrast with these results of continued habitat degradation despite protection in reserves, other studies comparing biogenic habitat between fisheries closures and fished areas indicated that cessation of fishing significantly influenced biogenic habitat. In a comparison of seafloor characteristics between one of the Georges Bank closures and an adjacent fished area, Lindholm *et al* (2004) found that the abundance of two biogenic microhabitat types, shell fragments and sponges, was greater within the closure than in the fished area, after 4.5 years of protection. In the same area, Collie et al (1997) had similarly documented that biogenic habitat was more abundant in areas undisturbed from fishing compared to disturbed sites. Undisturbed sites were characterized by an abundance of epifaunal taxa (bryozoans, hydroids, worm tubes) that provide a complex habitat for shrimps, polychaetes, brittle stars, mussels and small fish (Collie et al. 1997). Thus, in systems where habitat feature are dynamic, such as on soft sediments, habitat recovery in reserves may occur rapidly (few years).

Finally, spillover of reef-associated fishery species from Mediterranean MPAs is influenced by habitat configuration around reserves. In particular, fish densities decline significantly within tens of meters from the reserve boundaries on sandy bottoms, whereas gradual declines occur over ~ 2 km, indicative of greater spillover, over rocky bottom and mixtures of rocky outcrops and sand (P. Guidetti, *in preparation*). Thus, the function of structural habitat as 'corridors' connecting different areas, which has been demonstrated for vegetated habitats in estuarine environments (e.g. Micheli and Peterson 1999), appears to have the potential to influence spillover from reserves as well.

2.3 Effects on fisheries production

In contrast to the plethora of studies of effects of protection on populations and communities within reserves, fisheries effects of reserves have been addressed primarily through models (Section 3), and through studies conducted at specific locations. Here, we will review empirical evidence from these case studies.

Increased catch-per-unit-effort (CPUE), and in some cases, total catches around reserves has been documented in small no-take reserves established in coral reefs, temperate rocky reefs, and lagoonal or estuarine environments. In addition, extensive analyses of abundance and catch gradients across and away from reserve boundaries have recently been conducted around large (over 20 000 km^2 in total) fishery closures on Georges Bank (Murawski *et al.* 2004, 2005). These studies typically show fairly localized effects, with increased catches within hundreds of meters to a few kilometres from reserve boundaries, and variable results on whether increased CPUE around reserves or closures compensate losses associated with closure of fishing grounds. Examinations of trends for multiple species indicate that only a few exhibit patterns consistent with spillover, likely depending on species mobility, habitat preferences, and fishing patterns. Finally, the mechanisms underlying reserves' contribution to adjacent fisheries include juvenile or adult movements, as evidenced by examination of density gradients and tagging studies (reviewed by Gell and Roberts 2003). A few studies of species with sedentary adults also support the hypothesis of larval seeding from reserves into fished areas (Stoner *et al.* 1998; Gell and Roberts 2003), but empirical evidence for a larval contribution of reserves is more limited.

CPUE around coral reef reserves in Kenya increased by ~50 percent in a seven-year study of the fishery effects of a coral reef park in Kenya. Spillover was most pronounced for moderately mobile species in the families Lethrinidae (emperors), Acanthuridae (surgeonfish) and Siganidae (rabbitfish). However, this increase did not compensate for the reduced size of these coastal fishing grounds (~50 percent), and total catches were reduced by 30 percent following the establishment of the park (McClanahan and Kaunda-Arara 1996; McClanahan and Mangi 2000). By combining these field data and models, the authors concluded that the optimal reserve size for achieving an adequate balance between protection and spillover in coral reef fisheries dominated by species with moderate mobility should be 10-15 percent of the total area. However, the size of the optimal protected area may increase if larval export from the reserve is significant and if slow recovery of large-bodied species (see above) will contribute to larval, juvenile, and adult export over longer time frames (McClanahan and Mangi 2000).

Densities and biomass of large predators increased within 500 m from reserve boundaries in Apo Island, Philippines (covering ~10 percent of the coral reef fishing area of this island) during the first 11 years of establishment (Russ and Alcala 1996). Continued monitoring showed linear increase in biomass outside this and the Sumilon Island reserve boundaries over 18 years (Russ *et al.* 2005). Interviews with local fishermen indicated that fishery yields had increased following reserve establishment (Russ and Alcala 1996). Comparisons of fish yields from the early 1980s with roving creel surveys conducted between 1997-2001 at Apo Island confirmed increased CPUE from hook and line fisheries of nearly an order of magnitude between 1980-81 and 1997-2001, whereas total annual fish yields remained stable between 1980-2001 (Maypa *et al.* 2002), despite the reduced extent of the fishing area. The authors speculate that the islands setting relative to currents and large contributions to fish production by planktivores and their predators may contribute to supporting high and stable catches.

Additional examples are reviewed by Gell and Roberts (2003). These include fish trap CPUE increases between 46-90 percent five years after the establishment of coral reef reserves in St Lucia (Caribbean), more variable lobster catches close to the Leigh Marine reserve (New Zealand) boundaries than from areas far from the reserve, more common large catches, and 66 percent increases in trammel net CPUE of snappers groupers and emperors five years after the establishment of a network of five no-take reserves in the Egyptian Red Sea. Evidence of spillover also comes from studies of movements of individuals from protected to fished areas (crabs in the Sea of Japan, lobster in Newfoundland and New Zealand, sea breams in New Zealand and South Africa; see Gell and Roberts 2003). In addition, tagging studies have documented movements in the Nassau grouper from the Exuma Cays Land and Sea Park, Bahamas (Dahlgren 2004) and in lingcod from closures in south east Alaska (Starr *et al.* 2004). While temperate rocky reef studies typically documented spillover over scales of hundreds of meters to a few km from reserve boundaries, spillover can reach 10s or 100s km for more mobile species (e.g. tagged Nassau grouper migrating 100s km from the park, to spawning aggregations, Dahlgren 2004) and in estuarine and shelf habitats (e.g. Gell and Roberts 2003).

Murawski *et al.* (2005) documented local concentration of effort within 0-5 km from the boundaries of large fishery closures established in 1994 on Georges Bank. Average revenue per hour trawled ($pue) is currently greatest within 1 km from the boundary (averaging USD 470/hr), declining to USD 273/hr at distances between 10-50 km. Overall, $pue was approximately double within 4 km of closures compared to more distant locations, though catches near closure boundaries were more variable. Extensive analyses of density and catch gradients away from closure boundaries for 51 species/closed area combinations showed that only three species, haddock, yellow-tail flounder and winter flounder, showed significant density and catch declines with distance from closure boundaries, with haddock showing the strongest and most consistent patterns (Murawski *et al.* 2004, 2005). Aggregate measures also showing significant negative slopes (e.g. all species catch, groundfish catch, and $pue) were driven by catches of one or more of these species (Murawski *et al.* 2005). The authors stressed the possible roles of degree and patterns of movements of species (e.g. random dispersal vs. directional seasonal movements associated with spawning), the patterns of fishing effort distribution around closures, and habitat preferences of different species in influencing the occurrence and patterns of spillover (Murawaski *et al.* 2005).

Although most studies have documented spillover through movements of adults from the reserves to fished areas, only a few studies support the prediction of a contribution from the reserve to adjacent fisheries through larval spillover. This paucity of clear indications of recruitment effects is not surprising given the high variability in recruitment and the difficulties involved in ascertaining the source of recruits. On Georges Bank, legal-sized scallop densities were 9-14 times greater within the closures than outside after only five years from their establishment (Murawski *et al.* 2000). Areas of high fishing effort, based on remote monitoring of scallop fishing vessels, corresponded to the locations on the Bank where biophysical models of passive larval dispersal predicted increased recruitment through larval export from closed areas (Murawski *et al.* 2000, and references in Gell and Roberts 2003). Protection of 24-ha area of seagrass and mud flat to rebuild clam (*Anadara* sp.) stocks in Fiji resulted in increased abundances and sizes within the fishery closure and increased clam recruitment to adjacent fisheries (Gell and Roberts 2003). After three and a half years of protection, clam densities had increased 13 times within closures and 5 times outside, with significant increases in abundances within the smaller size classes both inside and outside closures, indicative of increased recruitment. Sampling of larval queen conch (*Strombus gigas*) within and around the Exuma Cays Land and Sea Park, a large Bahamian park protecting as no-take reserve 409 km^2 of marine habitat since 1986, documented increased larval production within the park, and larval export through the Exuma Cays (Stoner *et al.* 1998).

Review of these case studies indicates that increased CPUE commonly occurs, particularly close to reserve boundaries. Increased total catches, and thus evidence that reserves contribute to maintaining or enhancing overall fishery yields, are documented only in a few instances. Meta-analysis of results from nine studies of temporal change in catches coinciding with the establishment of reserves or fishery closures showed an average 306 percent increase in CPUE and 120 percent increase in total catches following reserve establishment (Worm *et al.* in press). Unweighted averages of effect sizes from these studies were significantly greater than 0, indicating significant overall enhancement associated with reserves, for CPUE but not for total catches. However, averages weighted by sampling sizes available in different studies resulted in both measures showing a positive effect of reserves, suggesting that the better replicated studies, driving patterns when weighting was applied, showed significant increases in total catches (Worm *et al.* in press).

Taken together, case studies indicate that fisheries benefits are likely to be context dependent (e.g. depending on the siting of reserves relative to oceanographic patterns, habitats included and adjacent to reserves, and patterns of fishing) and highly variable among species (e.g. influenced by movement patterns and habitat preferences of fisheries species). Thus, empirical studies of effects of marine reserves and fishery closure on fisheries production indicate that key considerations in the design of MPAs as tools for sustaining and re-building fisheries include the patterns of movement and dispersal in the larval, adult and juvenile phases, habitat configuration in the region and habitat use by focal species, and patterns of fishing and expected redistribution of effort. In addition, monitoring schemes with sufficient power to detect possible effects of reserves on fisheries yields need to be developed and implemented.

2.4 Community-wide effects through cascading interactions

Empirical studies of MPA effects within and outside their boundaries tend to show high among-species variation in responses, associated primarily with the species fishery status, life history characteristics, and trophic level. Often, responses to protection are driven by a subset of species. In cases where such a subset includes species that are strong interactors in the ecosystem, and are capable of controlling population abundances of prey or competitors, protection can result in broader community changes through cascading interactions. Indirect effects of protection through predator-prey or competitive interactions may affect pairs of interacting species or multiple trophic levels. Thus, in addition to community-wide change from differential species responses, build-up of strongly interacting species within reserves can influence whole community through trophic cascades.

Cascading trophic interactions influencing the structure and dynamics of whole communities within reserves have been documented in rocky intertidal ecosystems (e.g. Chile, southern California), coral reefs (Kenya, Caribbean), and temperate kelp beds and rocky reefs (in California, Alaska, New Zealand, Maine, and the Mediterranean Sea) (reviewed by Pinnegar *et al.* 2000). In these cases, cascades reversed community changes associated with predators' removal through fishing. For example, recovery of lobster and predatory fishes within temperate reserves in New Zealand, the Channel Islands, and the Medes Islands, Spain, coincided with decreased abundances of sea urchins, decreased grazing rates and recovery of macroalgae, and a shift from sea-urchin dominated barrens to higher-diversity macroalgal and kelp beds (reviewed by Pinnegar *et al.* 2000). Most examples highlight indirect effects of predator increases on specific species, most commonly benthic, relatively sedentary species such as herbivorous molluscs and sea urchins (Pinnegar *et al.* 2000).

No evidence of cascading effects on whole trophic levels has been detected by meta-analyses of empirical studies (Halpern 2003; Micheli *et al.* 2004). However, significant decreases within reserves were detected for an average of 19 percent of species across 31 locations examined by Micheli *et al.* (2004), suggesting that indirect effects on species, particularly small, relatively sedentary fish species not targeted by fishing, are relatively common. Negative correlations between time series of abundance indices for species linked through predator-prey or competitive interactions have also been documented at larger spatial scales in groundfish fisheries from the west coast of the United States (Mangel and Levin 2005) and the NE Atlantic Shelf (Worm and Myers 2003). Therefore, indirect effects of increases of strongly interacting species may be expected at both local and regional scales. In cases where MPA establishment results in increased mortality for species of commercial or conservation significance, responses may pose trade-offs between managing for population persistence or recovery of alternative species. Such potential trade-offs need to be addressed as considerations in reserve design, and the possible losses anticipated.

Few studies have addressed these trade-offs empirically. The re-colonization of central California by sea otters (*Enhydra lutris*) in the mid 1960s led to high predation rates and dramatic decreases in abalone (*Haliotis* spp.) abundances (Estes and VanBlaricom 1985; Wendell 1994). Recent comparisons of red abalone densities and size structure at sites within or outside the current range of sea otters in California showed that in the presence of sea otters, abalone have lower densities, smaller sizes, and tend to be restricted to cryptic microhabitats (Fanshawe *et al.* 2003). In the areas currently occupied by sea otters, fishing mortality of benthic invertebrates removed through the establishment of no-take marine reserves or the implementation of fishery closures may be replaced by high mortality from sea otter predation, with no apparent recovery of abalone and sea urchin abundances and mean sizes (e.g. Fanshawe *et al.* 2003). However, sea otter recovery has also likely allowed for kelp recovery from over-grazing by sea urchins (Estes and Duggins 1995). Thus, recovery of this predator may be accompanied by potential gains for other fisheries (e.g. rockfish, through recovery of kelp habitat). A systematic analysis of gains and losses with respect to multiple objectives in this and other ecosystems has not been conducted.

In addition, cascading effects of predator recovery in reserves may be more complex than the simple prediction of increased predators/decreased prey. Size structured species interactions, combined with species and size specific fishing mortality outside reserves can result in no change or even net increases in prey biomass following increased predator biomass. Mumby *et al.* (2006) compared the negative impacts of enhanced predation with the positive impacts of reduced fishing mortality on parrotfishes inside the Exuma Cays Land and Sea Park (ECLSP), Bahamas. Since the mass mortality of the urchin *Diadema antillarum* in 1983, parrotfishes have become the dominant grazer on Caribbean coral reefs. The grazing capacity of these fishes could be impaired by the documented six-fold increase in the biomass of their main predator, the Nassau grouper *Epinephelus striatus* inside the park. However, because large-bodied parrotfishes escape the risk of predation from Nassau grouper, the predation effect only reduces grazing by 4-8 percent. This impact is overwhelmed by the increase in density of large parrotfishes, which are caught in fish traps outside the park, resulting in a net doubling of grazing inside the park. Increased grazing caused a four-fold reduction in the cover of macroalgae, the principal competitors of corals, highlighting the potential importance of reserves for coral reef resilience.

An understanding of the patterns and strengths of species interactions in fished and unfished communities, and systematic analyses of possible indirect effects and trade-offs associated with alterations of community interactions through marine reserves are crucially important for including multiple fisheries, as well as other economic (e.g. from increased tourism revenues, in the case of sea otters and kelp forests) and ecological (restoration of processes allowing for habitat recovery, e.g.

increased grazing and decreased macroalgal cover in coral reef reserves) benefits as considerations for the design of reserves that may pose trade-offs for species recovery.

3. POPULATION DYNAMICS

The empirical results in the previous section give us some information on what to expect when an MPA is implemented, but they do not answer some of the basic questions we would have in designing MPAs: e.g. how many, how large and how far apart? Broadly speaking, observations of MPAs have thus far focused on strategic questions such as "How frequently do abundance, biodiversity, size, etc. increase inside reserves?" at the expense of the more difficult tactical questions of "*Why* do abundance biodiversity, size, etc. increase inside reserves?" and "When do catch and CPUE outside reserves increase?" Unfortunately, while it is comforting to know how often certain attributes change inside reserves, to design reserves that increase abundance and fishery yield we need the answer to the questions "Why?" and "What happens outside?"

There are several reasons why the observations of MPAs are limited. One is that the processes we wish to observe, especially recruitment, display high random variability. A second is that MPAs are typically not designed with experimental design or adaptive management in mind. Because many characteristics can lead to a difference in abundance between reserves, observations of a few reserves without specific experimental design will allow some effects to be occluded by others. For example, recall that in the empirical observations in Section 2, the effects of different movement patterns were obscured by the differences in level of fishing.

Because we do not have a broad empirical basis on which to design and implement MPAs, we need to use models to examine the consequences of both the empirical information we do have and the information we do not have (i.e. the different sources of uncertainty). Examples of the former include individual growth rates, mortality rates and fecundities, as well as their dependence on size or age. These models will depend on many parameters and processes from conventional fishery management, but they will also include processes we have not had to describe explicitly in conventional management. Examples include larval dispersal and spatial patterns of movement of juveniles and adults. Because these processes are not well studied, they may introduce uncertainty into the application of MPAs.

3.1 Persistence (or sustainability)

To design marine reserves or predict how well they will protect a certain species, we need to know how characteristics of MPAs (e.g. size and spacing) and life histories combine to produce sustainable or persistent populations. For example, we know intuitively that a 1 km by 1 km MPA will not sustain a population of a highly mobile species such as tuna, but we don't necessarily have a ready answer for the question of the minimum size MPA that would be necessary. Persistence of populations in MPAs depends on movement through the larval phase as well as swimming of juveniles and adults. We begin with the former.

3.1.1 Larval dispersal

Beginning with the simple case of a species with a dispersing larval stage but sedentary juveniles and adults, we wish to know how the size and spacing of the MPAs we are designing will affect persistence or sustainability in the MPAs. Our understanding of sustainability is based on modelling studies (Botsford *et al.* 2001; Kaplan and Botsford 2004; Lockwood *et al.* 2002). The results of these can be understood by examining two cases, a single MPA and a system of several MPAs distributed along a coastline. For a single MPA, species will persist if their mean dispersal distance is less than the linear spatial dimension of the MPA. In terms of the replacement interpretation described in Section 1.0, a population will persist in a reserve if a high enough fraction of the larvae released from that reserve return to the same reserve. Similar to the single, non-spatial population, that fraction is the fraction of natural, unfished LEP (e.g. 35 percent). In the second case, a system of reserves, a population with larvae that disperse any distance will persist in a system of reserves (of any size) that covers a certain fraction of the coastline. The replacement interpretation of this result is essentially the same: a population will persist if a certain fraction of the larvae released by the population return to the population. To understand this case consider a population at a location in a reserve to be dispersing larvae all along the coast, and assume that fishing removes all individuals between reserves before they reproduce. The fraction of reproduction that will be successful for long-distance dispersers will be the fraction of the coastline covered in reserves. From the single, well-mixed population results we know that a certain fraction of LEP is needed, hence the fraction of the coastline needed in the spatially distributed population is the same. This effect by which many reserves provide for the sustainability of a population when one MPA alone would not is referred to as a *network effect*. While the explanation is posed in terms of complete removal by the fishery outside reserves, it stands to reason that a lower fraction of the coastline in reserves is required as fishing is reduced and the FLEP outside reserves is greater.

Both the single reserve effect and the network effect can be seen in Fig. 6. For all three levels of Fraction of Lifetime Egg Production (FLEP) resulting from fishing outside reserves, the short distance dispersers (1 km and 5 km) persist in almost all of the reserves, even the smallest ones. The longer distance dispersers persist over areas where a larger fraction of the coastline is in reserves, and the area over which they persist is greater for less fishing (i.e. higher FLEP).

While we have presented these results in terms of heuristic explanations, they are supported by specific mathematical results, and it is important to know the specific assumptions on which they depend. The initial attempt to answer this question through modelling was to calculate the conditions for persistence of a population in a system of identical MPAs with uniform spacing and complete removal by the fishing that occurred between them (Botsford *et al.* 2001). The density-dependence in the population occurred between larval settlers at a location and those that were actually recruited, and it was assumed to be a Beverton-Holt relationship. Larval dispersal was assumed to decline exponentially in each direction from its origin, with mean dispersal distance a parameter to be varied, and total larval production each year was held constant, independent of dispersal distance.

The basic persistence result was originally described for the situation in which there was no reproductive contribution from outside reserves, i.e. complete removal fishing, but the sensitivity to less fishing outside reserves was also presented graphically (Botsford *et al.* 2001). Allowing less fishing led to a slightly more complex condition for persistence which indicated that, as would be expected, for any given size of MPA, less fishing outside reserves meant that species that disperse longer distances would be allowed to persist, and the fraction of coastline in MPAs required for persistence of a system of reserves was less (Kaplan *et al.* in press). An important aspect of these results is that the level of fishing outside of MPAs affects persistence only through the value of FLEP outside the MPAs.

Subsequent studies showed that as long as the dispersal pattern was symmetrical, the details of the shape of the larval dispersal pattern did not affect the results, rather they depended primarily on the mean distance dispersed (Lockwood *et al.* 2002). Sustainability or persistence was quickly reduced when advection (displacement of the symmetrical dispersal pattern) was introduced (Botsford *et al.* 2001).

These results indicate that a single MPA or a network of MPAs will provide for persistence of species that disperse up to a certain mean distance, AND all those dispersing shorter distances. The alternative view, that a variety of spacings among reserves was necessary in a system of MPAs to account for the variety of dispersal distances (e.g. Palumbi 2003) was tested by computing the persistence of randomly distributed MPAs (Kaplan and Botsford 2004). A random distribution of MPAs made little difference in population persistence, except in the rare cases where populations were marginally sustainable and the randomness fortuitously created a region of higher fraction of coastline covered by MPAs, leading to local persistent population (at the expense of persistence elsewhere along the coast).

While these results are useful in understanding the strategic question of why empirical observations of abundance and biomass increased or decreased inside (and outside) the MPAs reviewed in Section 2, to design MPAs we also need similar tactical tools that will allow projection of whether specific designs are likely to increase or decrease recruitment. Such tools are being developed and used in reserve designs based on direct extensions of the mathematical methods used in the studies described here (i.e. the two methods used in Botsford *et al.* 2001) (Hastings and Botsford 2006; Kaplan *et al.* 2006). The former provides an analytical method for determining the equivalent of lifetime reproduction (R_0) for spatially distributed populations, and emphasizes the importance of replacement loops over space. The latter describes a numerical method for computing the area over which a population will persist given a specific distribution of habitat and reserves, and a level of fishing outside reserves. These methods can be structured as one-dimensional models (i.e. along a coastline) or two-dimensional models. A one-dimensional model is shown here because it illustrates the effects of reserve size and spacing on persistence, and the way that the level of fishing outside the MPAs affects those relationships (Fig. 6). A two-dimensional model also demonstrates the effects of size and spacing on species dispersing different distances (Fig. 7). These models allow MPA designers to see how size and spacing interact with fishery management outside MPAs, as well as the distribution of habitat inside and outside MPAs.

3.1.2 Juvenile and adult movement

We can extend the view gained from these modelling results that consider larval dispersal only, to include the effects of juvenile and adult swimming. Because the results for persistence depend on the LEP of a population at a specific location, we can interpret the effects of swimming behaviour in terms of its effect on LEP. Generally, species with greater movement (e.g. larger home range) would be expected to spend a greater amount of time outside of the MPA, where they would be more susceptible to fishing. The consequent higher fishing mortality rate would lead to a lower LEP, hence lower expected recruitment in the MPA and a less sustainable population.

Several existing studies quantify these relationships. These have their origin in the special case of marine reserves in Beverton and Holt (1957) (see Guenette *et al.* 1998 for further description). They divided an area into reserve and fished portions, then examined the effect of having various fractions of the area in reserve. Movement between the areas was described in terms of specified transfer rates. Results were expressed in terms of eggs-per-recruit (EPR) and yield-per-recruit (YPR). For our purposes here, EPR can be considered the same as LEP, thus reducing EPR has the same effect on equilibrium recruitment as the effect of reducing LEP described above. This approach was extended by Polacheck (1990) and applied to species with different scales of movement by DeMartini (1993).

DeMartini (1993) computed the effects on EPR of various combinations of fishing mortality rate F and the fraction of habitat in MPAs for two species, one of which had a movement rate 25 times that of the other (Fig. 8). The major result is indicated by the difference in the slopes of the lines of constant EPR between Fig. 8A and Fig. 8B. From them it is clear that MPAs have much less of an effect on a species with greater movement in and out of the MPAs (i.e. slopes of constant EPR are steeper in Fig. 8A than Fig. 8B). Results indicated for a species with little movement (Fig. 8A), EPR increased approximately linearly with the fraction placed in reserves at high fishing mortality rate, but was virtually independent of fishing mortality rate. For low fishing mortality rates (0.5 y^{-1} to 1.0 y^{-1}), EPR depended on both fishing mortality rate and fraction in reserves (Fig. 8A). For the species with greater movement (Fig. 8B) at high fishing mortality rates, EPR increased with fraction in reserves and decreased with increasing fishing mortality rate. For low fishing mortality rate, EPR was more dependent on fishing mortality rate, with little dependence on fraction in reserves (Fig. 8B). In summary, MPAs appear to have a greater affect on EPR when fishing mortality rates are high for both species, and reserves have a greater effect on EPR for the species with less movement.

3.2 Fishery yield

To design MPAs that are being implemented for the purpose of fishery management, we would be concerned that it provide maximal, or at least adequate yield, or that it provide greater yield than the current conventional management. We have seen from the review of empirical results that there are several examples where the implementation of marine reserves appears to increase CPUE, and a few cases of increase in fishery yield, but there are not enough examples to determine empirically the characteristics of reserves that lead to greater catch, or to predict how a given MPA will affect yield. Mathematical modelling can be used to project the way that yield will depend on MPA design (i.e. spacing, size and location).

A useful way of assessing the consequences of implementing an MPA or a system of MPAs is to compare the fishery yield with the MPAs in place, to yield under conventional management. Following that approach, if we were to implement MPAs in an area, it would reduce the amount of area available for fishing. For yield to be the same as under conventional management, catch in the area outside MPAs would have to increase to the point that it could compensate for the decline in area fished.

An increase in catch in the area outside of reserves would consist of two components: (1) an increase in recruitment outside of reserves and (2) an increase in the number of fish swimming out of the newly protected area. The former term would be controlled by the dynamics of recruitment described above under persistence. The resulting recruitment at each location would depend on the LEP at all other locations nearby, as well as larval dispersal rates between those locations and the location of interest. It would require an increase in LEP inside the reserve area, minimal decrease in LEP outside the MPA area (due to displacement of effort from formerly fished MPA area), and that the dispersal pattern of the species be broad enough to reach that point. The latter term would be the same as YPR dependence on size limits and fishing mortality rate in single, non-spatial populations, except that the fishing mortality rate would depend on how the combination of the spatial configuration of marine reserves combined with the movement behaviour of juveniles and adults to change the effective F. Recall that in conventional management YPR will either increase monotonically with fishing mortality rate or increase rapidly to a maximum then decline monotonically (Beverton and Holt 1957). The latter term would depend in a complex way on how recruitment changed inside MPAs and how the change in effective fishing mortality rate inside the MPAs changed with the implementation of the MPA. This would affect both the yield due to fish moving out of the reserves, and the EPR in the MPA in an inverse way. Calculating or estimating these changes is complex and involves uncertain parameters as well as details of the specific MPA implementation.

3.2.1 Larval dispersal

For the case in which larval dispersal is the only source of movement over space (i.e. no juvenile or adult movement) a valuable benchmark allows us to avoid having to make extensive calculations to compare fishery performance in MPAs to conventional fishery performance. For a simple age structured model with post-dispersal density-dependent recruitment of the Beverton-Holt (1957) type, and larval pool dispersal, the problem of maximizing yield in a system with MPAs is mathematically exactly the same as the problem of maximizing yield in conventional management by setting fishing mortality rate (Hastings and Botsford 1999). This means that the yields possible with MPAs and conventional management are the same for this case. The possible difference for at least some other cases can be judged intuitively. For example, if there is pre-dispersal density-dependence, conventional management is likely to produce higher yield because MPAs are likely to increase pre-dispersal density to high levels.

An important consequence of this result is that if a population is being managed by conventional management to obtain the highest possible yield, changing to management by MPAs will not achieve higher yields. To phrase this in terms of the empirical results reviewed above, we should expect to see the greatest improvements in yield with implementation of MPAs in situations in which fisheries are recruitment overfished. This result can be seen in a number of simulation studies of MPAs (e.g. Quinn *et al.* 1993; Holland and Brazee 1996) (Fig. 9), and this question has also been addressed more specifically by Hart (2006).

The approximate equivalence of fisheries yield from MPAs and conventional management was also contained in a result indicating that for populations represented by a logistic model and implicit larval pool dispersal, yield depended only on the product of fishing mortality and area not in MPAs, and did not depend on the value of each factor (Mangel 1998, 2000).

There are several exceptions to this benchmark rule that yield from MPAs is approximately the same as yield from conventional management, and these may be important in some instances. Possibly the most important exceptions occur in situations with substantial source/sink structure in larval dispersal. For example, in a case in which a single self-persistent source population sustained three others, protecting the source population provided greater yield than conventional harvesting of all at the same fishing mortality rate (Morgan and Botsford 2001). An important constraint, however, was that the source/sink structure had to be known in order to take advantage of it. If it were not, yield with MPAs was not greater than with conventional management at maximum sustainable yield (MSY). In general, larval dispersal patterns are not well known. A similar exception is a case in which dispersal among populations along a coastline involved substantial advection in different alongshore directions each year (Gaines *et al.* 2003). In this case also, the dispersal patterns created a source/sink pattern. Gaylord *et al.* (2005) obtained higher fishery yields through marine reserves using a stage-structured model with spatial pattern in adult densities and larval dispersal. Hilborn *et al.* (2006) formulated a model with logistic populations and fisher movement, and obtained greater catches through reserves only when the fishing level would lead to extinction outside reserves.

A second area of exceptions to this rule involves the effects of density-dependence on the population in reserves; strong density-dependence leads to poorer performance of reserves in comparison to conventional management (Botsford *et al.* 2003). Parrish (1999) showed in a modelling study that the presence of over-compensatory density-dependence diminished yields obtained through use of reserves. Gardmark *et al.* (2006) used a model with density-dependent growth to show that it could lead to conventional fishery management having greater yields than management by reserves.

Equivalence in yield should not be equated with equivalence in performance: costs associated with extracting the same yield would be higher with MPAs than with conventional management. Under spatial management, the population outside the reserve would be exploited harder and therefore would be more depleted than when effort is spread over the entire spatial expanse of the fishery. Fishers would thus experience much lower densities and catch rates when a substantial fraction of the biomass that sustains the productivity is placed in a reserve (NRC 2001).

3.2.2 Juvenile and adult movement

Adding the possibility of juvenile and adult swimming behaviour to our assessment of the effects of movement on yield provides an important exception to the rough equivalence between MPAs and conventional management: the case involving ontogenetic, rather than inter-population movement. When there is substantial ontogenetic movement, protection of spawning and juvenile rearing areas can often provide greater catch than fishing all areas (Apostolaki *et al.* 2002).

While it is becoming widely appreciated that MPAs will be less effective for species whose juveniles and adults move frequently over large distances, there are few examples comparing the effects of different patterns of movement. However, we can gain some insight from the fact that recruitment at a location depends on LEP. As movement frequency and distances increase, fish spend greater amounts of time outside of MPAs subject to fishing. As noted above, one consequence of the greater catch is a reduction in LEP, which will likely decrease recruitment in the MPA. On the other hand an increase in yield is possible if the increase in YPR outweighs the decline in recruitment.

We can get some idea of the possibilities from the examples in DeMartini (1993), who plotted the lines of constant YPR and EPR as a function of fishing mortality F and proportion of area within reserves, for two species of different mobility (Fig. 8). The important characteristic of these plots is that the lines of constant YPR are essentially parallel to the lines of constant EPR. This represents a trade-off between EPR and YPR, but it runs in opposite ways for these species because they have different dependencies on F, even with no MPAs. For the species with low movement (Fig. 8A), note that with no MPAs YPR increases monotonically with F. As the fraction in reserves increases, this sign of this dependence remains the same, but the values of YPR decline. For the more mobile species (Fig. 8B), with no MPAs, YPR peaks at a low value of F, then declines. As the fraction in MPAs increases, the dependence of YPR on F again remains the same, but the values of YPR are lower. For the species with low movement this implies an inverse relationship between YPR and EPR. For the species with greater movement, the opposite is true, primarily because that is the relationship with no reserves (i.e. this is not necessarily a characteristic of greater movement).

3.3 Combining yield and persistence

Few studies have explicitly addressed the combined effects of MPAs on persistence and yield (though most simulations that assess yield do so with models that remain persistent). One study addressed the question of whether the spatial configuration of reserves should differ for the different goals of MPAs for fishery management or general conservation of biodiversity (Hastings and Botsford 2003). That study considered species with sedentary adults and larval dispersal as the only movement. The important conclusion of that study is that while cost considerations may dictate that for the biodiversity goal large reserves should be used (rather than covering a certain fraction of the coast), for fishery management a system of small reserves covering the minimal fraction of the coast required for persistence is the best. The basic reason for this is that the higher number of MPA edges provides greater larval spillover. This result would likely change if juvenile and adult movement were considered.

Another example was a simulation of a size structured model with dispersal exponentially from its origin and MPAs that were spaced 25 units apart with size varied from 0 to 10 units. Results show the combined effects for a species with no juvenile or adult movement, in a population for which individuals cease to replace themselves when F is greater than 1.1 y^{-1} (Fig. 10). With no reserves, as F increases catch at first increases, then collapses at F=1.1 y^{-1}, with no dependence on dispersal distance. When 8 percent of the coastline is in reserves, catch is slightly greater at high F for species that disperse short distances. As the fraction of coastline in reserves increases to 40 percent, catch remains high at all dispersal distances except short distances, in spite of high F.

4. EMPIRICAL RESULTS, MODELLING EXTENSIONS AND UNCERTAINTY

The empirical results available for marine reserves indicate that removing fishing pressure frequently does have the expected effect of allowing an increase in abundance, biomass and mean size inside reserves, but they provide little in the way of guidance regarding how to design MPAs to assure they produce these increases, as well as producing an increase in fishery yield or sustainability. The most common type of study is a comparison of conditions inside reserves with conditions outside, and there are fewer examples that follow a reserve over time from implementation. Trends useful for design of reserves include the tendencies for harvested species, species with greater body size, and species at higher trophic levels to be more likely to increase in reserves. There is also one study that indicates species with less potential for larval and adult movement were more likely to increase than species with greater potential for movement (Parnell *et al.* 2005). There appear to be few differences due to the size of reserves, and no attempts to assess the effects of spatial configuration. While habitat type is often accounted for in the design of reserves, there have been few attempts to address the effect of habitat quality and heterogeneity.

With regard to fishery performance, increased CPUE, and in some cases, total catches around reserves have been documented in small no-take reserves established in coral reefs, temperate rocky reefs, lagoonal or estuarine environments, as well as larger scale fishery closures. In most cases, increased CPUE is apparent within hundreds of meters to a few kilometres from reserve boundaries, and increases are driven by a few species. Movement patterns, habitat preferences and fishing patterns likely influence changes in fishery yield by different species. Effects on total catches are more variable, with overall increased or stable fishery yields documented only in few cases. In most documented cases, adult fish movements across the reserve or closure boundaries appear to underlie MPA contribution to adjacent fisheries. A few studies of species with sedentary adults also support the hypothesis of larval seeding from reserves into fished areas, but empirical evidence for a larval contribution of reserves is more limited.

Modelling studies extend our understanding of how populations respond to size and spacing of reserves beyond the direct empirical results by allowing examination of both known life history characteristics of fish, such as growth, mortality and fecundity, as well as poorly known characteristics, such as larval dispersal patterns and adult/juvenile mobility. Model results indicate that for sedentary species with dispersing larvae: (1) single reserves will allow for persistence of species dispersing mean distances on the order of the linear dimension of the reserve; (2) systems of reserves that cover a certain fraction of the coastline will allow for persistence of species dispersing a broad range of mean distances; and (3) a good benchmark estimate of the yield to be expected from reserves is that the maximum yield from reserves will be roughly equal to the maximum yield from conventional management controlling catch or effort. As juvenile/adult mobility increases, the sustainability of species in reserves will decline, but yield may increase.

4.1 Uncertainty

The significant uncertainties that affect the design and implementation of reserves involve movement rates of both juvenile/adult and larvae and productivity at low population size (i.e. the replacement threshold). The latter is also present in conventional management. Because the potential fisheries benefits derived from reserves of different sizes will depend on our ability to control Fs outside the reserves, we include a description of the implementation uncertainty associated with conventional management.

4.1.1 Reserves

We described in Section 3 how modelling has indicated that both sustainability and yield depend on larval dispersal patterns and juvenile/adult movement of the species of interest. While information on larval dispersal is available from several sources (reviewed in Shanks *et al.* 2003 and Kinlan and Gaines 2003), larval dispersal patterns are known only for the few species whose larvae disperse hundreds of meters or less. It is interesting that there is little empirical evidence for the effect of dispersal distance on persistence in reserves. There are several possible reasons for this lack: since dispersal distances are poorly known the analysis is difficult, the effect of dispersal distance diminishes as the impact if fishing on LEP outside reserves declines and it is possible that most species have short mean dispersal distances.

Adult and juvenile movement in marine species is better known than larval dispersal, and there are several examples of studies in the context of marine reserves (Section 2). The relative paucity of evidence for the effect of juvenile adult mobility on sustainability of implemented reserves could also be due to the fact that reserves have been implemented in areas where FLEP is still relatively high, but the confounding effect of variable exploitation rates across studies noted in Section 2 is another possibility.

4.1.2 Reserves and conventional management

The dependence of sustainability of different levels of protection (i.e. reserve sizes or fractions of habitat within reserves) on the minimum value of FLEP that achieves population replacement is common to conventional, single population management and management by reserves, thus linking the two management tools. In fisheries management this uncertain parameter is commonly associated with reference points or control rules. It plays a fundamental role in management, defining how hard a population can be fished before it collapses, whether managed spatially through MPAs, or by limiting catch or effort.

4.1.3 Implementation uncertainty in conventional management

The equivalence between conventional management and MPAs discussed above was established in terms of the fraction of area protected and the level of fishing mortality that would produce the same yield for sedentary species. In reality, the rate of fishing mortality F is only controlled through catch quotas and/or effort restrictions, the effects of which are very uncertain. In the case of quota-based management, the uncertainty in the estimates of stock biomass used to set quotas translates directly into uncertain Fs. Likewise, the relationship between effort limitations and F depends on highly uncertain predictions about catchability. Worse, assessment errors tend to be correlated from year to year, specially in cases of model misspecification, with the result that Fs can be consistently above (or below) target for several years in a row. So, while in theory conventional management may be equivalent to MPAs for some systems, in practice the consequences of implementing either form of harvest controls are so uncertain that it would be impossible to determine the actual regulatory tactics that would result in similar yields.

Indeed, one of the main arguments for advocating the use of MPAs has been as a buffer against errors in the implementation of conventional management (Lauck *et al.* 1998). While the effectiveness of MPAs themselves depends on very uncertain dynamic processes, the kinds of uncertainties that affect the two types of management are for the most part different and independent of each other (with the exception of the minimum replacement required for persistence). Thus, a combination of harvest controls involving catch and/or effort quotas and reserves may outperform either type of management when implementation uncertainty is substantial. Stefansson and Rosenberg (2005) illustrated this point using a simulation model inspired by the Icelandic cod fishery. They found that combining catch quotas with a large closed area was an effective system for reducing the risk of stock collapse and maintaining economic performance. In their model, which was based on the assumption that implementation errors were independent from year to year, best economic performance was still achieved by setting low target Fs. Another example is environmentally driven shifts in the spatial distributions of fished populations, which could affect MPA performance, but may not affect the effectiveness of quota management.

5. RECOMMENDATIONS FOR GUIDELINES AND TOPICS FOR THE WORKSHOP

The state of knowledge described in reviews and summaries of empirical observations and modelling results suggest guidelines for the design and implementation of MPAs. We presume that the guidelines to be provided will be a central topic for discussion at the anticipated workshop. First, we note that our ability to recommend guidelines here is somewhat limited by the fact that we have focused on the effects of ecological factors, whereas decisions regarding the design and implementation of marine reserves frequently involve tradeoffs among ecological, social, economic and other factors, which are case-specific. Here we provide the ecological perspective on potential guidelines, and point out additional required information.

In addition the guidelines most appropriate in each specific situation will depend on the amount of data available. Accordingly, our recommendations span the range from data rich to data poor.

5.1 Data-rich situations

For a data-rich situation, with the resources and infrastructure for technical planning through a decision framework, modelling through some of the techniques shown here (e.g. Hastings and Botsford; Kaplan *et al.*) can be used to evaluate the robustness of alternative reserve designs and fishing controls to achieve management goals, such as persistent populations and good associated yields. For example, plots such as those in Fig. 6 could be examined for each proposed spatial design to determine how well they provided for persistence of species over a range of dispersal distances. The effect of fishery management outside reserves could be accounted for by choosing the plot with the appropriate value of LEP (Fig. 6 a, b, or c). Values of FLEP can be taken from values of spawning potential ratio (SPR) for species for which a stock assessment has been done, or they can be estimated by methods that are less data intensive (e.g. O'Farrell and Botsford 2005). For example, estimation of FLEP for several species of rockfish on the west coast of the United States, this method indicated values at levels as low as 0.2 (O'Farrell and Botsford 2006). Values of FLEP estimated from assessments may need to be modified to account for the effects of increased fishing mortality outside the reserves associated with displacement of fishing effort from the closed areas, and of course to reflect any possible modifications in the management outside the reserves, if those are considered. Once the areas of persistence are determined, the expected distributions of yield along the coastline can be computed from them, as in Kaplan *et al.* (in press). Proposed combinations of reserve configuration and fishery management outside reserves can then be chosen.

While these equilibrium methods offer valuable and computationally efficient means to evaluate the interaction between reserve size and spacing, fishing outside reserves and dispersal distance, they still depend on uncertain parameters and processes. To incorporate the effects of dispersal distance, even though dispersal patterns are very poorly known, they assume an exponential decay from the origin with a specified mean distance. Effective replacement, through lifetimes and over space, are ultimately compared to a threshold that is unknown, just as it is in conventional fishery management. Both of these sources of uncertainty require specific evaluation of their effects on the management decision processes. This would involve sensitivity assessments and application of a precautionary approach. The aim should be to find combinations of reserve designs and other management controls that appear to work well (i.e. are robust) for a range of scenarios considered likely, and not on the determination of an optimal solution for any single scenario.

In addition to uncertainty about key processes in the population dynamics, the relative merits of different regulatory schemes involving reserves and conventional harvest controls (e.g. catch and effort quotas) will depend on our ability to implement the desired harvest targets, as discussed in Section 4.1.3. The so-called implementation uncertainty needs to be considered as well in the decision framework.

Beyond the equilibrium approaches outlined in Section 3.1.1, more complex simulation models could be used to evaluate management performance in data-rich situations, if specific scenarios about fish movement, fleet behaviour and/or implementation uncertainty were to be examined. Examples of this type of spatially-structured models are the models used by Steffanson and Rosenberg (2005) for Icelandic cod or by Little *et al.* (2005) for common coral trout on the Great Barrier Reef. The downside of these approaches, of course, is a steep increase in complexity and computing time.

5.2 Data-poor situations

The decision as to whether to implement reserves for fishery management will depend to some degree on the anticipated yield for different management schemes. In conventional management, different proxies for MSY have been proposed to guide decisions in data-poor situations. Some of the same guidelines may be applicable to the design of MPAs by taking advantage of the rough equivalence between MSY with reserves and MSY with conventional management. While there are exceptions to this equivalence, the processes involved can frequently be accounted for (e.g. pre-dispersal density dependence) or they have to be ignored because their use to improve reserve design would require more information than is possible to obtain (e.g. estimating reserves provide greater catch because of source sink structure). Yields possible through implementation of marine reserves would be compared with yields through a change in conventional management, and the costs of management by each method. For example, if a fishery involves multiple species with the same gear, and the species are poorly known, it may be advisable to manage with reserves, provided they can be enforced at reasonable costs.

In the design of the spatial configurations of reserves, to obtain higher yields, a number of smaller reserves would be preferable over fewer large reserves, to maximize larval spillover. For species with greater juvenile/adult mobility, yield would likely be greater than for sedentary species. However, for species with greater mobility, eventually the effect of reserves could tend to zero so that the reserves would provide no increase in sustainability, but would also not diminish catch.

In data-poor situations, different assumptions about the type and level of uncertainty associated with implementation of different regulatory schemes would change the anticipated effectiveness of alternative combined rules. In the extreme, quota-based management may simply be impractical in many situations due to one or more of the following conditions: (i) insufficient information to conduct quantitative stock assessments on which to base quotas; (ii) unenforceability of quotas; and (iii) inappropriateness of global controls in the case of populations with persistent spatial structure. It is not uncommon that these conditions are all true simultaneously. Typically, this is the case of many small-scale artisanal fisheries based on spatially-structured stocks, in which data-poorness has some structural correlates that also lead to lack of compliance with fishing regulations and makes conventional fisheries assumptions untenable (Parma *et al.* 2003). Interestingly, in some of these artisanal fisheries, marines reserves, combined with effort controls or at least restrictions to fleet size/capacity, may provide a more feasible system for the control of harvest rates than catch quotas. Indeed, MPAs have met with success in some artisanal reef fisheries, especially when fishing communities have been involved in the process and have seen the benefits derived from their implementation (White *et al.* 2006).

5.3 No evaluation

It is also worthwhile to provide guidelines regarding the risks and potential benefits of simply implementing marine reserves without evaluation of ecological effects based on the premise that they will improve fishery yield or sustainability. If the species of interest in the implementation of a reserve does not have high juvenile or adult mobility (e.g. large home ranges that would take them outside the reserve frequently), it is likely that biomass will increase in the reserve. In addition, if the larval dispersal distance is substantial but not greater than the linear dimension of the reserve, the species is likely to remain persistent inside the reserve and provide increased replacement paths for parts of the population near the reserve. The question then is whether the increased larval input to fished areas and juvenile/adult movement outside reserves are large enough to increase yield by an amount that compensates for: (1) the effects of removing the reserve area from the fishable area and (2) the effects of additional effort in the fished area that has been displaced from the reserve area.

5.4 Importance of monitoring.

An important guideline is the recommendation of monitoring to accompany the implementation of a marine reserve. Monitoring of reserves is commonly recommended as a means to demonstrate that a system of reserves is achieving its goals, and that rationale often draws greater attention when reserves are implemented with the goal of improving fishery management. That one should monitor any resource management project to determine whether it is accomplishing goals is now well accepted, whether on the basis of demonstrating that it was a justified expenditure or the appeal of the optimality of adaptive management. However, in the case of marine reserves, because their wide-spread use is in a nascent phase, there are broader reasons for monitoring that go beyond individual implementations themselves. As indicated by the reviews of empirical information and modelling results, the performance of marine reserves depends on design attributes (e.g. location, size, spacing) and life history characteristics in a way that is not well understood. There is a general need for improvement in our ability to design and implement marine reserves, that can be met through more careful monitoring.

To date monitoring reserves has typically consisted of post hoc comparison of abundance, biomass, mean size and diversity inside reserves in relation to outside. However, there is increasing awareness that before/after comparisons at the same location are superior, and a broader range of attributes are being monitored. The information presented here provides the motivation for including size and spacing as well as the level of fishing outside reserves as "treatments" in whatever experimental design might be involved in monitoring. As noted in Section 2, we have little empirical information on whether we should be using large or small reserves, and what level of persistence we can expect as fishing increases outside the reserves currently being designed. Such information is needed to improve our design, and reduce the uncertainty in our projections of reserve performance.

5.5 Context-recommendations by others

As a final section we add a comparative note of the fact that others have made similar suggestions for the future path of research and implementation of marine reserves. For the most part recommendations are similar in calling for steps toward a better understanding of the dependence of performance on spatial design, but there are some differences.

The conclusions of Hilborn *et al.* (2004) are similar to ours (which is not surprising since two of us were also co-authors of that study). That study addresses the general conditions under which the use of reserves or MPAs is advisable for fisheries, while we focus here on the ecological aspects. The authors note that marine reserves are likely to be a useful tool for management of fisheries on more sedentary stocks (consistent with our description of the dependence of yield and sustainability on juvenile adult movement) and fisheries that are multi-species (consistent with Section 5.2). They recommend careful planning and management so that in the future we will know what aspects of our design worked and why.

Sale *et al.* (2005) present another view of the state of knowledge of the functioning of marine reserves. They review some of the same modelling results described here, to identify gaps in the science underlying the performance of marine reserves. The gaps identified are: (1) our poor understanding of larval dispersal, (2) limited understanding of juvenile and adult movement, (3) limited knowledge of ecosystem aspects of reserves, (4) poor understanding of coastal circulation and (5) "remarkably few well designed studies of no-take reserves that can rigorously demonstrate that they have sustained or enhanced fishery yield in the surrounding region." Their conclusions are, for the most part, consistent with ours, though we would include arguments associated with the network effect described in Section 3.1.1 as a way of justifying a specific fraction of the coast as reserve (see Box 1 of Sale, *et al.* 2005). As shown in Fig. 6, persistence of longer distance dispersers depends on the fraction of coast in reserve, which declines as FLEP outside reserves increases.

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ANNEX 1: FIGURES

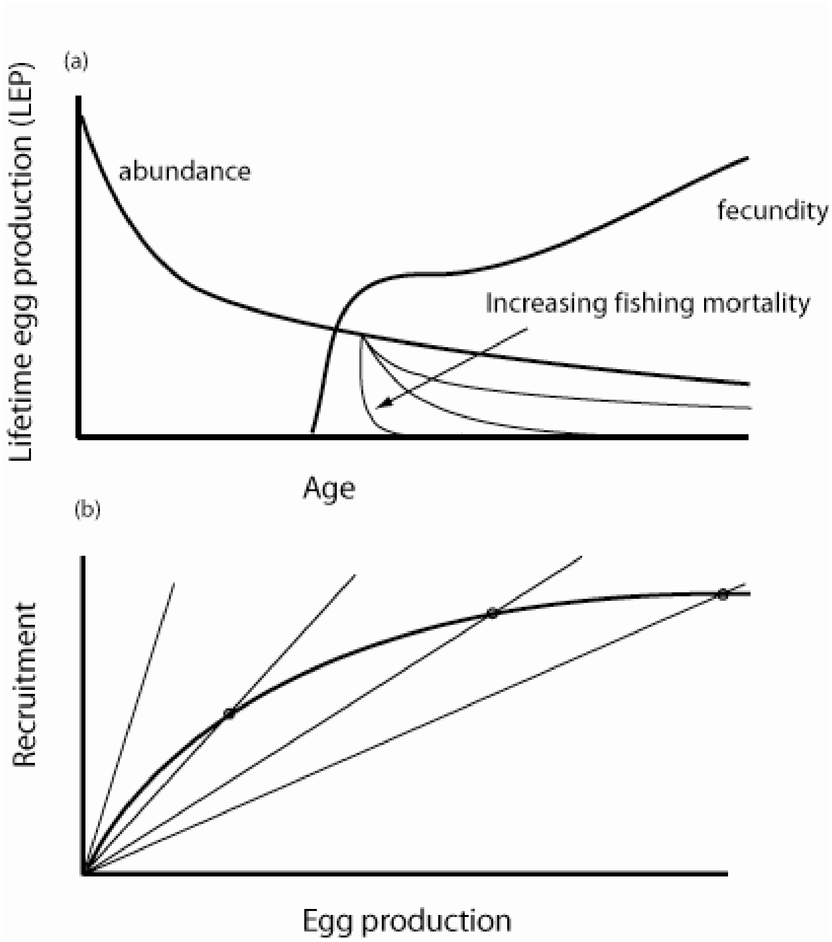

Figure 1. The dependence of population equilibrium and collapse on Lifetime Egg Production (LEP). (a) LEP is the sum over age of the product of abundance and fecundity. As fishing increases, there are fewer old, fecund females, and LEP declines. (b) The equilibrium level of recruitment occurs at the intersection of the recruit/egg relationship and a line through the origin with slope 1/LEP. As fishing increases, LEP and equilibrium recruitment decline. When 1/LEP is greater than the slope of the recruit/egg relationship at the origin, the population collapses. Because that slope is poorly known, fishery biologists assume that collapse occurs when the fraction of LEP (FLEP) is below a certain value (e.g. 35 percent).

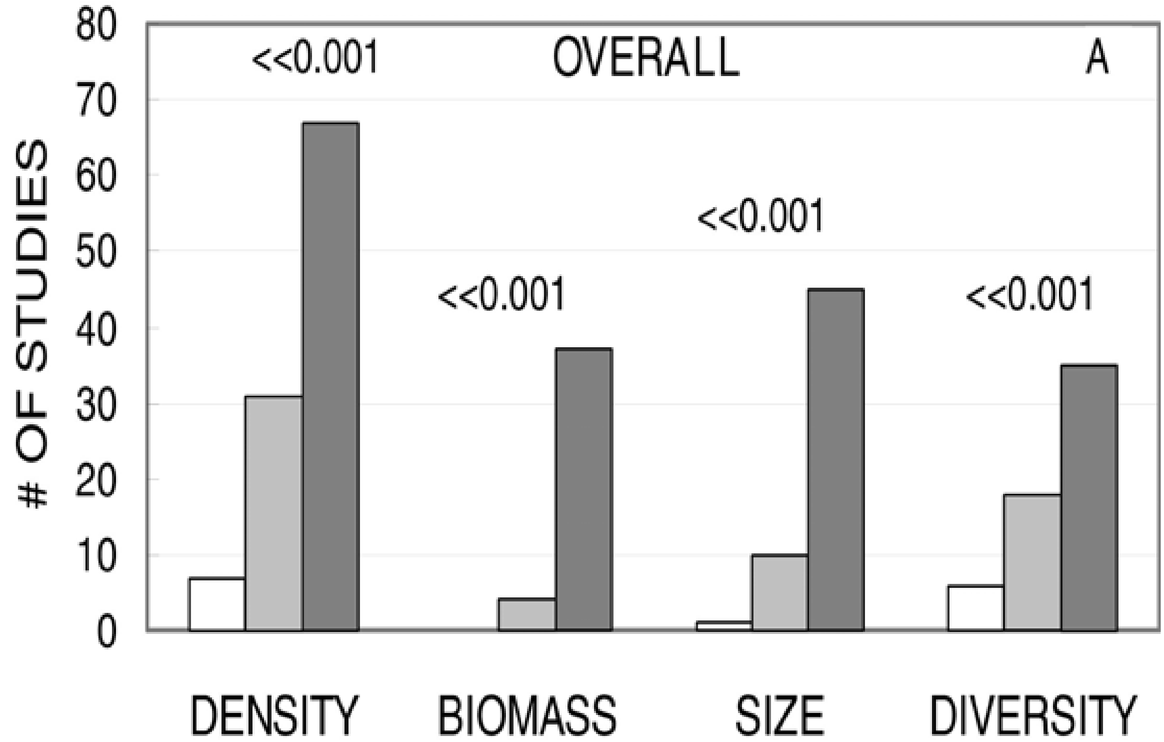

Figure 2. Number of independent marine reserve measurements (density, as No. individuals/area; biomass as mass/area; mean size of organisms, and diversity, as total species richness) plotted separately for each of three trends: lower values inside reserves compared to reference conditions (white bars); no difference between reserves and non-reserve areas (grey bars); and higher values inside the reserve (dark bars).

Source: Halpern 2003

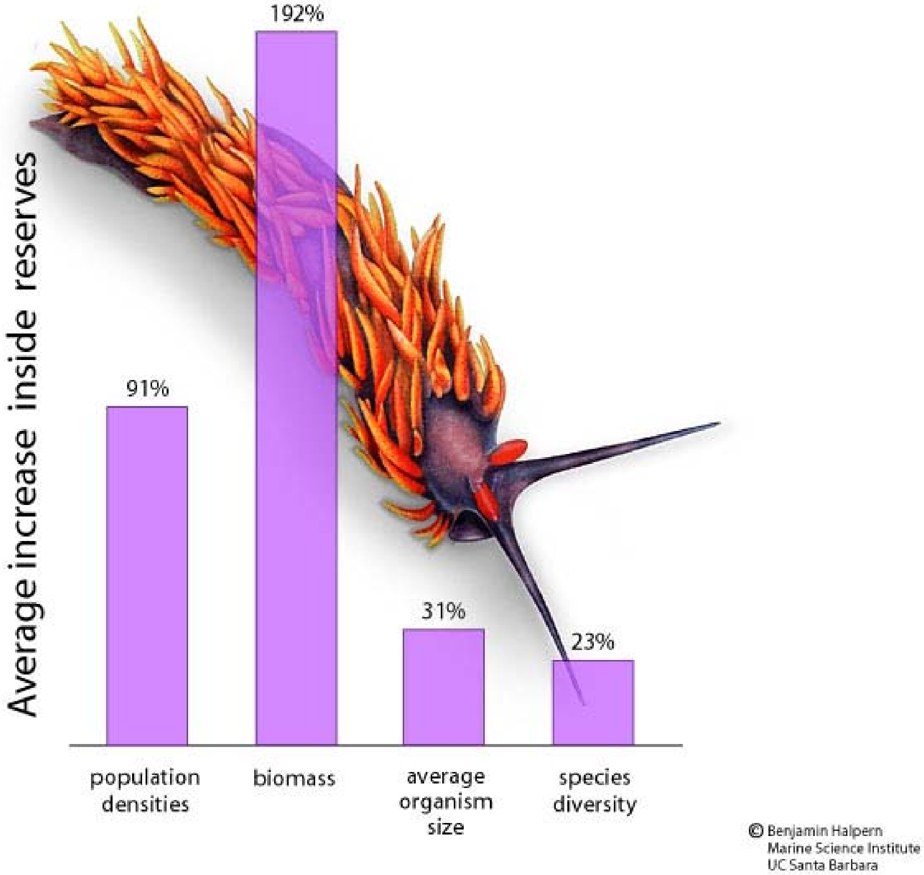

Figure 3. Average increases in population densities, biomass, organism size, and species diversity inside reserves. Overall averages were based on 69 studies of marine reserves from tropical and temperate coastal ecosystems.

Source: Halpern 2003

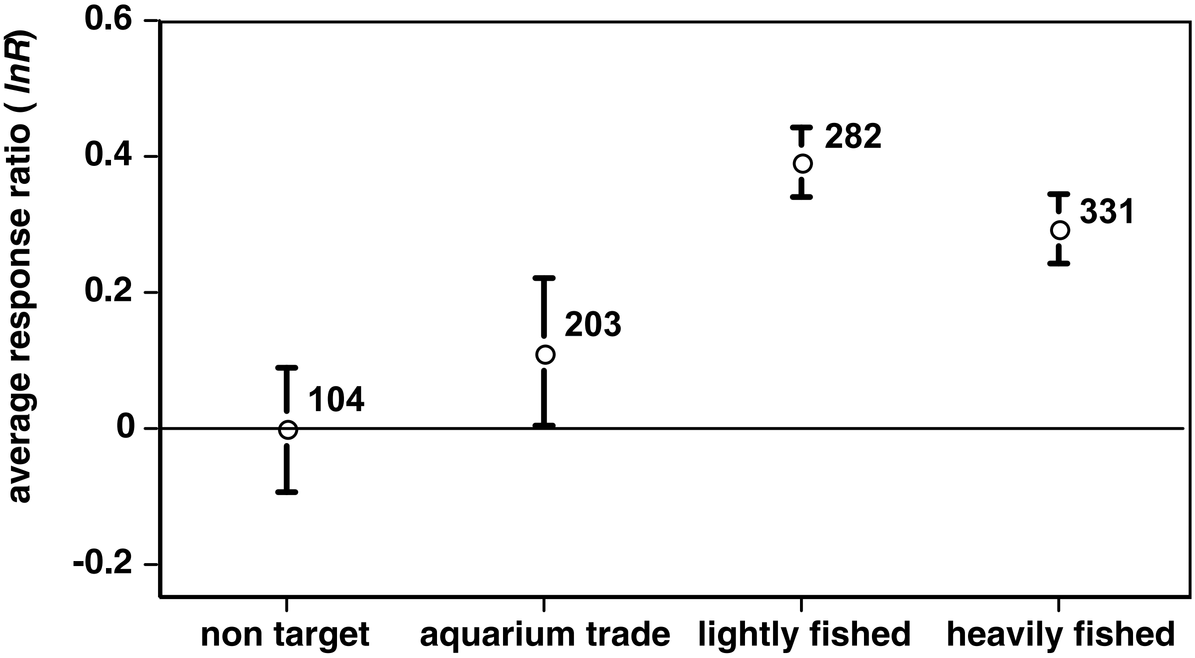

Figure 4. Results of meta-analyses of the response ratios (*lnR,* where R is the ratio between abundances inside and outside reserves, or before and after reserve establishment) for each of four exploitation levels of coastal fish populations (non-target species, and species targeted by aquarium trade, lightly fished or heavily fished). Average response ratios, weighted by sampling variances, are reported for each category. Bars represent 95 percent confidence intervals. When confidence intervals do not overlap 0, weighted averages are considered significantly different from 0. The number of comparisons within each category is reported to the right of each average.

Source: Micheli et al. *2004*

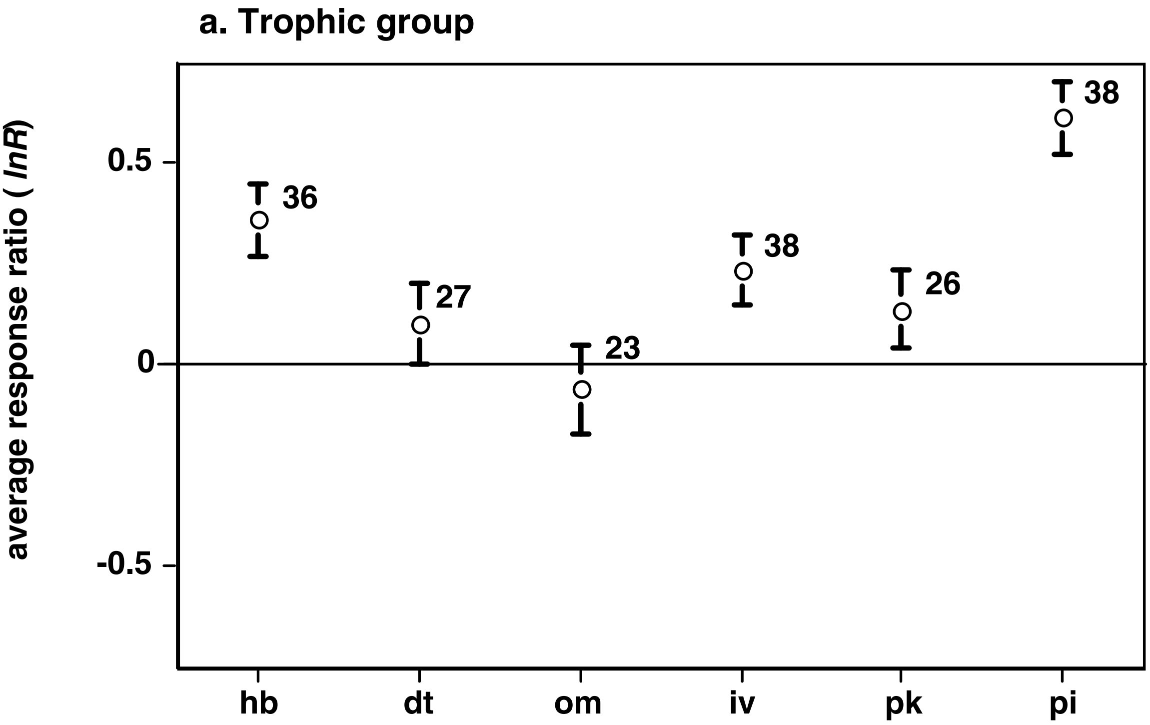

Figure 5. Results of meta-analyses of the response ratios (*lnR,* where R is the ratio between abundances inside and outside reserves, or before and after reserve establishment) for each six fish trophic groups (hb=herbivores; dt=detritivores; om=omnivores; iv=invertebrate feeders; pk=planktivores; and pi=piscivores). Average response ratios, weighted by sampling variances, are reported for each category. Bars represent 95 percent confidence intervals. When confidence intervals do not overlap 0, weighted averages are considered significantly different from 0. The number of comparisons within each category is reported to the right of each average.

Source: Micheli et al. *2004*

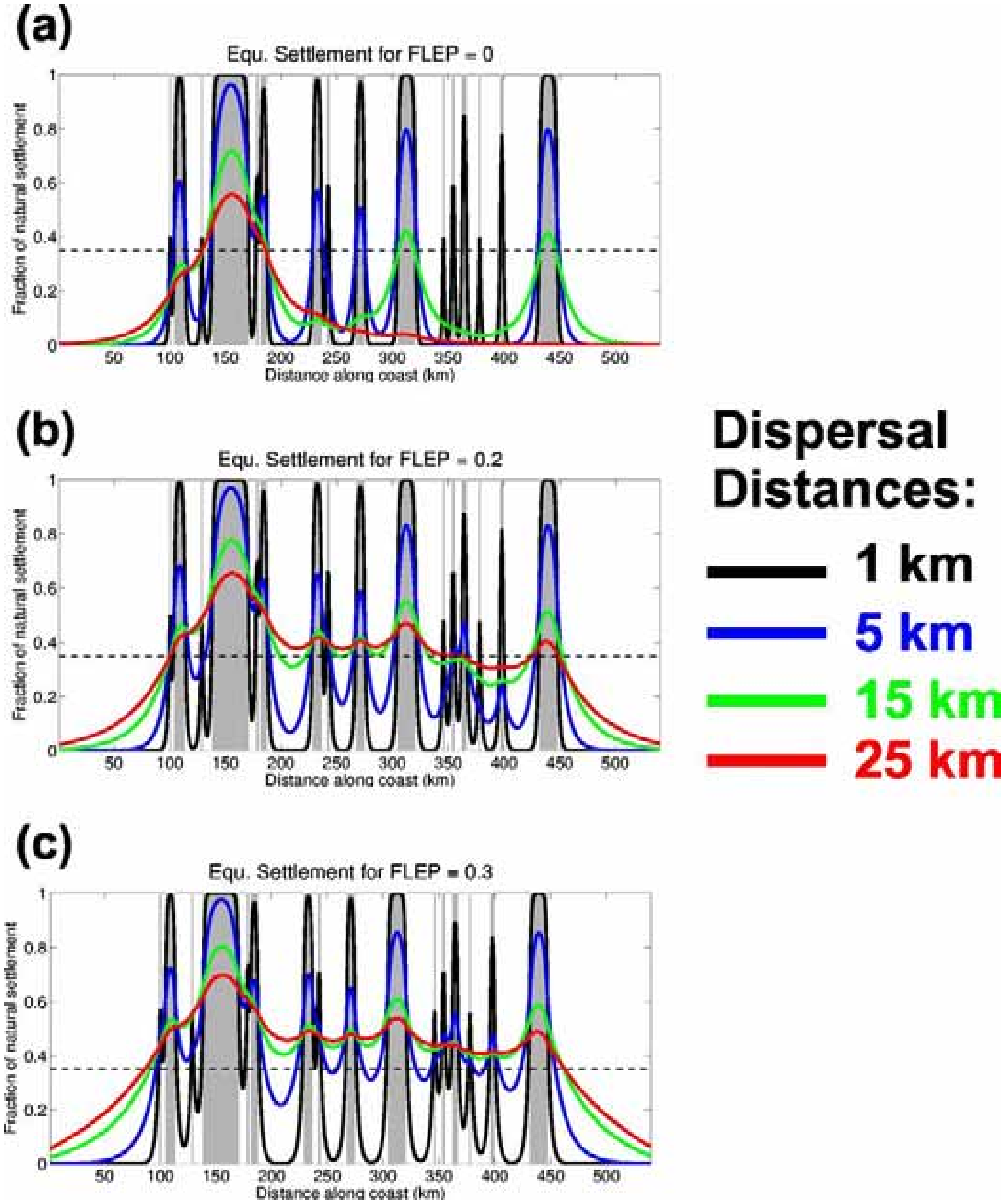

Figure 6. The effects of MPA width and fishing outside of MPAs on persistence. The shaded areas are MPAs of varying widths. The black, blue, green and red lines are plots of the fraction of natural settlement at each location. We can expect persistent populations wherever these lines are above the dashed line at 0.35. The level of fishing outside of the MPAs is represented the Fraction of natural, unfished Lifetime Egg Production left outside the MPA. In (a) fishing is very intense, and there is no reproductive contribution from outside the reserve, fishing in (b) has reduced FLEP to 20 percent of the natural level, an overfished state, and in (c) the populations is just barely overfished at FLEP = 0.35. With regard to the effect of MPA width, note that in (a) the narrower MPAs can support species dispersing 1 km and 5 km, but not those dispersing 15 km and 20 km. Note that in (b), where there is less fishing outside reserves, there is generally greater persistence. Species dispersing 1 km and 5 km persist in individual reserves, while there is a network effect across several MPAs for species dispersing longer distances.

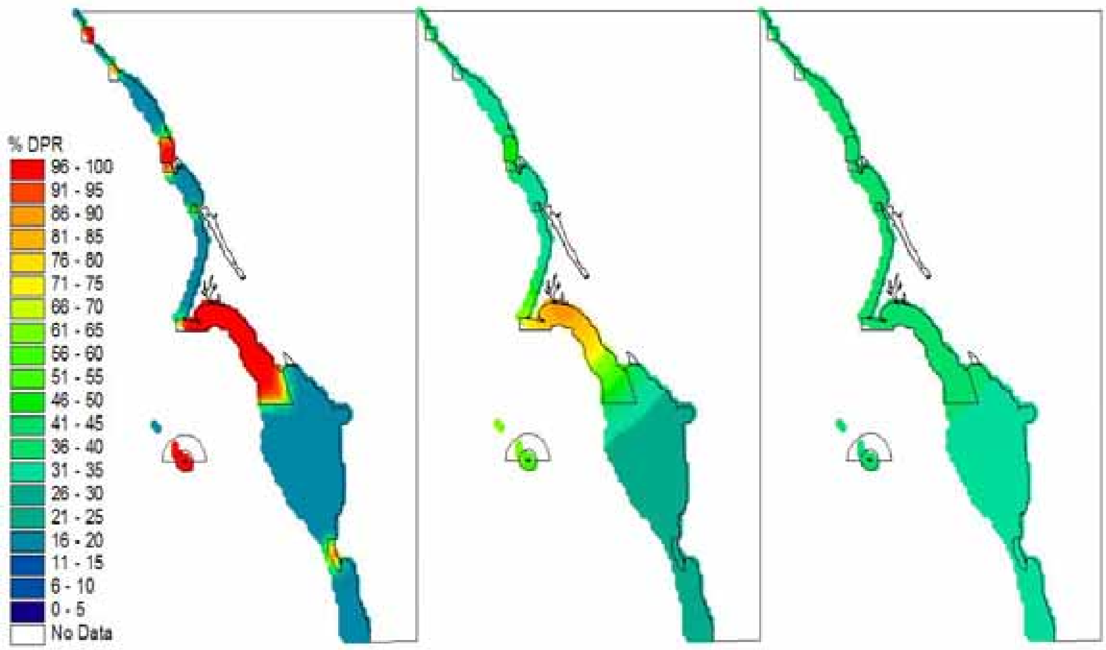

Figure 7. A two-dimensional analysis similar to the one-dimensional analysis in Fig. 2. An example of the workshop tool used to assess and display the area over which sustainable populations would persist for proposed reserves in the Point Reyes area on the west coast of North America, north of San Francisco, California, in the United States. Dispersal distances are 1km, 10km and 100km from left to right. Sustainable populations will occur where %DPR is greater than 35 percent. This tool accounts for larval dispersal only.

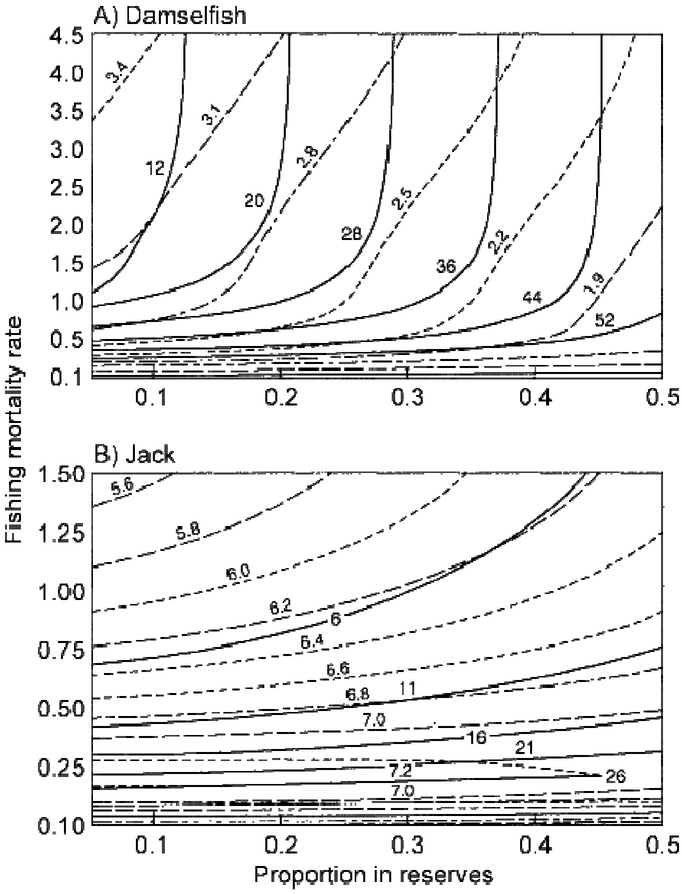

Figure 8. The effects of juvenile and adult movement on Yield Per Recruit (dashed lines) and Egg Per Recruit (similar to LEP) (solid lines) for two species, a damselfish with low movement and a Jack with extensive movement (redrawn from DeMartini 1993).
See text for interpretation.

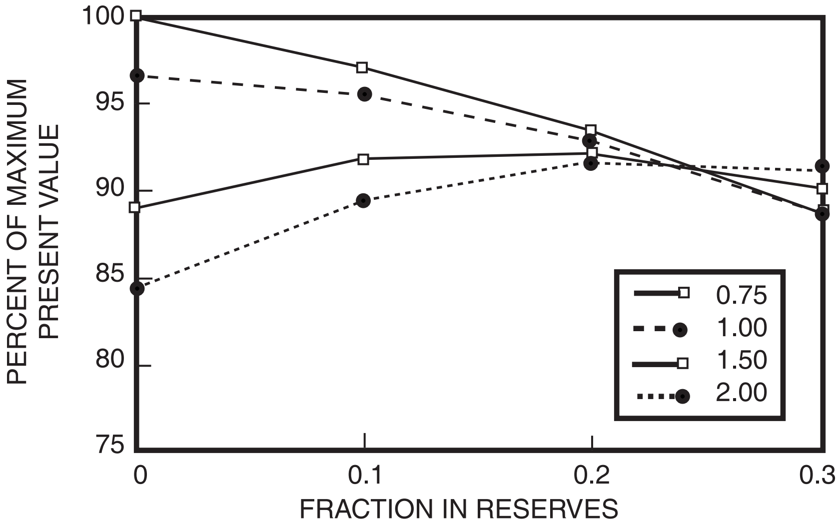

Figure 9. A simulation example of the rough equivalence of the effects of fishing mortality rate (legend in box) and fraction of area in reserves (MPAs) in their effect on fishery yield, expressed here as present value. If the population is heavily fished (e.g. F = 2.0 y-1), adding reserves increases yield up to a point, while if the population is lightly fished (i.e. F < 1.00 y-1), adding reserves decreases yield (redrawn from Holland and Brazee (1996).

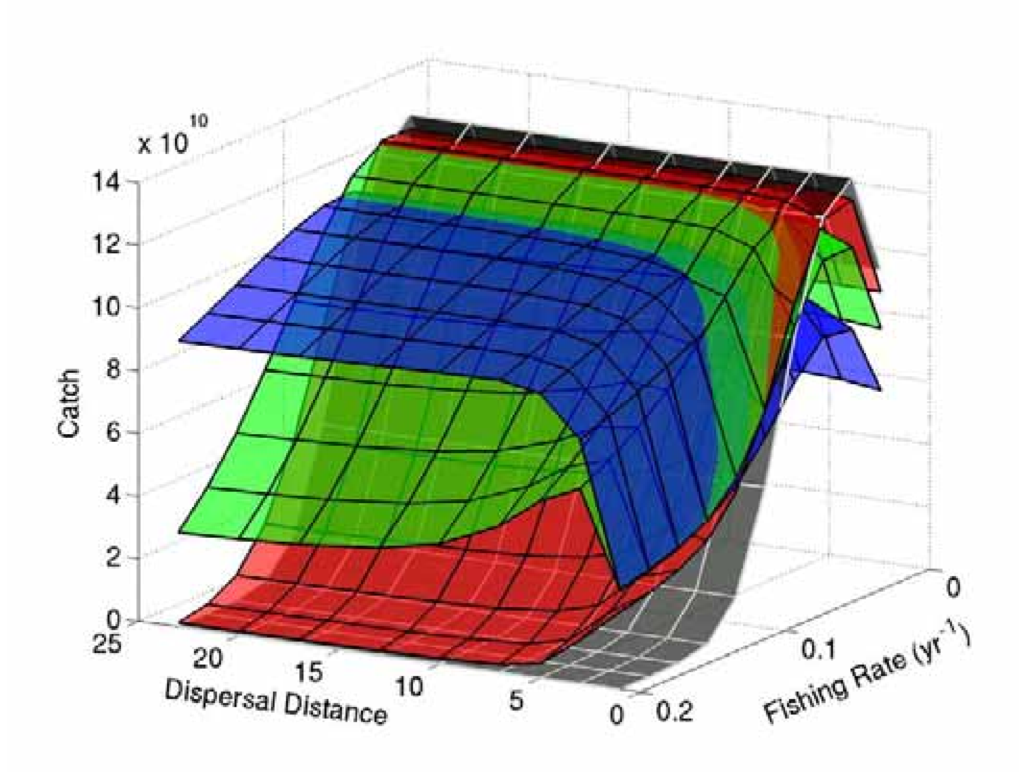

Figure 10. The combined effects of fishing mortality and the fraction in MPAs on species with different dispersal distances. Colours represent fraction of coastline in MPAs: grey represents no MPAs, red represents 8 percent of the coastline in MPAs, green represents 20 percent in MPAs and blue represents 40 percent in MPAs. Note that as the fraction in reserves increases, short distance dispersers are protected first, but as the area increases further, they never produce as much yield as longer distance dispersers.

BACKGROUND PAPER 3

MARINE PROTECTED AREAS: THE SOCIAL DIMENSION[1]

by

Robert S. Pomeroy, Michael B. Mascia and Richard B. Pollnac[2]

Summary

The ecosystem-based approach to fisheries management sees the linkages between human and natural systems and recognizes the need for management approaches that address these linkages. One of the most significant new ecosystem-based management approaches is the marine protected area (MPA). MPAs, as management tools, are the product of social institutions. They are human creations whose purpose is to manage the behaviour of people in their use of coastal and marine resources (Bromley 1991). MPAs result from human decision-making processes and establish an incentive structure that requires changes in human behaviour to achieve success. The development, management and performance of MPAs are shaped by a convergence of institutional interests between resource users, resource stakeholders, community, local government, national government, and international agencies. Research suggests that social factors, not biological or physical variables, are the primary determinants of MPA success or failure. It is often more difficult to get the social components of an MPA "right" than the biological or physical components.

Fishers, fishing households and fishing communities worldwide are not homogeneous. It is critical to recognize that each location has its unique social and ecological context that influences MPA design, implementation and impact. This often makes it difficult to transfer lessons from one location to another and to understand behaviour and the incentives that drive behaviour. That said, however, social science has identified some generalities about coastal people and communities which may affect MPA design and implementation, and that are important to take into consideration. Coastal communities in many locations around the world face a growing degree of insecurity as a result of poverty and high dependence upon natural resources. This vulnerability is often compounded by declining resources, high population growth, limited alternative livelihoods, limited access to land, economic and political marginalization, unsustainable land use practices and development, competition and conflicts over resources, health burdens, and civil strife. MPA design and implementation should seek to understand the diversity of coastal people and communities, especially in relation to their livelihood strategies. It also requires understanding the means by which households adapt to reduce their risks, the incentives that drive the decisions of resource users, and the sources of vulnerability to stresses and shocks.

MPAs will have potential benefits and costs to fishers that are realized over both the short and long terms. These benefits and costs will potentially affect the individual fisher, the fisher's household, and the fishing community. The magnitude of the benefits and costs will be affected by the MPAs objectives, size, location, allowed uses, and level of compliance. An important distributional issue with MPAs is that the benefits are diffuse while costs are concentrated. It should be noted that the sociocultural dimensions of MPA performance have not been well studied.

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[2] The views expressed in this paper are solely those of the authors, Robert S. Pomeroy, University of Connecticut-Avery Point, Groton, CT 06340 USA, Michael B. Mascia, WWF Conservation Science Program, and Richard B. Pollnac, Professor of Anthropology and Marine Affairs, Department of Anthropology, University of Rhode Island, Kingston, RI, USA.

An MPA is a socially constructed set of rules that collectively govern human interactions within a specified area. The design of an MPA is the specific configuration of rules that defines, explicitly or implicitly, *who* may do *what*—and *where*, *when*, and *how* they may do it—with respect to the portion of the marine environment designated as an MPA. The configuration of MPA rules, and the processes through which these rules are developed, implemented, and adapted over time, significantly influences MPA success. The four principal elements of MPA design – decision-making arrangements, resource use rules, monitoring and enforcement systems, and conflict resolution mechanisms – directly and indirectly shape human resource use patterns and, ultimately, the biological and social performance of MPAs. Each of these four MPA design elements may have both formal and informal components derived from diverse sources, including legal statutes, policy statements, judicial decisions, organizational practices, social norms, and cultural traditions. As a result, the *de facto* rules that *actually* govern MPAs often differ sharply from the *de jure* designs established through formal legal structures and policy processes.

A critical factor for success of MPAs is early core group formation, which influences both number of initial trainings and participation, both of which influence introduction of successful alternative livelihoods.

1. INTRODUCTION

In recent years, the ecological collapse and associated social impoverishment of some of the world's best known and most productive fishing grounds (e.g. George's Banks) has fuelled a widespread and growing belief that the conventional fisheries management approaches, with a focus on controlling the exploitation of a single fish stock, is more part of the problem rather than of the solution (National Research Council 1999). Increasingly, it is being recognized that we must incorporate species interactions such as competition and predation, conservation of habitat, and protecting critical life history stages of species and other ecosystem considerations into fishery management (Ecosystem Principle Advisory Group 1999; National Marine Fisheries Service 1999). As a result, the objectives, approaches and policies of fishery management have begun to change. The objectives have shifted from maximizing annual catches and employment to sustaining stocks and ecosystems, and from maximizing short-term interests to addressing both short- and long-term interests. There is a shift away from conventional production and stock- and species-based management toward conservation and ecosystem-based management (Garcia and Newton 1994).

Discussions of marine ecosystems now recognize that they are composed of both natural and human elements. Just as the fish are part of the marine ecosystem, so are the resource users situated within the broad socioeconomic environment. Fish populations are one portion of complex marine ecosystems that are affected by many natural and human-induced factors. In turn, fisheries should be considered as systems in which human systems and ecological systems are linked. This perspective calls for a new way of managing fisheries - an ecosystem-based approach. Ecosystem-based management has emerged as an approach to maintaining ecosystem health and integrity through emphasis on protecting the productive potential and biological diversity of the system that produces goods and services from the ecosystem, as opposed to protecting an individual species or stock as a resource (Costanza *et al*. 1998; NRC 1999; Gislason *et al*. 2000). An ecosystem-based approach to fisheries management is geographically specified fisheries management that takes account of knowledge and uncertainties about and among living marine resources, their habitat, and human components; and strives to balance diverse societal objectives (Sissenwine and Mace 2001). The aim is to ensure that despite variability, uncertainty, and likely natural changes in the ecosystem, the capacity of aquatic ecosystem health is maintained indefinitely for the benefit of present and future generations.

The ecosystem-based approach to fisheries management sees the linkages between human and natural systems and recognizes the need for management approaches that address these linkages. It is also an approach with a human face and a people focus – fishers and fishing communities. One of the most significant new ecosystem-based management approaches is the marine protected area (MPA) (Bohnsack 1993; Roberts and Polunin 1993; Costanza *et al.* 1998; Halpern 2003). An MPA focuses on protecting an area of the marine environment by limiting or eliminating human activity. IUCN has defined MPAs as "any area of intertidal or subtidal terrain, together with its overlaying water and associated flora, fauna, historical, and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." (IUCN 1988) The health of the resource is affected by human activities, but also livelihoods and prosperity of people depend upon the condition of the resources. Thus, humans both affect and are affected by the MPA.

The environment in which the MPA operates incorporates economic, social, political and institutional elements at the community, regional, national and international levels, all of which can influence the goals and objectives pursued by the MPA. MPAs are designed and implemented by people, and there are both natural and human impacts from their use. How MPAs perform is directly linked to human behaviour and how humans want them to perform. Thus, MPAs are directly linked to the socioeconomic environment in which they operate.

The purpose of this paper is to discuss the social dimensions of MPA design, implementation, and performance and the relationship between these three elements; and, based on the social dimensions, to provide recommendations for best practices in the use of MPAs. For the purpose of this paper, social dimensions will refer to social, cultural, political, institutional and economic factors collectively. This introductory section will be followed by a section on MPAs as social institutions. This will be followed by two sections that discuss how the social context affects MPAs and how MPAs affect the social context. Issues in MPA design and implementation will be discussed in Section 5. MPA success factors will be discussed in Section 6. The final section will present recommendations for best practices in the use of MPAs.

2. MPAs AS SOCIAL INSTITUTIONS

MPAs, as management tools, are the product of social institutions. They are human creations whose purpose is to manage the behaviour of people in their use of coastal and marine resources (Bromley 1991). MPAs result from human decision-making processes and establish an incentive structure that requires changes in human behaviour to achieve success. The development, management and performance of MPAs are shaped by a convergence of institutional interests between resource users, resource stakeholders, community, local government, national government, and international agencies. Mascia (2004) states that,

> "Marine reserves are not only the product of social processes, but also have social ramifications. Marine reserves, like other forms of resource management, allocate access to and use of marine resources among individuals and social groups and, thereby, directly and indirectly shape society."

Those who are concerned with reorienting fisheries management through MPAs to promote socially-oriented and sustainable policies need to recognize this convergence of institutions and interests if they are to restructure them effectively.

The goals and objectives for an MPA are established by people through various social processes, including a central authority or a consultative mechanism with resources users. Most MPAs have biological, socioeconomic and governance goals and objectives (Pomeroy, Parks and Watson 2004). Biological goals include sustaining or protecting marine resources, protecting biological diversity, protecting individual species, protecting habitat, and restoring degraded areas. Socioeconomic goals include fostering food security, livelihoods, and non-monetary benefits to society, as well as equitably distributing benefits from the MPA, maximizing compatibility between management and local culture, and enhancing environmental awareness and knowledge. Governance goals include maintaining effective management structures and strategies, maintaining effective legal structures and strategies for management, ensuring effective stakeholder participation and representation, enhancing management plan compliance by resource users, and managing and reducing resource use conflicts. Biological, socioeconomic and governance goals may be contradictory or unequally appealing to different constituency groups, resulting in controversy and conflict (Christie *et al.* 2003). These dynamics contribute to the high rate of MPA failure – approaching 90 percent in some countries (White *et al.* 2002).

Research suggests that social factors, not biological or physical variables, are the primary determinants of MPA success or failure (Fiske 1992; Kelleher and Recchia 1998; McClanahan 1999; Roberts 2000). MPA design and impacts are usually examined from a biological perspective. The focus on primarily biological evaluation criteria may result in an MPA being classified as a success, when, in fact, the reality is much more complex. Christie *et al.* (2003) have stated that,

> "A particular MPA may be both a biological "success" – resulting in increased fish abundance and diversity and improved habitat – and a social "failure" – lacking broad participation in management, sharing of economic benefits, and conflict resolution mechanisms. Short term biological gains will likely disappear unless these social issues are addressed (Pollnac *et al.* 2001; Christie *et al.* 2002)."

3. HOW THE SOCIAL CONTEXT AFFECTS MPAs

As stated above, MPAs are the result of social processes, and are established to change human behaviour by restructuring the incentives that people face in their use of coastal and marine resources. To change human behaviour requires an understanding of the "drivers" of human behaviour. This has often been the weak point of MPA design and implementation.

In general, the design and implementation of MPAs has relied on natural science-driven planning, with limited integration of social science information on resource users, households and communities into the design and evaluation process. This has often resulted in social science information that is "too little, too late", resulting in a poor understanding of frequently contentious social interactions operating on multiple levels (local, national, international, gender, class, ethnicity), unintended negative consequences, missed opportunities for positive change and reallocation of resources, and an incomplete scientific record." (Christie *et al.* 2003) Social science information can help managers identify (Bunce *et al.* 2000; NOAA-CSC 2005):

- Public (and other stakeholders') attitudes, perceptions, beliefs and values
- Use patterns, uses of the marine environment, users of the environment, and relationships between different user groups
- Value of the MPA and the resources
- Impacts of the MPA on the stakeholders and the community
- Relationships between submerged cultural resources and local populations
- Existence of difference in opinion between users and government
- Socioeconomic trends or demographic characteristics
- Informal/traditional marine governance systems
- Social capital

When an understanding of the social context is explicitly integrated into the design and implementation process, it can contribute to MPA management in a number of ways (NOAA-CSC 2005):

<u>Assessment</u> – Managers must have an understanding of conditions before making decisions, by gathering baseline information. Incorporating social science into the assessment process can identify affected groups, as well as potential areas of conflict. Incorporating social science early in the decision-making process can be useful in building upon existing beliefs, values, governance systems, and social structures/capital to foster MPA success.

<u>Feedback</u> – Regular feedback can be helpful in establishing the effectiveness of management techniques and tracking effectiveness over time. Social science research can be used to gauge public perceptions of management focus and effectiveness while also giving the public the opportunity to

suggest management changes. Eventually the feedback process may lead to open dialogue between managers and stakeholders and adaptive management, especially participatory assessment.

Prediction – A range of social science tools, including economic tools and case studies of similar communities, can predict the potential outcomes of management decisions and strategies and enhance management effectiveness.

Mitigation – Identifying stakeholder motivations and areas of concern may help reduce, or even avoid, conflicts among users.

Acceptance – Social science can be used to understand and address public concerns. Concerns can be addressed through changes in MPA management practices or through targeted outreach and education programs, which may lead to increased support from the public and constituents.

3.1 Understanding coastal people and communities

Fishers, fishing households and fishing communities worldwide are not homogeneous. It is critical to recognize that each location has its unique social and ecological context that influences MPA design, implementation and impact. This often makes it difficult to transfer lessons from one location to another and to understand behaviour and the incentives that drive behaviour. That said, however, social science has identified some generalities about coastal people and communities which may affect MPA design and implementation and that are important to take into consideration.

Coastal communities in many locations around the world face a growing degree of insecurity as a result of poverty and high dependence upon natural resources. This vulnerability is often compounded by declining resources, high population growth, limited alternative livelihoods, limited access to land, economic and political marginalization, unsustainable land use practices and development, competition and conflicts over resources, health burdens, and civil strife. MPA design and implementation should seek to understand the diversity of coastal people and communities, especially in relation to their livelihood strategies. It also requires understanding the means by which households adapt to reduce their risks, the incentives that drive the decisions of resource users, and the sources of vulnerability to stresses and shocks (Pomeroy *et al.* 2006).

3.1.1 Diversity

Although the dominant livelihood in many coastal communities, capture fishing is not the only livelihood. Indeed, even when fishing and agriculture are accounted for, all the other livelihoods (ranging from fish-processing to tourism) combined can employ an equal or greater number of people in many coastal communities. These other livelihoods are also likely to employ a wider mix of persons, including women and those from non-fishing communities that live near the coast.

As stated above, coastal communities and the people who live in them are not homogeneous. Even within a single community, coastal resource users may have quite distinct economic orientations. They may be full-time, part-time, seasonal or migratory, and coastal households may have a commercial or subsistence orientation. Livelihoods may be based on a subsistence, "satisficers" (fishing to obtain 'enough income'), or wealth creation/profit-maximizing goal and on a diversified or specialist strategy (Charles 2001; Smith *et al.* 2005). Within the community and groups within the community, there may be differences in internal social cohesion (feelings of attachment to the community or group).

3.1.2 Adaptation

Many households in coastal communities undertake a range of activities in order to cope financially and reduce the risks associated with high economic dependency on natural resources (Bailey and Pomeroy 1996; Allison and Ellis 2001). Fishing itself is a diverse occupation, with many fishers operating in multi-species and multi-gear fisheries. Existing livelihood strategies may be modified or new strategies adopted to meet changing conditions.

It is important to focus not only on the resource user but also on the whole household and household livelihood strategy. For example, all or some of the family members may engage in different livelihood activities. Depending on economic, resource and environmental conditions, these activities may change temporally and spatially throughout the year. The household livelihood strategy may be based on relationships between the extended family or within the nuclear family.

The household livelihood strategy mix will depend upon season, access to the resource (whether fishing areas or farm land), access to capital, skill base, education, and risk preference. Coastal residents may also engage in illegal activities for livelihood, such as dynamite fishing, smuggling or poaching inside MPAs. Rather than being specialized, and therefore vulnerable to a sudden change, many households in coastal communities are well situated to adapt to changing circumstances. The net result of this occupational diversity is that many coastal communities are best understood as dependent not on a single resource but on a whole ecosystem, marine and terrestrial.

Fishers in Southeast Asia, for example, generally like their occupation, despite the risks, and few would change to another occupation with similar income (Pollnac *et al.* 2001). Those most likely to leave fishing for another occupation tend to obtain less of their income from fishing and coastal activities and to have more education. If it is deemed appropriate to provide an alternative occupation that is attractive to fishers, it should, at least, have some of the same characteristics as those considered desirable in fishing. These characteristics include the relative ease of obtaining food and income, the pleasure of being at sea, and the independence of being self-employed. A common alternative livelihood considered for fishers is aquaculture. Evidence exists that fishers would consider aquaculture as an alternative source of food and income, especially if the cost of the technology was low, income was good, and other family members could be involved in the operation (Pomeroy 2004).

3.1.3 Incentives

The incentive structures that individuals and households face are partly economic and partly related to other external factors, such as property rights, rules governing resource use, and levels of enforcement. Many coastal resource users exist at the subsistence level and have a short-run survival strategy of taking care of the daily needs of themselves and their family. These resource users (e.g. fishers), due to limited capital mobility and lack of alternative livelihoods, will use whatever resources are available to them (technology, skill, capital) in order to harvest as much of the resource as possible. These resource users have what is called a *high discount rate* concerning use of the resource – they prefer profits and food now over a continual flow in perpetuity (Pomeroy 1991). This behaviour results in unsustainable levels of resource extraction and reduced profitability. Implementation of an MPA in the context of this economic uncertainty will only shift the problems of competition and conflict into other areas. Until the base issues of resource tenure, excess fishing capacity, and the race for fish are resolved, the ability of the MPA to improve management effectiveness will simply be a stop-gap measure.

Cultivating an awareness of the problems of unsustainable resource use is therefore only a small first step. The more difficult and vital work involves shifting the incentives that resource users face. This includes efforts that build on the array of opportunities and resources at people's disposal – so that they become less directly dependent on the local natural resources for their daily subsistence – and strengthen their security of tenure (whether private or communal) – so that users have a greater stake in a longer-term perspective.

Recognition must also be made between individual decisions and the achievement of broader community and/or societal objectives. Charles (2001) states:

> "Consider the reality in many fisheries, located in regions of isolated fishing communities, where few alternative employment possibilities are available. Often the maintenance of sustainable livelihoods, i.e. stable employment with reasonable incomes, is a priority among society's fishery objectives. This is not just a matter of providing jobs in the fishery, but also of maintaining a

strong 'engine' of the coastal economy, given the extent of spin-off benefits from the fishery into coastal communities." (p. 67).

3.1.4 Vulnerability

The physical isolation of some coastal communities makes them highly resource-dependent and reduces access to alternative livelihoods; this can make them especially vulnerable to any disruptions. Yet even physical isolation can be mitigated through appropriate improvements to infrastructure, health and education services, and improved access to information and markets.

Some aspects of household vulnerability vary with the seasons. While occupational diversification may allow households to maintain a level of income throughout the year, there may be periods of high income (as when crops are harvested or fishing is good) and low income (as when fishing is poor or not possible due to storms). A household's ability to weather these slack periods depends also on the availability of other sources of income, including remittances from family members living outside the area, informal loans from money lenders or traders, and systems of mutual support at the community level.

Other root causes of vulnerability in coastal communities are social and economic power imbalances, lack of participation in decision-making, limited asset ownership, resource dependence, and laws and regulations that influence people's ability to use assets. Once the root causes of vulnerability are recognized, interventions can be put in place to address them and to increase the resilience of the community to shocks, seasonal factors, and human and natural changes. Building resilience means, in part, reducing reliance upon natural resources for livelihoods, strengthening community institutions, organizations and infrastructure, and diversifying livelihoods.

3.2 Perception, attitudes and incentives

Fishers will tend to oppose the establishment of MPAs. (Although it should be stated that there are many instances of fishers establishing MPAs or seeking help to do so, either as a way to establish preferential use rights [i.e. reduce competition with "outside" fishers] or to catalyze transition out of a fishing economy [through tourism]). This is due to the issues discussed above, as well as their experience with past management measures, their natural antagonism towards and suspicion of managers and regulators, and their concerns about resource rights and access reallocation. Any management measure is, rightly or wrongly, most often perceived by fishers as being costly to them by limiting their ability to fish and earn a living. Any proposal to restrict use of the sea will always be controversial. Information about the MPA is shaped and reshaped into many forms by different stakeholder groups, and it is often very difficult to change once positions have been established. Communication about the purpose and intent of the MPA must be clear and transparent and presented early in the process so that any misperceptions can be addressed. Different perspectives of individuals and local groups will need to be understood and considered.

If people, individually and as a group, feel that they have not been part of the decision-making process of the MPA, and have not been able to actively participate in and influence the process, it will be difficult to obtain support and compliance. The attitudes of the group will tend to be negative towards the MPA. Compliance with the MPA rules appears to be based on a combination of three principal factors: coercion, self-interest, and legitimacy (Mascia 2000).

Controversy and conflict are associated with almost all MPAs because they reallocate resources (and wealth) within and among groups. Attitudes of all stakeholders towards the MPA will need to be understood and followed, as they will shift over time. An understanding of the basis of the conflict, whether due to data and facts, needs and interests, values, and/or relationships, will need to be made. Attitudes toward various approaches to conflict management and willingness to compromise should be assessed (Pomeroy and Rivera-Guieb 2006).

Fishers will be concerned about equity issues and the redistribution of benefits and costs resulting from this new management measure. A perception of MPAs is that fishers will give up benefits from an area in exchange for highly uncertain future returns. Traditional access rights in an area may be disrupted or accustomed uses of resources will be reallocated to other uses and users. There is often the perception that MPAs are highly subject to political manipulation (Zinn and Buck 2001).

Perceptions and attitudes towards MPAs will also be shaped by cultural traditions and values. Different groups of resource users and stakeholders may hold different, or unexpected, positions regarding MPAs and marine resources due to their uses of the resource, culture, family and community traditions, beliefs, expectations about the future, environmental knowledge, and the value that they put on the resource.

Individuals will require an incentive structure (economic, social, political) to participate in the MPA and the process of design and implementation. Individuals must have a sense that the rules in place for the MPA are equitable and there must be sharing of costs and benefits among all the stakeholders. Individuals must feel that the benefits to be obtained from participation in the MPA, including compliance with rules, will be greater than the costs of such activities. Individuals must also trust in protected area management (Stern in press). The MPA often involves the individual giving up short-term benefits for real or perceived longer-term benefits. For the individual, the cost of participation, especially in terms of the time involved, cannot be too high or participation will fall. Often, the short-term costs are high in terms of lost income or voluntary labour. For a poor fisher with a family to feed, the incentive structure to support and participate in the MPA must be clear and large. Risk is involved for the individual in changing management measures. The fisher must recognize an incentive for the support of the MPA and long-term stewardship for the resources before the design and implementation process begins. The incentive may simply be the hope for a better tomorrow, but usually changes as the individual gains more information and as the process develops over time. It is often easier to design and implement an MPA where the individual already recognizes an incentive for changing management, rather than pushing change on the individual. Different incentive structures may appeal to different individuals. The incentive may be economic, in terms of higher income, food security, jobs, or protection of livelihoods. It may also be social, in the form of higher prestige among peers or legitimate access to resources (Pomeroy *et al.* 2001).

Incentives should also include real economic benefits. MPA projects should not just focus on resource management, which may take years to show benefits. Combining resource management with livelihood opportunities that provide economic benefits in the short-run are useful to address any economic disruptions to the individual or household. This will be an important incentive for participation and long term sustainability of the MPA (Pomeroy *et al.* 2005).

3.3 Socioeconomic assessments

A socioeconomic assessment is a way to learn about the social, cultural, economic and institutional context and conditions of individuals, groups and communities. There is no fixed list of topics that are examined in a socioeconomic assessment, however, the most commonly identified topics are (Bunce *et al.* 2000; NOAA-CSC 2005):

- Resource use patterns
- Stakeholder and community characteristics
- Gender issues
- Stakeholder perceptions, attitudes and beliefs
- Organization and resource governance and governance processes
- Traditional knowledge
- Community services and facilities
- Market attributes for extractive use
- Market attributes for non-extractive use
- Non-market and non-use values

Socioeconomic assessments vary in the extent they cover these topics, and this will depend on the purpose of the assessment. Some socioeconomic assessments may be a full evaluation of all these topics; others may focus on only one topic such as stakeholder perceptions or resource use patterns. As with all sciences, when conducting a socioeconomic assessment, the reliability and credibility of any information is dependent on the precision of the data collected and the accuracy of the method of analysis. The types of socioeconomic assessments differ, and they can be characterized by two main characteristics (Bunce *et al.* 2000):

- Whether they are participatory (a broad range of people involved in data collection, analysis and use) or extractive (outsiders conduct the assessment and take the information with them)
- Whether they are product-oriented (report produced for specific stakeholder group) or process-oriented (the process of collecting information is as important as the information)

4. HOW MPAs AFFECT THE SOCIAL CONTEXT

MPAs serve as a resource reallocative mechanism, within and among groups of resource users, and at varying spatial and temporal scales. As such, MPAs can either help or hurt local people and communities around them depending upon how they are designed and implemented. As CANARI (2005) state:

> "But realistic assessments of the impacts of MPAs on local households have not been part of official planning processes, and planners are often surprised when fishers resist the establishment or expansion of MPAs because they fear, often with justification, that access to their fisheries will be restricted or cut off completely. The establishment of MPAs thus often results in conflicts between fishers and state agencies. It can also create or increase tensions between fishers and tourism sectors, since objectives and programs of MPAs often are skewed in favor of tourism at the expense of other sectors."

MPAs will have potential benefits and costs to fishers that are realized over both the short and long terms (Dobrzynski and Nicholson 2003; Goodridge *et al.* 1996; Mascia 2000; McClanahan and Mangi 2000; Sanchirico *et al.* 2002). These benefits and costs will potentially affect the individual fisher, the fisher's household, and the fishing community. The magnitude of the benefits and costs will be affected by the MPAs objectives, size, location, allowed uses, and level of compliance (Thomson 1998). An important distributional issue with MPAs is that the benefits are diffuse while costs are concentrated (Hanna 2004). It should be noted that the sociocultural dimensions of MPA performance have not been well studied.

An obvious potential benefit to fishers from an MPA that is able to stabilize or increase fish populations inside its boundaries and produce spillover effects is reduced variations in aggregate catch levels and an increase in the long-run total catch (Sanchirico *et al.* 2002). Sanchirico *et al.* (2002) state that, "MPAs can also increase the market value of a fishery by changing the composition of the catch." Another possible increase in revenues could occur if the changes in catch composition from smaller to larger fish are accompanied by a shift to a more valuable product form (such as frozen to fresh product) (Sanchirico *et al.* 2002). A potential cost to the fisher is that catch, and revenues, may be decreased, at least in the short-term, as a result of the implementation of the closure. The coastal community adjacent to the MPA, especially those with a high economic dependency upon the fishery, may face a disproportionate impact, particularly in the short-term, as a result of aggregate reduction in fishing revenue.

McClanahan and Mangi (2000) report a 60 to 80 percent decline in the number of fishermen at the Jomo Kenyatta Beach fish landing site following establishment of the no-take Mombasa Marine Park in Kenya. Many displaced resource users gain full or partial employment in other sectors, such as construction or tourism, but older fishermen, in particular, appear less able to take advantage of alternative economic opportunities. Marine reserves may also induce new migration patterns by restructuring economic opportunities, drawing people to local communities in the case of some reserves and displacing them from adjacent communities in other situations. These shifting migration patterns frequently change the demographic profile of user groups and coastal communities. Perceptions of individual, household, and community well-being appear to vary by stakeholder group and depend largely upon the distributive economic impacts of reserves (Mascia 2000). No known research has examined the impact of marine reserve establishment upon social indicators such as rates of crime, domestic violence, or alcoholism, demonstrating the need for further study.

Research suggests variation in the social impacts of MPAs on the four principal dimensions of poverty: wealth, health, political empowerment, and education. With respect to wealth, MPA establishment generally induces shifts in resource access and use that vary within and among social groups. Often these shifts involve changes from extractive activities (e.g. fishing) to non-extractive activities (e.g. ecotourism) and/or local resource users moving to exclude "outsiders" (users from outside the immediate community) from accessing nearby marine resources. For those gaining preferential resource access, MPA establishment has often resulted in increases in income, food security, and material assets, while those losing access may suffer corresponding losses or adopt mitigation strategies by shifting resource use patterns or livelihoods strategies. (Resource users engaged in mobile forms of resource use, for example, have greater flexibility to respond to shifting marine resource governance regimes [e.g. MPAs], and are therefore better able to mitigate negative impacts and capture benefits.) The social impact of MPAs on health, political empowerment, and education are poorly studied, though one might expect that changes in these dimensions of poverty would generally follow shifts in patterns of access to MPA resources. Variation (spatial, temporal, and across MPAs) in the magnitude and extent of these MPA social impacts remains largely unexamined and unexplained, highlighting the need for further study to better understand the role of MPAs in poverty alleviation (Mascia *et al.* in preparation).

The establishment of the MPA will result in a reduction of area that is available for fishing. This could potentially result, at least in the short run, in higher levels of congestion and fishing effort in the remaining areas (Hanna 2004). Fishers may also be forced to travel to other, sometimes more distant, fishing grounds (NRC 2000). The effects could be higher fuel, labour and other operating costs and potentially increasing capital expenditures in the fishery (e.g. the need for larger boats and engines and new technology such as GPS). This could increase the hardships on local fishers, especially the poorest of fishers. As Mascia (2004) states:

> "Measures of relative change in income, wealth, or wealth disparity among specific groups or subgroups (e.g., fishermen and divers, line fishermen and net fishermen), for example, represent useful indicators of the distributive economic effects of reserve establishment. The effect of marine reserves on economic equity may also be measured using indicators that track the net economic effect of reserves on populations of particular concern, such as women, minorities, the poor, the elderly, or traditional cultures. The geographic distribution (e.g., local versus national) of costs and benefits is also a useful indicator of the economic equity of a marine reserve."

Sanchirico *et al.* (2002) explore these social issues further, noting that,

> "In addition, significantly reducing the amount of fishable waters could lead to increased conflicts between users of the resource, such as allocation disputes and gear entanglements. … Congestion effects might not only be concentrated in the fishery for which the closure was implemented, as establishment of an MPA could shift fishing pressure from one species to another, thereby increasing the competition for the catch of that second species."

The establishment of MPAs potentially creates short-term losses and hardships for fishers. It has been suggested that short-term economic assistance, through compensation, should be explored to address these losses. There is disagreement about whether or not it is appropriate to compensate fishers for the loss of access to a public resource (Rettig 1994). Compensation may be offered in the form of cash to loans, vessel buy-back to re-training, or joint venture contracts (Roberts and Hawkins 2000). Advantages of compensation include better (uncontested) outcomes, higher levels of support and compliance, reduction in long-term transaction costs, and government consideration of the opportunity costs of actions (Rettig 1994).

Shifts in fishing grounds and travel time as a result of the MPA may potentially result in increased occupational risks to the fishers (Sanchirico *et al.* 2002). The combination of inadequate vessels and lack of experience of the displaced fishers to operate in the new environments poses the potential for greater occupational risks.

MPAs have been shown to increase fish stock abundance, biodiversity and recovery of habitats. As a result, MPAs can be highly attractive to non-extractive users who value the biological and cultural resources for their tourism and recreational opportunities. New visitors can lead to diversification of the local economy through new businesses, jobs and income and tax revenues for the local community. Potential increases in revenue from visitors could lead to potentially offsetting losses to fishers due to the MPA (Sanchirico *et al.* 2002) and help to finance MPA management. Improvements in the environment of the MPA "… may also appeal to individuals who might never intend to use the area, but who value its existence nonetheless." (Sanchirico *et al.* 2002) MPAs can reduce potential conflicts between fishers and other users by providing areas where non-fishery users can pursue non-consumptive uses of the resources.

Excessive visitation of MPAs, and the development that can accompany tourism, can be damaging to the environment and reduce the biological, cultural and economic benefits obtained from the closure. It is important to monitor and manage MPAs to ensure that sustainable levels of tourism are not exceeded (Roberts and Hawkins 2000).

Fishers could potentially face the loss of customary access to fishing areas as a result of the MPA. Local fishers who do not have the resources to fish in another location could be forced out of the fishing business. Alternative or supplementary livelihood opportunities may not be available for all fishers and their families as a result of economic base shifts in the community, increasing hardships to many (Sanchirico *et al.* 2002). Some community members may be negatively impacted as a result of economic changes in the community, such as tourism, and the lose of their traditional way of life (Hoagland *et al.* 1995).

The effects of MPA establishment on economic equity are perhaps even less well understood and less well studied than reserve effects on efficiency. Among those MPAs that permit non-consumptive uses, the general qualitative pattern that follows MPA establishment is a transfer of direct use benefits from consumptive resource users such as fishermen to non-consumptive users such as dive operators and scientists. In Barbados, for example, establishment of the Barbados Marine Reserve shifted the local system of resource use rights from a virtual "open access" system that permitted both consumptive and non-consumptive uses to an ecotourism and scientific use regime that allowed only non-consumptive uses (Mascia 2000). Among MPAs that prohibit both consumptive and non-consumptive uses, all direct users incur costs associated with the loss of resource use rights within the reserve. In this instance, equity indicators include measures of the relative magnitude or significance of the costs incurred by user groups or populations of particular concern (Mascia 2004).

Among both consumptive and non-consumptive users, the distributive economic effects of reserve establishment vary by subgroup. In St. Lucia, for example, establishment of the Soufriere Marine Management Area affected net fishermen and trap fishermen differently (Goodridge *et al.* 1996). In general, small scale fishermen, especially those who use fixed gear or fish within informal fishing territories, are more vulnerable to the loss of fishing grounds than larger scale, transient fishermen employing mobile gear. Small-scale and territorial fishermen, when affected by reserve establishment, lose a larger percentage of their fishing grounds than large-scale or transient operators. The latter groups, however, may be more likely to lose a portion of their fishing grounds to MPAs simply because they fish a larger geographic area. The distributive economic impact of reserve establishment on non-consumptive users appears correlated with users' degree of economic dependence upon the natural environment. Dive operators, for example, are more likely to benefit from reserve establishment than jet-ski businesses (Mascia 2004).

5. MPA DESIGN AND IMPLEMENTATION[3]

As mentioned previously, MPAs are social institutions. In essence, an MPA is a socially constructed set of rules that collectively governs human interactions with a specified area of the marine environment. Rules define MPA boundaries, the activities that may take place within these boundaries, and the individuals who may engage in MPA activities. Rules also specify protocols for enforcing MPA rules, monitoring the effectiveness of these rules, and for resolving stakeholder conflicts. Most importantly, rules govern the decision-making processes that establish MPA boundaries, resource use rights, monitoring and enforcement systems, and conflict resolution mechanisms. Thus, the design of an MPA is the specific configuration of rules that defines, explicitly or implicitly, *who* may do *what*—and *where*, *when*, and *how* they may do it—with respect to the portion of the marine environment designated as an MPA. The configuration of MPA rules and the processes through which these rules are developed, implemented, and adapted over time, significantly influence MPA success (see Section 6).

The four principal elements of MPA design – decision-making arrangements, resource use rules, monitoring and enforcement systems, and conflict resolution mechanisms –directly and indirectly shape human resource use patterns and, ultimately, the biological and social performance of MPAs. Each of these four MPA design elements may have both formal and informal components derived from diverse sources, including legal statutes, policy statements, judicial decisions, organizational practices, social norms, and cultural traditions. As a result, the *de facto* rules that *actually* govern MPAs often differ sharply from the *de jure* designs established through formal legal structures and policy processes. Commercial fishing continues in Glacier Bay National Park (Alaska, United States), for example, despite legal prohibitions dating to 1966 (NRC 2001; 156–157).

5.1 Decision-making arrangements

MPA decision-making arrangements specify the rights of individuals or groups to make choices regarding other aspects of MPA design and management. These rules determine, for example, who may participate in making decisions and who may not (e.g. government officials, resource users), how decision makers are selected for their positions (e.g. elected or appointed), and how decisions are made (e.g. consensus or majority vote). MPA decision-making rules are significant because policy preferences often vary among individuals or social groups; the particular structure of decision-making arrangements determines whose interests, beliefs, and values are represented in decision-making processes and thus manifest in policy and management decisions. During the development of the Florida Keys (United States) National Marine Sanctuary management plan, for example, commercial fishermen shared limited decision-making authority with environmental groups and commercial dive operators, among others. Commercial fishermen generally opposed the establishment of no-take areas as part of the Sanctuary management plan, whereas environmental groups and commercial dive operators generally supported widespread no-take areas (Suman *et al.* 1999). Had any of these groups held exclusive decision-making authority, its policy preferences alone would likely have been reflected in the Sanctuary management plan. In practice, the system of shared decision-making authority resulted in a policy compromise—immediate establishment of a system of nearly two dozen relatively small no-take areas within the Sanctuary and a commitment to develop a larger no-take area at a later date.

MPA decision-making arrangements are usually complex. The responsibility and authority for decision making often rests with different (though frequently overlapping) sets of individuals or

[3] This section is adapted from and builds upon Mascia (2004).

groups during the different stages of the policy process (i.e. agenda-setting, assessment, selection, implementation, evaluation, and termination; Brewer and deLeon 1983). The decision-making rights of particular groups are sometimes limited to narrow aspects of MPA development or management (e.g. enforcement, conflict resolution). Procedural rules that govern voting, decision-making criteria, and the use of scientific information also vary depending upon the stage in the policy process. At each stage, subtle differences in the rules that govern MPA decision making may have significant impacts upon MPA design, implementation, and evaluation.

MPA decision-making arrangements range along a continuum from highly centralized to highly participatory. Centralized decision-making arrangements limit decision-making responsibility and authority to a single individual or a small group, often specialists within a single government agency. Participatory decision-making arrangements, by contrast, permit sharing of decision-making responsibility and authority among diverse groups: resource users; nongovernmental organizations; local, state, and national government officials; and other stakeholders.[4] Because the amount, diversity, and type of information brought to bear upon decisions depends upon who has the right to participate in decision-making processes (Healy and Ascher 1995), participatory MPA decision-making arrangements generally increase the amount and diversity of information integrated into MPA design and management. Participatory MPA decision-making arrangements thus increase the likelihood that policy decisions will be based upon accurate assessments of social conditions and environmental dynamics.[5] Participatory MPA decision-making arrangements also tend to enhance the perceived legitimacy of decisions (Dalton 2005). The proposed boundaries of the Hol Chan Marine Reserve (Belize), for example, were revised prior to implementation at the request of local fishermen, which enhanced the legitimacy of the MPA in the eyes of affected individuals (Mascia 2000).

In particular, participatory MPA decision-making arrangements create mechanisms for integration of traditional or local ecological knowledge into MPA design (Dalton 2005).[6] This collective knowledge, based upon centuries of resource use or much more recent interactions with the environment, can promote more effective MPA design by bringing information not captured by formal science into the decision-making process. In particular, local knowledge may help to contextualize general scientific understandings of natural and social phenomena. Local knowledge, for example, frequently serves as the basis for identifying ecologically and socially significant marine areas (e.g. fish spawning aggregations, sacred sites) that merit protection within MPAs (McClanahan and Glaesel 1997; Heyman and Graham 2001).

The procedural rules that govern how decision-makers make choices can shape the results of MPA decision-making processes. Voting rules shape the balance of power between majority and minority interests. Decision-making by consensus, for example, grants significantly more power to minority interests than decision-making by simple majority. Voting rules also shape perceptions of the legitimacy of decision-making processes among both minority and majority groups. Similarly, the rules and criteria established to govern decisions (e.g. requiring a specific percentage of the coast be designated as MPAs) often shape the outcome of decision-making processes.

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[4] We use the term *resource user* to refer to individuals who derive consumptive or non-consumptive benefits from their physical interactions with the marine environment. The term *stakeholder,* which includes but is not limited to resource users, refers to individuals and organizations with a significant interest in the marine environment or its management.

[5] Though little studied, organizational culture may play a significant role in MPA design. Centralized MPA decision-making processes, in particular, may allow the particular beliefs and values held by a government agency or other decisionmakers to predominate – and potentially result in ineffective policy choices because of incorrect assumptions regarding how the world works or policy preferences out of step with those of other stakeholders (Mascia 2000). Participatory processes allow for diverse perspectives and information exchange that can challenge the foundations of organizational culture and foster more effective MPA design.

[6] Traditional ecological knowledge is "a cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes *et al.* 2000: 1252).

In some situations, the absence or delegation of formal government-led MPA decision-making arrangements creates opportunities for resource users to establish MPAs and manage their own resources collectively. Historically, resource user self-governance was common, leading to the emergence of MPA-like marine resource management systems throughout Melanesia and elsewhere in the tropics (Ruddle 1996). Though emergence of stronger central government governance of marine resources eroded the authority of local resource users in colonial and post-colonial periods (Johannes 1978), a legacy of local user-based marine resource management remains in many coastal communities (Ruddle 1996; Johannes 2002). The frequent failure of governments to meet the challenge of marine resource degradation has led many resource users to reassert decision-making authority over marine resources, resulting in establishment or re-establishment of user-based MPAs in coastal communities around the world (Woodley and Sary 2003; Hoffman 2002; Johannes 2002).

The structure of MPA decision-making arrangements has a significant effect upon reserve performance. In MPAs and analogous natural resource governance regimes, research demonstrates that the right of resource users to participate in the design and modification of rules governing resource use is correlated with regime performance - environmental and social (Christie and White 1997; Mascia 2000, 2003; Ostrom 1990; Pollnac *et al.* 2001). Research also suggests that resource user self-governance rights (i.e. the right to govern the behaviour of one's group, independent of external authorities) are correlated with reserve establishment and performance (Mascia 2000, 2003). Selecting basic rules and criteria to govern decision making (i.e. process guidelines) before attempting to make substantive choices about reserve design may help to reduce conflict and facilitate informed decisions among stakeholders with diverse interests, beliefs, and values (Mascia 2003).

5.2 Resource use rules

Rules governing resource use are the second principal element of MPA design. Resource use rules—including laws, regulations, formal and informal policies, codes of conduct, and social norms—specify the rights of individuals or groups to access and appropriate resources. These rights may be held by individuals, groups, organizations, or the state, and are often shared among these actors. Moreover, resource use rights are seldom absolute. The United States government, for example, may alter the resource use rights of individuals without compensation when legitimately exercising its public trust authority. Though the right to change the rules governing resource use is generally held by governments, this decision-making authority may be shared with or delegated to resource users or other stakeholders. In the state of Maine (United States), for example, lobster fishermen are governed by formal laws and informal codes of conduct that specify where, when, and how they may fish. The Maine state government granted lobstermen limited decision-making authority over resource use rules, including the right to specify trap limits, through the establishment of regional lobstermen-only "councils" (Acheson 2003).

MPA rules governing resource use thus specify how individuals may interact with each other and with the marine environment. Infinite possible configurations of resource use rules exist, ranging along a continuum from "open access" (i.e. no rules) to a complete prohibition on human activities. MPAs generally fall into one of three broad categories: no-take MPAs, zoned multiple use MPAs, and unzoned multiple use MPAs (see Figure 1). No-take MPAs prohibit all consumptive uses of marine resources and sometimes non-consumptive commercial, recreational, and scientific activities as well.[7] Zoned multiple use MPAs establish sets of defined, spatially-explicit rules that allow for different uses of the marine environment in different portions (zones) of the MPA. Unzoned multiple use MPAs, by contrast, establish use rights that differ from the surrounding marine environment, but do not create spatial boundaries within the MPA. Within each of these three categories, MPA rules governing resource use vary in subtle but significant ways. The Florida Keys (United States) National Marine

[7] No-take MPAs are frequently referred to as *marine reserves*, but in some parts of the world "reserves" allow fishing and other forms of extractive resource use. Similarly, marine "parks" and "sanctuaries" permit consumptive resource use in some countries and prohibit all consumptive resource uses in other countries. In discussing marine resource rules, therefore, we prefer to use the generic term "MPA" and to refer to specific permitted and prohibited resource uses.

Sanctuary, for example, has several categories of regulatory zones, including three types of no-take zones, each of which has a different policy objective.

Rules governing resource use shape MPA performance by establishing use rights that foster specific policy outcomes. Because it is impossible to maximize multiple policy objectives simultaneously, the design of MPA rules reflects tradeoffs among social, economic, and environmental goals. No-take MPAs, for example, may reflect decisionmakers' efforts to promote tourism development by setting aside areas for recreational activities, whereas zoned multiple use MPAs may represent efforts to mitigate conflict among resource users by physically separating the relevant parties. Despite efforts to promote specific policy outcomes, MPAs frequently shape human behaviour in unanticipated ways and result in unanticipated social and environmental impacts.

The precision and stability of resource use rights mold individual behaviour. Precise MPA rules specify *who* may do *what, where*, *when,* and *how*. This precision minimizes conflict among resource users or between resource users and enforcement personnel. In some MPAs, for example, dive operators may only use particular dive sites at assigned times; such arrangements prevent crowding and conflict among users. MPA rules facilitate non-compliance and foster conflict when they are unclear or contested (Erdman and Bishop 2003), which raises the costs of resource use and dissipates the benefits of use to resource users. Likewise, imprecise and unstable resource use rights create uncertainty over future opportunities, causing users to discount the future sharply and exploit resources more heavily than they otherwise would. Well-defined resource use rights—precise, stable, easily understood, and easily enforceable—enhance the economic benefits and environmental sustainability of MPAs by reducing social conflict and creating greater certainty regarding future resource use.

Since resource use within MPAs is spatially-defined, rules defining internal and external MPA boundaries are critical to the establishment of precise resource use rights. MPA boundaries are often formally delineated by geographic coordinates (i.e. latitude and longitude) delineated in law or agency regulations. Authorizing legislation and MPA management plans also frequently include provisions for the physical demarcation of MPA boundaries with floating buoys and other markers. For resource users who do not have access to technologies that allow easy geo-referencing based on latitude and longitude alone (e.g. GPS), physical representation of MPA boundaries is necessary for clear definition of resource use rights. In many smaller-scale MPAs, particularly those based on traditional marine resource management systems, boundaries are often effectively delineated by physical markers, underwater features, and landmarks.

MPA rules defining human "boundaries" are equally critical to the establishment of precise resource use rights. By specifying who may and who may not engage in particular forms of resource use, MPA rules effectively allocate marine resources to a subset of privileged individuals (communities, user groups, social classes, etc.). The distributive equity of MPA rules directly shapes MPA social impacts by structuring access to the wealth associated with marine resource extraction (Mascia 2000), with obvious implications for the ability of MPAs to achieve specific policy outcomes (e.g. alleviate coastal poverty). In addition, the distributive structure of MPA rules indirectly shapes MPA effectiveness by influencing resource user perceptions of MPA legitimacy and subsequent compliance with these rules (see below).

Designing precise MPA rules also requires reconciling MPAs rules governing marine resource use with pre-existing marine resource governance systems. Establishment of MPA rules rarely occurs in a governance vacuum. Formal government management systems regulate marine resource use in most countries; in many coastal areas, resource users have also developed rules to govern marine resource use. Failure to reconcile novel MPA rules with existing regulations may foster uncertainty, non-compliance, accelerated resource use, and conflict among resource users (Erdman and Bishop 2003). By contrast, using existing governmental and resource user governance systems as the foundation for MPA rules can enhance understanding, support, and compliance among resource users and government officials.

Research demonstrates that the clarity and congruence of rules governing resource use influence MPA performance. Clearly defined resource and reserve boundaries, as well as clearly defined individual resource use rights, tend to improve the social and environmental performance of MPAs and other natural resource governance regimes (Ostrom 1990; Mascia 2000, 2001). Rules governing resource use that are explicitly linked to local conditions also tend to enhance reserve performance (Mascia 2000). Research also suggests that the presence of economically congruent resource use rights—where the resource users who benefit most from reserve establishment bear the greatest cost of sustaining reserve benefits, while those who derive the fewest benefits incur the least cost—foster MPA performance (Mascia 2000). Among effective MPAs, research suggests that the rules governing resource use have sufficient scale and scope to address all threats that significantly affect the social or environmental systems of the reserve (Mascia 2000). Finally, the performance of legally designated MPAs tends to be enhanced when reserve resource use rights are consistent with existing informal or culturally based resource use rights (Fiske 1992; Mascia 2000).

5.3 Monitoring and enforcement systems

MPA monitoring systems track changes in the state of MPA-associated social and environmental systems. MPA monitoring systems vary in what they measure and who does the measuring, as well as where, when, and how measurements are made. Carefully designed monitoring systems— which generally include robust performance indicators, baseline data, and control sites—can provide insights into the changes in social and environmental systems due to MPA establishment. Participatory MPA monitoring systems, which involve resource users and other non-scientists in formal data collection and analysis, provide a mechanism for increasing awareness, improving resource management, and empowering communities (Obura and Wells. 2002). In practice, many MPAs lack formal systems for monitoring environmental and, especially, social phenomena. As a result, resource users, managers, and other stakeholders often informally monitor environmental and social indicators to assess MPA performance. Monitoring-based assessments of performance can guide future MPA policy and management decisions, as well as enhance confidence in current policies and management practices. In Belize, for example, formal and informal assessment of the social and environmental performance of the Hol Chan Marine Reserve led to widespread support for expansion of the MPA (Mascia 2000).

Enforcement systems attempt to increase compliance with rules governing resource use by monitoring user behaviour and punishing those engaged in prohibited activities. By increasing the severity and likelihood of sanctions and, thus, raising the opportunity cost of non-compliance, enforcement systems act directly upon resource users to foster adherence with established rules. Monitoring user behaviour forces would-be poachers to engage in deceptive practices that diminish the benefits of engaging in prohibited activities. Sanctioning non-compliance further diminishes the benefits of engaging in prohibited activities and thus deters malfeasance. The role of enforcement systems has been demonstrated in the Bahamas, where aggressive enforcement of "no fishing" regulations at the Exuma Cays Land and Sea Park dramatically reduced the frequency and extent of fishing within the MPA (Mascia 2000).

Enforcement systems also shape compliance indirectly. First, by shaping perceptions of overall compliance rates, enforcement systems affect rates of "contingent compliance," where individuals base their decision to obey rules upon the (perceived) rate of compliance by others (e.g. Himes 2003). The theory of contingent compliance posits that, because individuals seek to avoid being a "sucker" by obeying the rules while others are not, individuals become increasingly likely to obey the rules as the perceived rate of overall compliance increases (Levi 1997). Second, through both the design of sanction mechanisms and the perceived "fairness" of enforcers, enforcement systems shape perceptions of legitimacy. As the perceived legitimacy of MPA enforcement increases, compliance rates also appear to increase (Mascia 2000). Research suggests that meaningful but graduated and context-dependent sanctions, which ensure that punishment fits the crime, are generally perceived as more legitimate than draconian, one-size-fits-all penalties (Ostrom 1990).

Research on the role of monitoring and enforcement systems in MPA performance highlights the importance of accountability, legitimacy, equity, and flexibility. Monitors who actively assess resource conditions and are accountable to resource users (or who are themselves resource users) tend to improve the performance of MPAs and analogous resource governance regimes (Buhat 1994; Ostrom 1990; Woodley and Sary 2003). Likewise, reserve performance is enhanced by the presence of active and accountable monitors of resource use behaviour (Mascia 2000; Roberts 2000; Woodley and Sary 2003). Again, monitors may themselves be resource users. Sanctions for non-compliance must not only be likely and severe enough to raise the cost of non-compliance but also graduated and context-dependent to ensure that punishment fits the crime (Ostrom 1990; Mascia 2000).

5.4 Conflict resolution mechanisms

Conflict resolution mechanisms are formal and informal processes for resolving disputes. Conflict resolution mechanisms permit information exchange, clarification of resource use rights, and adjudication of disputes related to decision making, resource use, monitoring, and enforcement. Critical questions in the design of conflict resolution mechanisms include *Who may participate?* and *Who adjudicates?* Other important design issues include the frequency and location of conflict resolution activities. Readily accessible and low-cost conflict resolution mechanisms enhance regime performance directly by mitigating social conflict and thereby minimizing resource overexploitation and dissipation of MPA benefits (Ostrom 1990). Conflict resolution mechanisms also enhance MPA performance by giving voice to aggrieved parties and acknowledging their concerns, which increases the legitimacy of MPA rules and regulations.

The role of conflict resolution mechanisms in MPA performance is not yet clear. Available data suggest that low cost, local, and readily accessible conflict resolution mechanisms tend to enhance the performance of MPAs and analogous natural resource governance regimes (Ostrom 1990; Mascia 2000). Additional research is clearly needed to understand better the role of conflict resolution mechanisms in reserve performance.

6. MPA SUCCESS FACTORS – EXPERIENCE FROM THE PHILIPPINES

Traditional comparative, statistical analyses of variables influencing success of community-based MPAs involve bivariate correlations and regression analyses (e.g. Pollnac *et al.* 2001; Crawford *et al.* 2006), selecting the variables and/or combinations of variables that are significantly correlated with the measure of success. Variables manifesting significant relationships are often referred to as "predictor variables" to be used in designing future projects.

Although these types of analyses are important and interesting, they do not indicate preconditions for the predictor variables or clearly illustrate the complexity of their interrelationships, which may be essential for the proper structuring of project activities. For example, among the many variables linked to MPA success in the literature, we often hear that peoples' participation is an important factor. But the important question is, exactly how is it related to success? Is it directly influencing success, or does it influence success through its impact on another variable with more direct influence? An understanding of the ordering of these complex links, especially given the tens of variables allegedly related to MPA success may assist project planners in their task of structuring necessary activities.

Usually project planners make decisions concerning implementation activities by using a model based on training and past experience. This type of model is known as a heuristic model. Sometimes this model works and sometime it does not. Variance in success suggests the need to adjust these personal heuristic models, but as noted previously, traditional statistical analyses are not adequate for the task. One way to transcend this inadequacy, however, is to develop a model of factors influencing success of community-based MPAs by using a correlation matrix to identify linkages between the independent variables. The most efficient way to do this is to first identify variables that are most strongly related to the dependent variable, then trace their interrelationships throughout the intercorrelations of all the independent variables. The following example is derived from a re-analysis of data first presented in Pollnac *et al.* (2001).

6.1 Methods

6.1.1 Dependent and independent variables – MPA success

Previous analyses of this community-based MPA data evaluated success using a summary measure that included differences in coral health (inside and outside the MPA), fishers perceptions of resource changes, compliance with MPA rules, MPA features (e.g. marking buoys, guard house, monitoring program, etc.) and empowerment of villagers with respect to the MPA (Pollnac *et al* 2001). The current example uses only a biological measure of success. This measure is composed of observed differences inside and outside the MPA with regard to coral health (mortality index), numbers of fish families observed, and numbers of top predators (large groupers) observed. Data concerning these indicators were obtained using a systematic snorkel method.[8] Differences for each of the three indicators inside and outside the MPA were calculated, standardized and summed to create the biological measure of community-based MPA success.

6.1.2 Independent (predictor) variables

Previous research involving meetings with focus groups composed of MPA practitioners in the Philippines (Crawford *et al.* 2000) and literature reviews (Crawford *et al*. 2000; Pollnac 2000) identified a number of variables purported to be important for implementation of successful MPAs. The list of independent variables can be found in the analysis section, and details concerning their measurement and justification are in Pollnac *et al.* (2001).

6.1.3 Sample

The analysis is conducted within one nation as a means of controlling for aspects of national legislation and policies that could impact establishment and sustainability of community-based MPAs. A cross-national study would only further complicate an already complicated analytical problem. The Philippines was selected since the nation has had more experience and a larger number of community-based MPAs than any other country. The community-based MPAs in the Philippines also manifest a wide range of levels of success, ranging from "paper" (existing only in legislation) and non-functional community-based MPAs to those that have achieved world-wide recognition for their achievements (e.g. Apo Island).

The sample is a quota sample[9] including only community-based MPAs that include coral reef area, allow no fishing within the boundary, and were officially recognized by municipal ordinance for at least three years. Three years seems to be a sufficient time interval to reduce the impact of the novelty of a new project and the impact of external attention. The sample was selected to include sites manifesting a range of "success", with a stress on geographic representativeness across the four

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[8] The systematic snorkel method used required the observer to swim (using a dive mask, snorkel, and fins) over a shallow reef area (1-5 meters deep). The observer had to swim along an imaginary transect line 500 to 1000 meters in total length. The depth of the transect line was maintained by following the contour of the reef. The observer visualized a square meter area on the substrate and, based on a list of parameters, noted the percent cover of each parameter within the imaginary square as seen from the surface. The squares were required to be 50 meters apart (approximated by a predetermined number of fin kicks); hence, ten to twenty 50 meter interval observations were accomplished. This was done both inside and outside (adjacent to) the MPA.

[9] Ideally, it would have been best to use a stratified random sample. We started out with this as our goal, but it soon became apparent that the information we had concerning the "universe" of community-based MPAs in the Visayas was faulty. In most cases we used locally available transportation (buses, jeepnies, tricycles, and motorcycles); hence, travel took up a significant proportion of our time. It was thus difficult to ignore MPAs that fit our sampling criteria if they appeared where we did not expect to find them, especially when many we expected to match our criteria, based on available information, did not.

provinces. The final sample is composed of 14 community-based MPAs located in Bohol, 12 in Leyte, 8 in Cebu and 11 in Negros Oriental (see Figure 2).

6.2 Analysis

The goal is to identify variables that can be used to predict successful community-based MPAs rather than a point estimate on the success indicator; hence, sites were first dichotomized into two groups—very successful and not very successful—with the dividing line one-half standard deviation above the mean on the biological success indicator. In the next step, correlations between the independent variables and the dichotomous biological success measure are calculated (Tables 1 through 3). The results indicate that 15 of the independent variables are statistically significantly correlated with community-based MPA success ($p<0.05$). While the results are interesting, our goal is to identify the structure of the interrelationships between the variables to construct a heuristic model of the factors influencing MPA success. This type of analysis may also indicate why so many variables, expected to be related to MPA success, were not.

6.3 Constructing the model

As noted previously, one way to construct a model is by using the correlation matrix to identify linkages between the independent variables. The most efficient way to do this is to first identify variables that are most strongly related to the dependent variable, then trace their interrelationships throughout the intercorrelations of all the independent variables. There are 83 independent and one dependent variable, resulting in a total of 84 variables. The correlation matrix for 84 variables (to the left of the diagonal ones) includes 3,486 unique correlation coefficients. The matrix will not be presented in this document because it is too large.

Starting with independent variables manifesting correlations of 0.45 or greater (Tables 1 through 3) with the dependent variable (more than approximately 20 percent of the variance), we find the interrelationships identified in Figure 3. The model in Figure 3 indicates that, based on our selection criteria, percent successful alternative income projects, MPA resource monitoring carried out by community members, and adaptive management are the proximate variables influencing MPA success. Arrows are used in the models to suggest a possible causal linkage. Where there are no arrows, it is difficult to suggest a causal relationship. Since the models are developed post analysis, the reader may wish to treat them as informed hypotheses, which should be tested with further research. In Figure 3 the arrows suggest that successful alternative income projects give the incentive and time for project participants to become involved in monitoring the resources within the MPA. Alternative income may also reduce perceived need to fish in the MPA, influencing its success. In turn, the improved resources in the MPA probably provide additional stimulus to remain involved in the monitoring program. The double-headed arrow represents these latter two relationships. Finally, a management system which adapts to phenomena observed during monitoring is more likely to be successful than one which is inflexible.

Figure 4 depicts the independent variables closely related to monitoring by community. We already discussed the relationship between this variable and successful alternative income. Small island is the only variable which meets the criteria in terms of size of correlation, but working into the matrix from small island, we find that community heterogeneity is strongly negatively correlated, so it is also entered into the model. It should be further noted that when a variable meets the criteria and is entered into the model, its relationship with other variables in the model are examined, and if they are statistically significant ($p>0.05$) arrows are drawn to illustrate the relationships. Examples of this are the arrows between MPA performance and the two independent variables village heterogeneity and small islands. The small islands in the sample were the small islands off shore the larger named islands in Figure 2. Relatively small populations where inhabitants know each other and are in almost constant face-to-face interaction carrying out similar activities characterize these islands. People sharing similar backgrounds and in face-to-face interaction are probably more likely to cooperate in a joint venture like a community based MPA; hence the negative correlation with heterogeneity.

Following the same model building criteria working out from adaptive management we find the relationships depicted in Figure 5. Monitoring conducted by advisors has the strongest relationship with adaptive management in Figure 5. In turn adaptive management and monitoring by advisors has a relatively strong impact on number of ongoing trainings. This is probably due to the fact that the monitoring reveals areas where community members could benefit from further training. These ongoing trainings are relatively strongly related to the MPA features score. This makes sense since the training would facilitate maintenance of activities and features that compose the MPA features score. Ongoing trainings are also strongly related to community empowerment concerning the MPA. The knowledge imparted by the ongoing training informs villagers concerning the significance of their activities (e.g. surveillance of the MPA, maintenance of MPA boundary markers, not fishing in the MPA, etc.) with regard to resource protection. This is reflected in the very strong relationship between community empowerment and compliance. Empowerment may also result in the community asking for more training, hence the double-headed arrow between the two variables. Monitoring of MPA features by the advisors also influences changes that are reflected in the two-way interrelationship between adaptive management and the MPA features score.

Finally we use the same criteria to extend our model out through successful alternative occupations. Figure 6 indicates that a fairly large number of variables are related to percent successful alternative income projects. Perhaps the most important is formation of a core group of community members early on in the implementation process. Early community involvement in all types of development projects, including MPAs, has frequently been cited as a factor that influences success (see Rogers 1995; White *et al.* 1994; Morss 1972). The strong relationship this variable has with other variables related to the alternative income variable (e.g. community participation scale, number of initial trainings, MPA features score, and compliance) illustrates the importance of early involvement of a core group of community members. It is probably safe to assume that this group is both logically and temporally prior to and manifesting no feedback from the other variables with which it is connected by an arrow. Arrows connecting MPA success with compliance and MPA features are included although the correlations are below 0.45 since these variables are probably influenced by alternative income and are intermediary between alternative income and MPA success. Participation and initial trainings probably have a direct impact on successful alternative income projects, and the alternative income, in turn, facilitates compliance and the MPA features. For example, villagers will be less likely to violate the MPA due to need if some needs are fulfilled by the alternative income, as well as more likely to support aspects of the MPA features scale. The positive feedback from MPA success will also impact compliance and support of MPA features.

6.4 Conclusions

The model developed here is unquestionably superior to traditional analyses which indicate only direct relationships with the success of MPAs. For example, the model clearly indicates the dynamics of the interrelationships between the so-called “predictor” variables. For example, the model makes it obvious that successful alternative incomes are the result of first, early core group formation, which influences both number of initial trainings and participation, both of which influence introduction of successful alternative livelihoods. The model indicates that early formation of the core group has multiple statistically significant relationships with variables that both directly and indirectly impact MPA performance, yet the bivariate correlation presented in Table 3 (0.30, $p>0.05$) is not statistically significant. The important position of this variable alone in our heuristic model justifies the claim that the modelling process can lead to findings that are of significance in project design. In conclusion, we contend that application of the findings of this section of the report can significantly increase our ability to develop successful and sustainable MPAs.

7. RECOMMENDATIONS – BEST PRACTICES

In some circles, MPAs have come to be advocated as the solution for all fisheries and ecosystem management problems. In reality, MPAs are not substitutes for fishery management, but are one of several tools in the toolbox. This paper has identified a number of social dimensions of MPA design, implementation, and performance that should be considered in the best practices in the use of MPAs.

- MPAs are the product of social institutions and are established to change human behaviour by restructuring the incentives that people face in their use of coastal and marine resources.
- Goals for the scope and purpose of MPAs must reflect a balance between scientific and social and economic needs and realities.
- MPA design and implementation should seek to understand the diversity of coastal people and communities, especially in relation to their livelihood strategies.
- MPA design and implementation requires understanding the means by which households adapt to reduce their risks, the incentives that drive the decisions of resource users, and the sources of vulnerability to stresses and shocks.
- Communication about the purpose and intent of the MPA must be clear and transparent and presented early in the process so that any misperceptions can be addressed.
- People, individually and as a group, should be made to feel that they have been part of the decision-making process of the MPA, and have been able to actively participate in and influence the process. Without this, it will be difficult to obtain support and compliance.
- Perceptions and attitudes towards MPAs will be shaped by cultural traditions and values.
- Individuals must feel that the benefits to be obtained from participation in the MPA, including compliance with rules, will be greater than the costs of such activities.
- Combining resource management with livelihood opportunities that provide economic benefits in the short-run are useful to address any economic disruptions to the individual or household.
- A socioeconomic assessment can be used to learn about the social, cultural, economic and institutional context and conditions of individuals, groups and communities, and identify the potential impacts of the MPA.
- The benefits and costs of MPAs will potentially affect the individual fisher, the fisher's household, and the fishing community.
- The magnitude of the benefits and costs will be affected by the MPAs objectives, size, location, allowed uses, and level of compliance.
- A potential cost to the fisher is that catch, and revenues, may be decreased, at least in the short-term, as a result of the implementation of the closure. The coastal community adjacent to the MPA, especially those with a high economic dependency upon the fishery, may face a disproportionate impact, particularly in the short-term, as a result of aggregate reduction in fishing revenue. Efforts should be made to minimize disruptions to lives and livelihoods through impact assessment and preparing strategies to address the disruptions.
- Strategies need to be put in place to address increased occupational risks to the fishers due to shifts in fishing grounds and travel time as a result of the MPA.
- MPAs can reduce potential conflicts between fishers and other users by providing areas where non-fishery users can pursue non-consumptive uses of the resources.
- Excessive visitation of MPAs, and the development that can accompany tourism, can be damaging to the environment and reduce the biological, cultural and economic benefits obtained from the closure. It is important to monitor and manage MPAs to ensure that sustainable levels of tourism are not exceeded.
- Alternative or supplementary livelihood opportunities may not be available for all fishers and their families as a result of economic base shifts in the community, increasing hardships to many. Some community members may be negatively impacted as a result of economic changes in the community, such as tourism, and the loss of their traditional way of life.

- Share responsibility and authority by bringing diverse stakeholder groups, including resource users, into MPA decision-making and management processes improves the substance and legitimacy of these decisions, increases management capacity, and enhances the legitimacy of management activities.
- Accountability mechanisms (e.g. elections, consultative sessions, or open meetings) increase the likelihood that decision makers will further constituents' interests rather than personal interests in decision-making processes. Accountability mechanisms also foster fair and active enforcement of rules governing resources use by enforcement personnel.
- Resource user self-governance initiatives that are consistent with reserve policy objectives can serve as effective complements to other management efforts.
- Clear MPA boundaries and clear rules governing resource use within reserves foster compliance and simplify enforcement.
- Linking reserve rules to the state of social and environmental systems fosters adaptive (and more socially and environmentally sustainable) management of these systems.
- Reserve rules that allocate resource use benefits to users in rough proportion to the costs that these users incur to provide the same MPA resources will likely be perceived as more legitimate, and thus enjoy greater compliance, than rules that allocate benefits disproportionate to their costs.
- Building MPAs on the foundation of existing systems of informal or customary resource use rights enhances reserve legitimacy and fosters compliance among resource users.
- Tracking the environmental and social dimensions of MPA performance provides the basis for adaptive management.
- Enlisting stakeholders, including resource users, in data collection and analysis educates participants, builds capacity, and fosters trust.
- Sharing information regarding the environmental and social performance of MPAs may enhance reserve legitimacy or provide the impetus for necessary policy reform.
- Graduated, context-dependent sanctions enhance compliance by raising the opportunity cost of non-compliance and enhancing the perceived legitimacy of the reserve.
- Broad dissemination of information regarding compliance rates and enforcement actions can enhance reserve legitimacy and foster contingent compliance.
- Highly accessible conflict resolution mechanisms provide a vehicle for resolving disputes that would otherwise increase costs of resource use and, thus, diminish reserve benefits.

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ANNEX 1: TABLES AND FIGURES

Table 1. Correlations between socioeconomic and cultural variables and MPA biological success measure.

Number of occupations in village	-0.10
Number of religions (heterogeneity index)	-0.36*
Percent farmers	0.02
Percent fishers	-0.07
Reef fishery important to village	-0.06
Level of tourism activities	0.35*
General village development	-0.11
Level of advanced village development	-0.04
Level of moderate village development	-0.28
Level of basic village development	-0.09
Percent children underweight	-0.13
Percent children moderate/severe underweight	0.07
Level of village market integration	0.04
Level of village transportation integration	-0.22
Level of village communication integration	-0.29
Level of village political integration	-0.23
Total village integration score	-0.28
Village stability (leader turnover)	-0.20
Peoples' participation in village decisions	0.15
Number of cooperative groups in village	-0.08
Level of intra-village conflict	0.07
Level of municipal development	-0.03
Percent with electricity (municipal)	0.17
Percent with private water faucet (municipal)	0.00
Percent with unsealed toilets (municipal)	-0.23
Percent with no toilet (municipal)	0.03
Percent with no or unsealed toilet (municipal)	-0.15
Density of unsealed or no toilet households	0.30
Municipal stability (mayor turnover)	0.12

*p<0.05 **p<0.01

Table 2. Correlations between environmental and demographic variables and MPA biological success measure.

Village area	-0.30
Distance from municipal center	0.16
Village population (1995)	-0.35*
Municipal population (1995)	0.01
Small island location	0.33*
Village population density (1995)	0.17
Change in village population density (1975-95)	0.11
Perceived pre-MPA crisis in coral	0.16
Perceived pre-MPA crisis in fish stocks	0.26
Amount of trash (garbage, water and beach)	0.16
Amount of debris (natural, water and beach)	0.22
Amount of trash and debris	0.21

*p<0.05 **p<0.01

Table 3. Correlations between project activities and output variables and MPA biological success measure.

MPA public ceremony at implementation	0.43**
Government officials visit MPA	0.30
MPA area	0.21
Distance of MPA from village	-0.03
MPA visible from village	-0.22
Other CRM projects in village	0.31
Non-MPA issues addressed through early action	0.17
Percent successful alternative income projects	0.49**
Village influenced size and location of MPA	-0.01
Village initiated development of MPA	-0.16
Village received external advice for MPA	0.11
Distance of MPA advisors from village	-0.06
MPA advice continued after implementation	0.16
Villagers can go to organization for advice	0.26
Consultations with villagers about MPA	0.16
Formal MPA consultations (formal meetings)	0.14
Informal consultations	0.34*
Frequency of village MPA consultations	0.23
Villagers voted on MPA	0.14
MPA core group formed early in process	0.30
Level of community empowerment concerning MPA	0.39*
MPA project participation component score	0.23
Monitoring causes change--adaptive management	0.46**
MPA monitoring done by villagers	0.49**
MPA monitoring done by advisors	0.06
Village had a live-in expert	-0.07
Villagers visited other MPAs(cross visits)	0.10
Number of initial trainings	0.35*
Number of ongoing trainings	0.38*
MPA project training component score	0.30
Any municipal inputs	0.25
Any village inputs	0.09
Any other inputs	0.07
Total MPA inputs score	0.27
Any community contribution to MPA	0.16
Satisfactory municipal inputs	0.43**
Satisfactory village inputs	-0.01
Satisfactory inputs from other sources	0.16
Community contribution to MPA project	0.23
Level of MPA rule compliance	0.41**
MPA features score	0.38*
Fishers perception of MPA influence on resource	0.29

*p<0.05 **p<0.01

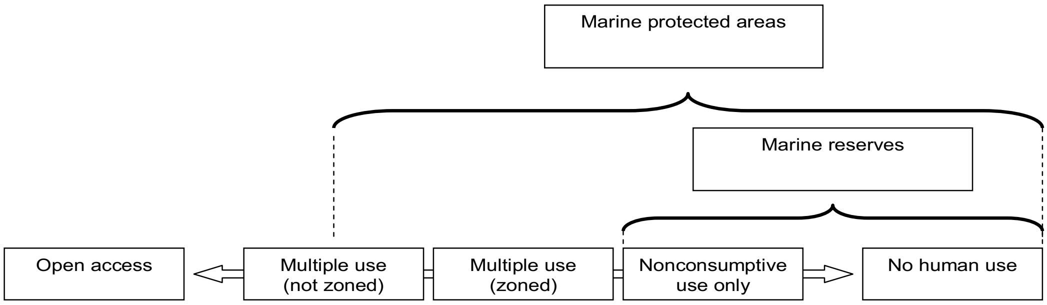

Figure 1. Relationship of MPAs to other forms of marine resource governance. Redrawn from Mascia (2004).

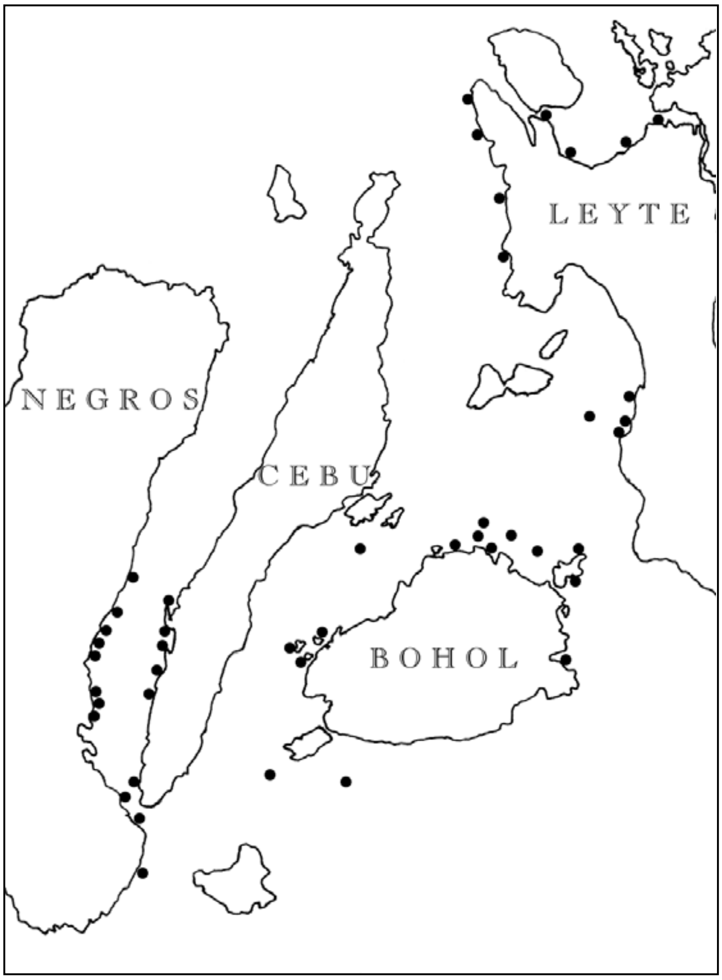

Figure 2. Locations of MPAs in sample.

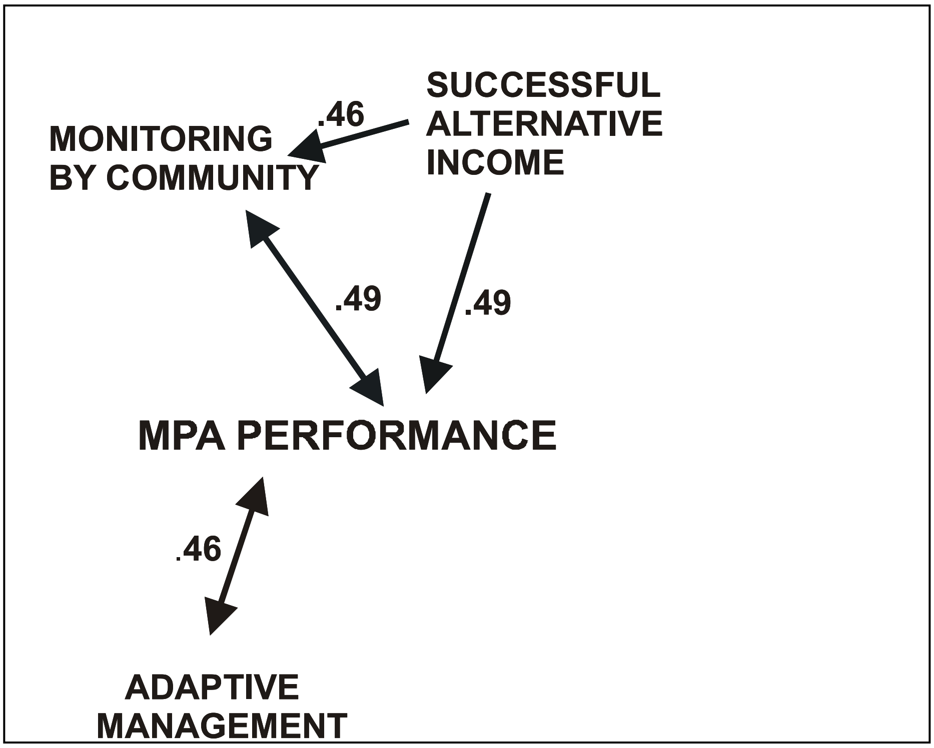

Figure 3. Variables directly related to MPA performance.

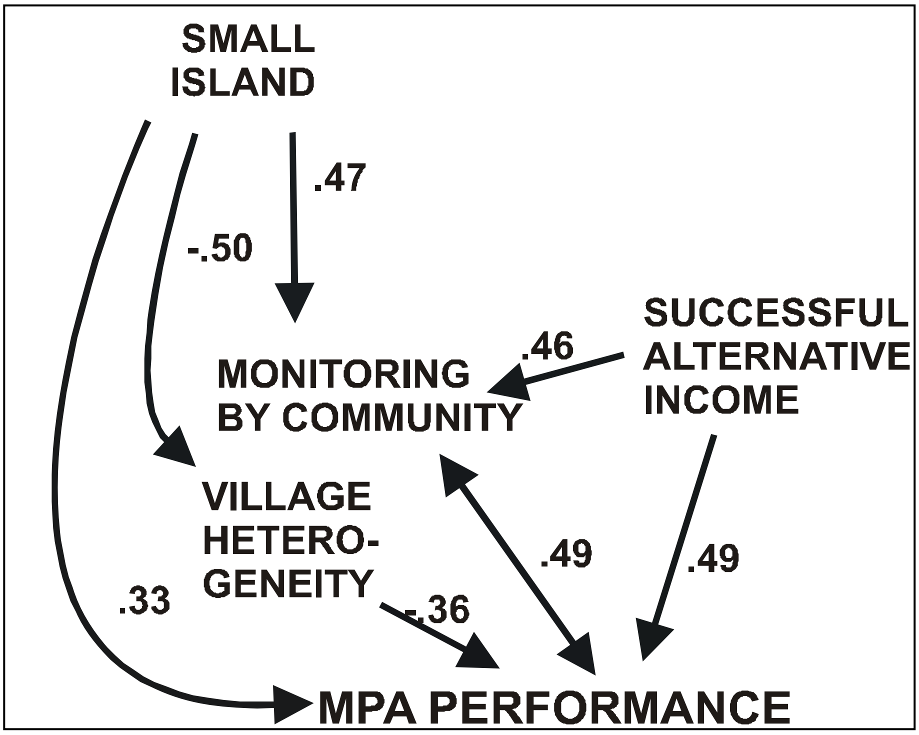

Figure 4. Variables related to MPA performance through monitoring by community.

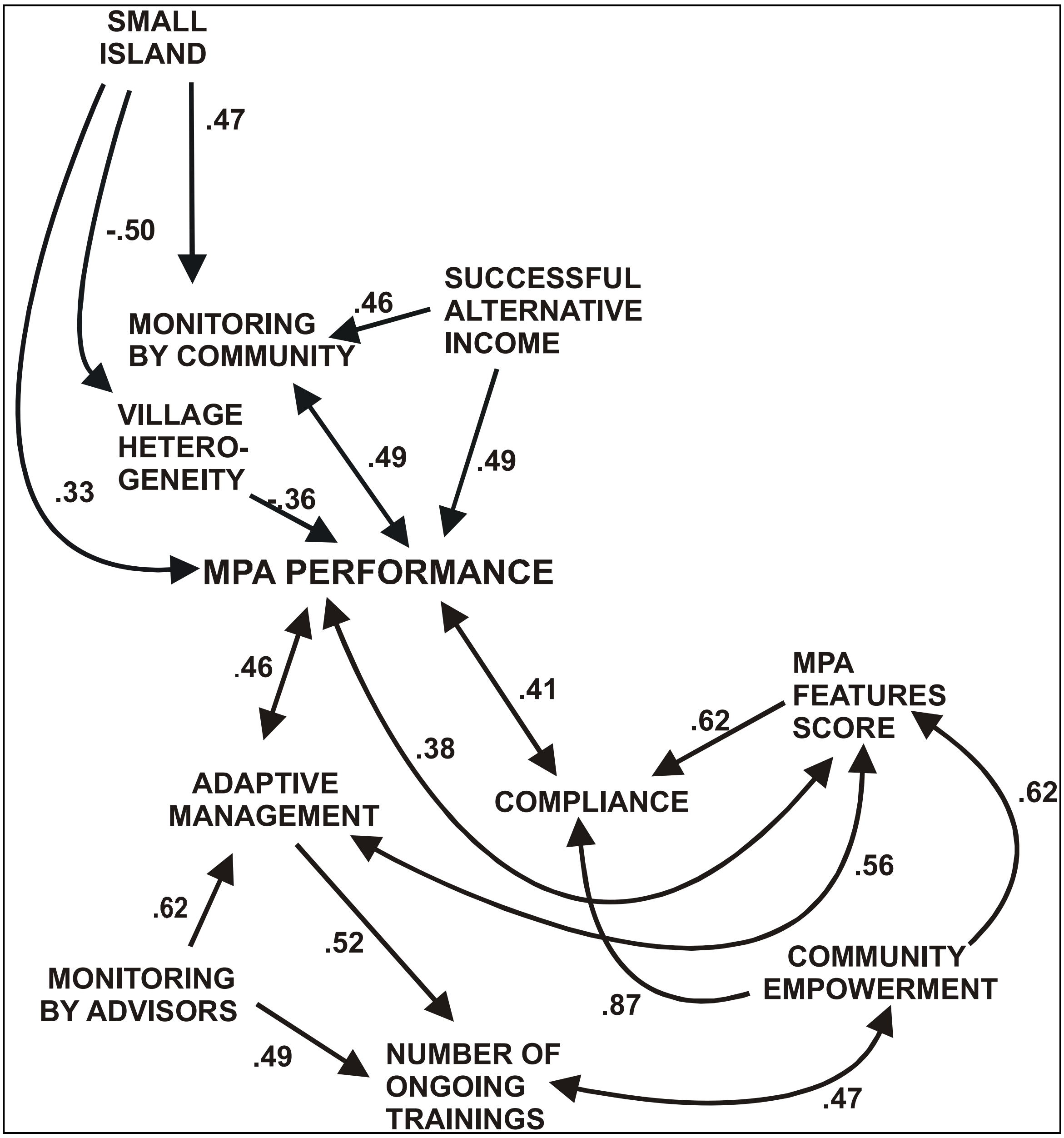

Figure 5. Including variables related to MPA performance through adaptive management.

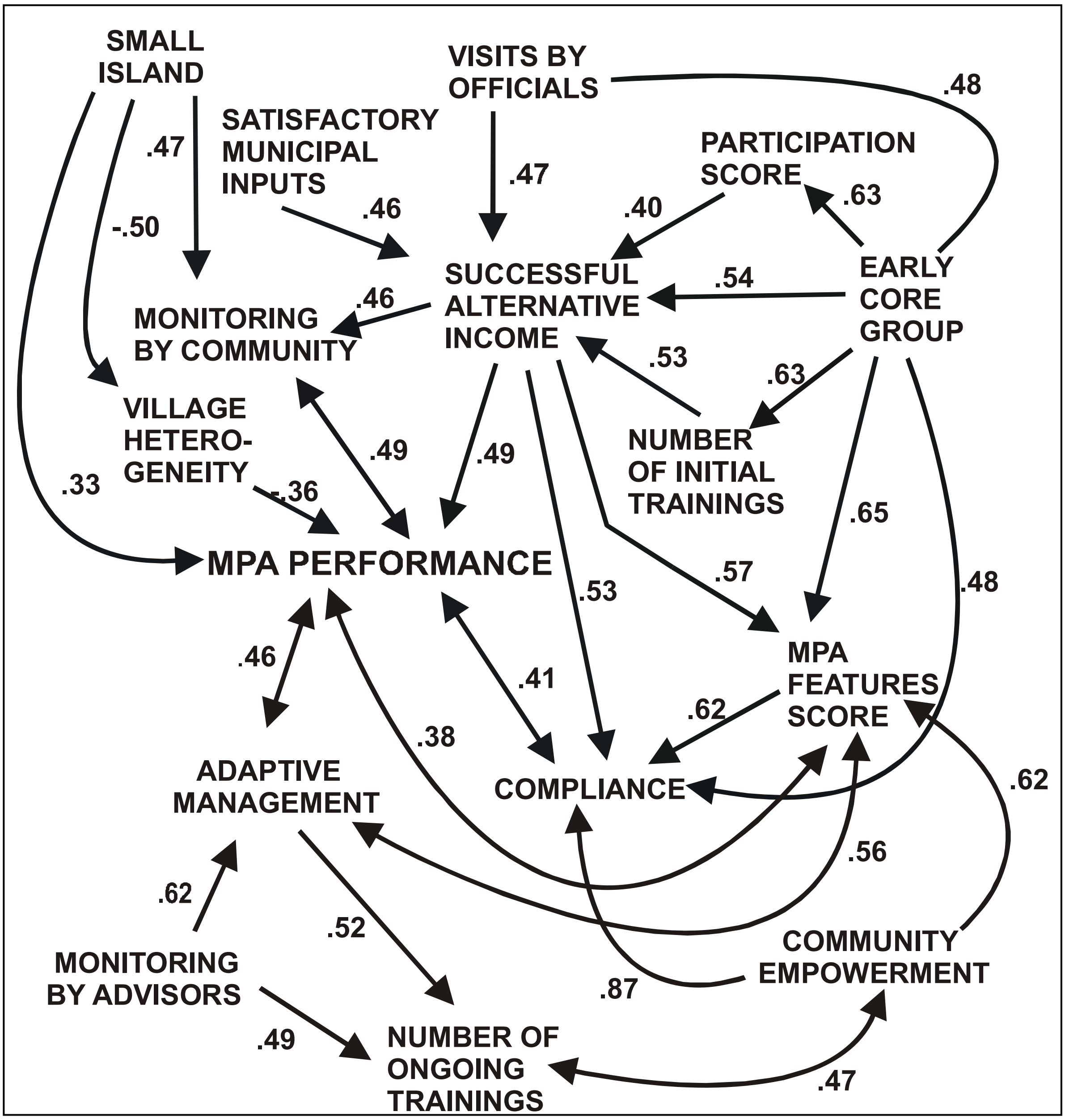

Figure 6. Including variables related to MPA performance through successful alternative income.

BACKGROUND PAPER 4

BEST PRACTICES IN GOVERNANCE AND ENFORCEMENT OF MARINE PROTECTED AREAS: AN OVERVIEW[1]

by

Patrick Christie and Alan T. White[2]

Summary

Marine protected areas (MPAs) have emerged as an important tool for meeting various biodiversity conservation, fisheries management and social goals. While global targets have been set and considerable effort and resources are being expended, important governance and institutional questions remain largely unanswered. In particular, greater attention to social dynamics, trade-offs and incentives is necessary to ensure MPA success in a variety of contexts. This study attempts to capture our current understanding of these matters in various locations. It is limited, to some degree, by the lack of published work on these matters.

There is considerable understanding as to how MPAs, particularly community-based ones, are most effectively planned and implemented in places such as the Philippines. This knowledge is grounded in decades of trial and error, as well as carefully designed empirical research. A standard planning process generally follows these phases.

- Phase I: Issue identification and baseline assessment
- Phase II: Plan preparation and adoption
- Phase III: Action plan and MPA implementation and enforcement
- Phase IV: Monitoring and evaluation
- Phase V: Information management, education and outreach

Each of these phases is grounded in a carefully orchestrated education and community organizing process designed to empower resource users. The planning process should be flexible and iterative. MPA implementation and stabilization is a slow process. Such systems generally evolve into co-management regimes to ensure that resource user communities and government entities (and other constituencies) are engaged in a productive and collaborative partnership.

Such community-based MPAs are designed to meet both artisanal fishery management and biodiversity conservation goals. Experience and empirical evidence demonstrates that the generation and equitable distribution of benefits from such MPAs is essential to long-term success. Important challenges, such as scaling up such MPAs into networks and improving their resilience in light of global change processes, remain ahead. This type of MPA has been most commonly implemented in the tropics, although attempts are underway in developed country contexts.

Large-scale, centrally-planned MPAs are important for biodiversity conservation and will likely emerge as an important tool for remote areas and high seas. They require strong institutions and

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[2] The views expressed in this paper are solely those of the authors, Patrick Christie, School of Marine Affairs and Jackson School of International Studies, University of Washington, patrickc@u.washington.edu, and Alan T. White Advisor, Fisheries Improved for Sustainable Harvest (FISH) Project , Tetra Tech EM Inc. and USAID, Philippines, Alan.white@ttemi.com.

considerable financial resources to implement and, as such, are likely most appropriate for developed country contexts. Reviewed examples strongly suggest that governance mechanisms which ensure meaningful consultation with the public about design and management are possible and essential to success.

Traditional MPA systems as found in the West Pacific and with private reserves, will likely have an important, but more limited role globally. Most traditional management systems have been undermined for too long by colonial and globalizing economic systems in most contexts. Private MPA management, while potentially effective, tends to generate considerable controversy given the typical status of marine resources as either public or common pool resources.

To be effective on a wide scale, MPAs should be embedded within large planning frameworks such as integrated coastal management (ICM) or ecosystem-based management (EBM). ICM has been under development around the world for at least 30 years, although it is only beginning to take hold in many countries. EBM is a more recent planning framework, and is largely untested. These frameworks are designed to balance resource management and economic development, consider ecologically-significant processes, and encourage cross-sectoral planning. Impacts from terrestrial activities, inter-sectoral conflicts, overfishing and the management of trophic interactions are central issues being addressed by these broad models. These comprehensive frameworks should emerge incrementally from past management practices and match institutional human and fiscal capacity.

MPAs and networks of MPAs are increasingly important tools for EBM and ICM. The networking of MPAs to improve ecological and implementation function is widely recommended, however little field experience exists. Many so-called networks are actually collections of MPAs in a particular region without carefully designed ecological or social linkages. Networking can strengthen the management of an individual MPA by linking resource users and managers to support systems. The transactions costs and complexity of formal network management are likely considerable, although not well established. As a result, careful ongoing evaluation of such nascent efforts is critical.

MPA implementation requires supportive legal and jurisdictional frameworks—a relatively rare condition around the world. MPAs affect resource user behaviour and large-scale development and transportation patterns and, as such, entail trade-offs. The legal encoding of the boundaries and management rules of any MPA is a fundamental step that legitimates management decisions. Similarly, multiple institutions and various levels of governance will likely become involved in any MPA implementation process. Clear jurisdictions between formal institutions are not common in most marine contexts.

MPAs are now at the centre of an important and fascinating debate about resource and environmental management. The common pool or open access nature of most living marine resource management regimes creates both opportunities and challenges for MPA implementation. Collective action by interested and informed constituencies has proven to be an effective means for MPA implementation. Conversely, the lack of clear tenure rules can undermine MPAs. In many cases, the MPA debate tends to pit conservationists and advocate natural scientists justifiably concerned about condition of the world's oceans against sceptical resource users and social scientists and natural resource management institutions concerned with economic dislocations and trade-offs. While sustainable resource use and biodiversity conservation are important goals for any management regime, there are clearly many means to attain these goals. MPAs are one of many important management tools that if implemented carefully have tremendous potential. The process will necessarily require global dialogue (due to the desire for global networks) as well as local efforts. These experiments should be carefully studied and documented to support field activities and capture lessons (in addition to developing ecological and social knowledge). Given the tight linkage of human and ecological systems, such evaluation should be multi-disciplinary suggesting that, for now, much more attention is needed on developing a rigorous and comparative understanding of governance and institutional principles.

1. INTRODUCTION

Marine protected areas (MPAs) have been established as an important tool for fisheries management, biodiversity conservation, habitat restoration and tourism development. They take many forms, but all have in common the characteristic of management interventions that are spatially organized. Likely the most widely accepted definition for an MPA is the following.

> "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." (Resolution 17.38 of the IUCN general assembly [1988] reaffirmed in Resolution 19.46 [1994])

The growth of interest in MPAs has been remarkable. As ocean ecosystems, and associated human communities, are stressed as a result of overexploitation and habitat degradation, MPAs have been commonly offered as an important management intervention.

This overview of governance and enforcement of MPAs will emphasize some of the challenges and opportunities associated with MPAs. It will draw from experiences around the world, but will emphasize the Philippines where both authors have worked extensively and where there are a variety of long-term MPA examples to draw from. The lessons and management approaches developed in the Philippines are widely relevant for other, especially, tropical contexts. The intent is to strike a balance between conceptual ideas and practical guidelines for MPA governance and enforcement.

2. MPAs TAKE MANY FORMS IN NAME, GOVERNANCE AND FUNCTION

MPAs take various forms around the world and the terminology is confusing. A "sanctuary" in the Philippines is strictly off limits to extractive uses, while a "national marine sanctuary" in the United States context usually allows fishing but prohibits other activities such as oil exploration. Geographic scales also vary tremendously—from 2 hectare community-based MPAs to the thousands of square kilometers of the zoned Great Barrier Reef National Marine Park. MPAs can consist of temporary or permanent closures. For the purposes of this study, MPAs will consist of a "no-take" area(s) with some type of buffer or other nearby zones within which extractive and non-extractive uses are regulated.

Governance may be conceived as "the formal and informal arrangements, institutions, and mores which determine how resources or an environment are utilized; how problems and opportunities are evaluated and analyzed, what behaviour is deemed acceptable or forbidden, and what rules and sanctions are applied to affect the pattern of resource and environmental use." (Juda 1999) Various models, including top-down, bottom-up, co-management, and traditional management regimes, are utilized to implement MPAs (Christie and White 1997). As a general premise, how these management models evolve is influenced by whether there are functional common property regimes in place or resources are open access. MPAs can, in fact, serve to reinvigorate common property regimes that had been dismantled over time. Ostrom has demonstrated, mainly through an analysis of terrestrial systems, that various design principles are associated with successful and long-term common property regimes (Ostrom 1990:90).

Ostrom's design principles illustrated by long-enduring common property regimes are as follows:

1. Clearly defined boundaries defining who has rights to withdraw resources and the boundaries of the common resource
2. Congruence between appropriation (restricting time, place, technology, etc.) and provision rules (requiring labor, material, and money) and local conditions
3. Collective-choice arrangements
4. Monitoring of conditions and behavior
5. Graduated sanctions depending on the seriousness of an offense

6. Conflict-resolution mechanisms
7. Minimal recognition by government authorities of rights of appropriators to organize
8. Nested enterprises with monitoring, enforcement and governance activities organized in multiple levels for CPRs that are part of larger systems

Various authors (Christie *et al*. 2003a; Mascia 2000) have extended Ostrom's principles to the marine realm, but comparative, empirical evidence is not yet available.

It is beyond the scope of this work to discuss examples of specific MPAs from around the world in detail. But a review of relevant research[3] and of published descriptions of MPA implementation[4] provides sufficient grounding for these summary conclusions. As a starting point, it is critical that MPA designers recognize that effective MPA governance is heavily influenced by the particular socio-political, historical, and socio-economic context of a site. The problems associated with the development of globalized management models that can be effectively exported around the world is, in fact, one of the most important lessons of a decade of research (Brechin *et al*. 2003; Christie *et al*. 2005). For example, the Philippines has been a leader in community-based and co-management MPA management. Its global influence, while significant and understandable, must be carefully assessed. Such models need to be made context-appropriate. Similarly, centralized management regimes, reliant on strong formal institutions and funding bases, are not effective in much of the developing world.

A matrix of common MPA governance systems, characteristics, and examples is presented in Table 2.1. Some of the MPAs straddle management approaches, but the characterization suggests that there is a broad diversity of strategies around the world. While the below section will attempt to elucidate general principles, there are serious limitations with the MPA governance literature which consists principally of grey literature and case studies that are influenced by particular site dynamics.

Table 2.1 MPA governance systems, characteristics, and key examples as discussed in report.

	Traditional: Based on pre-colonial management systems and traditional ecological knowledge, taboo systems	**Bottom-up: led primarily by resource users, generally small-scale, participatory**	**Co-management: Joint management by resource users and government**	**Centralized: Led by government agency, consultative with resource users**	**Private: Private sector led**
Africa			Mafia Island (Tanzania), Kenya		Chumbe Island, Tanzania
Asia		Apo Island (pre 1992), San Salvador Island (pre 1990), Philippines	Tubbataha National Marine Park, Apo Island and San Salvador Island (at present), Philippines		
Pacific Islands	Palau, America Samoa, Locally Managed Marine Areas (LMMA				

[3] Consisting primarily, but not exclusively, of a review of the leading marine policy journals: *Ocean and Coastal Management*, *Marine Policy* and *Coastal Management*.
[4] Consisting primarily of a review of MPA News (www.mpanews.org), the gray literature, and various MPA guidebooks and reviews (e.g. Salm and Clark 2000, Sobel and Dahlgren 2004, NRC 2001), and personal communications.

	network) in Western Pacific				
Latin America			Galapagos Islands, Ecuador, Brazil extractive reserves	Galapagos Islands, Ecuador	
Caribbean			Souffriere, St. Lucia		
United States				Florida Keys and Channel Islands, United States	
European Union				Italy network, Mediterranean MPAs, Britain	
Australia				Great Barrier Reef National Marine Park	
Offshore				Pelagos Whale Sanctuary in Mediterranean Sea	

Trade-offs are associated with each of these governance systems. The interplay between social and ecological goals, and a consideration of context, will suggest a particular approach.

2.1. Traditional

Traditional ocean governance became known globally through the seminal work of Robert Johannes (1981) and Kenneth Ruddle (1988, 1994). The fact that, in some societies, MPAs had existed for millennia, grounded in taboo and social norms, suggests that these governance systems are sustainable and effective in some contexts. While uncertain, many other societies (e.g. the Philippines, Indonesia) that are highly reliant on nearshore coral reef fisheries and related to Pacific Island cultures likely had similar regimes prior to the disruptions caused by colonialism. The negative effects of globalization on Palau's traditional management systems suggests that they are potentially fragile and best suited to support modest, local commercial and subsistence activities (Johannes 1981).

Recently, there has been considerable effort to strengthen such traditional management systems throughout the West Pacific Islands. The Locally Managed Marine Area network, discussed below, represents one such effort. The formal institutionalization of traditional management practices, while potentially supportive, should not reify these adaptive systems (Ruddle 1988).

2.2 Bottom-up management

In a context of weak formal institutions, or where resistance to colonialism is strong, bottom-up or community-based MPA management strategies are frequently employed. Weak formal government support may be due to a lack of financial or technical resources. In some contexts, especially in non-democratic or post-colonial states, governments may not effectively serve the public. In these contexts, that are common through much of the tropics, bottom-up governance regimes may be the only feasible option. Its relevance is not limited to the tropics however (McCay and Jentoft 1996) and is now being practiced in places such as the San Juan Islands, Washington, United States (MPA News 2000). Much of this report emphasizes the means by which to operationalize such strategies.

There are various advantages to bottom-up strategies. They tend to engage resource users more effectively than top-down strategies since they lead to a sense of trust, collaboration, and ownership among participants (Christie and White 1997; Pollnac *et al*. 2005). These strategies are also responsive to local conditions that resource users know intimately from regular interactions (e.g. Christie *et al*. 2000; Johannes 1981). Finally, if carefully implemented, their attention to meaningful participation tends to lead to sustainable long-term management regimes, especially if the bottom-up process and participating resource users and organizations eventually engage the government (Balgos 2005; Christie 2005; Christie *et al*. 2005; White *et al*. 1994). Once a strong and self-reliant planning process is established, empowered resource users are more effective in contributing to a co-management process with government agencies (described below). Developing a sense of self-determination is a central desire in many fishing communities, and, if realized, can engender a sense of pride that attracts participation in management and inspires people to educate others in a similar situation (hence the importance of cross visits as highlighted in Section 7). In the broader sense, bottom-up management approaches represent an important means by which communities are able to reassert historic authority over resources upon which they depend. Colonialism and, now, globalization are forces that tend to erode such authority.

Establishing bottom-up processes is fraught with challenges, and unless eventually articulated with government authorities through a co-management arrangement may not be sustainable. The legacies of colonialism and dependence (globally) on government agencies and the private sector tend to remove incentives to participate in such a time-intensive process. If resource users have been disenfranchised from their resource bases and marginalized from decision making for decades or even centuries, change will likely proceed at a slow pace and will encounter many obstacles both internally and from external forces that are not in favour of change (Christie *et al*. 2000; Morris and Mueller 1992). Community-based initiatives may also be destabilized when neighbouring communities and leaders do not support MPA implementation (Aitaoto 2006). On a pragmatic level, funding horizons and non-governmental organization (NGO) planning timelines are generally not long-term. At a minimum, such processes need approximately three years of financial support and one decade of at least part-time external technical support (with conflict management, leadership development, etc.). Finally, the scaling up of bottom-up management to address large-scale processes affecting coastal environments and communities (including climate change, overfishing, and pollution) is challenging. The incentives for participating resource users or local officials to become engaged in issues outside their areas are unclear and the issues are frequently highly technical and difficult to grasp. Recent efforts to develop learning networks as highlighted below are an important first step toward effective scaling-up.

2.3 Co-management

The fundamental principle of co-management is that it involves resource users and formal policy makers (e.g. the government) in a process of joint decision-making (Christie and White 1997; Nielsen *et al*. 2004; Pinkerton 1989; Pomeroy *et al*. 2006; Pomeroy *et al*. 2001; White *et al.* 1994). It is frequently one of the outcomes of a community-based process that has matured to the point whereby resource users and policy makers (and other entities such as the private sector) have comparable influence and willingness to collaborate (Christie 1999). Co-management can also be mandated (as with tribes in Washington State, United States) and used to strengthen historically-established rights that affect the allocation of resources and implementation of MPAs (Pinto da Silva 2004).

Co-management, as a compromise between bottom-up (led by resource users in the strict sense) and centralized management, potentially represents the best of both models—engaging resource users and government officials in an equitable and transparent planning process that is formally recognized and sanctioned. Ideally, co-management efforts are able to utilize local knowledge and improve compliance by engaging resource users, while formalizing management decisions with government support. However, based on comprehensive, comparative research in Southeast Asia and Southern Africa, "the practical adaptation by governments of the co-management approach has most often been limited to involving fishing communities in the implementation process—an 'instrumental co-management' approach. Governments have generally not perceived co-management as a means to introduce more democratic principles into fisheries management, but have recognized co-management as an instrument to reach its management objectives more efficiently by involving fishing communities in the implementation process" (Nielsen *et al.* 2004:154). Experience in Tanzania, Nicaragua, Brazil and the United States demonstrates that co-management processes that are not attendant to power dynamics and establishment of conflict resolution mechanisms run the risk of breaking down (Christie 1999; Christie *et al*. 2000; Dukes *et al*. 2001; Pinto da Silva 2004; Walley 2004). The establishment of multi-sectoral management boards is difficult unless mandates are clearly established and long-term financing available. With these challenges in mind, examples such as the Tubbataha Marine Park management council demonstrate the potential of co-management and multi-sectoral management boards to ensure balanced representation from stakeholder groups (Arquiza and White 1999; UNESCO 2006).

As with community-based approaches, co-management efforts will require future attention to developing larger-scale initiatives, reconciling local and global management agendas, balancing of local and scientific knowledge, and developing conflict resolution strategies (Christie and White 1997; Nielsen *et al*. 2004).

2.4 Centralized management

Centralized management has historically been the most common governance regime in countries with strong national governments. Colonial governments frequently replaced more decentralized, traditional governance systems as a means of efficiently extracting natural resources (Christie and White 1997; Nielsen *et al*. 2004; Robinson 1997; Walker 1997). In a globalized world in which indebted countries require hard currency, fisheries allocations for valuable resources are most frequently made by government agencies. In the global North, strong government bureaucracies and clear legal mandates frequently established fisheries (and possibly environmental management) agencies as policy makers for catch allocations and MPA design and management. For example, in the United States MPA planning tends to be rather centralized, with final policy making resting with the National Oceanographic and Atmospheric Administration National Sanctuaries program that consults with various constituencies and scientists (NOAA 2006; Scholz *et al*. 2004; Suman *et al.* 1999).

International protocols and multi-national agreements should also be considered under this management approach. Attempts are underway to utilize international agreements and protocols to establish MPAs—although linking issues such as vessel-source pollution control and MPAs is not always successful (Detjen in press). International protocols will likely determine the range of possibilities for offshore MPAs such as Pelagos Whale Sanctuary in the Mediterranean Sea (MPA News 2003a). These offshore MPAs are likely to meet some obstacles resulting from their potential impacts on fishing and navigational interests (Kaye 2004).

Centralized management is commonly perceived as having the benefit of efficiency and scientific grounding. Technical specialists who understand the theory associated with MPA planning and assessment are able to design sophisticated plans, especially with recently developed software that aids modelling and decision making (e.g. MARXAN, ECOPATH, etc.). Ecological connectivity, animal migrations, and changing climatic conditions over large areas may be taken into account when MPA designs are made. On occasion, framing resource management as mainly reliant on science is a means to centralizing management decision making in the hands of scientists and government officials. Currently, a heated debate regarding protected area management and the role of scientific and local (non-scientific) knowledge is underway (Chapin 2004; Terborgh 1999; Brechin *et al*. 2003).

The most serious limitations of centralized management are associated with how stakeholder groups will respond to policies that will affect them but for which they do not feel responsible. The recent establishment of global targets for MPAs implies, in some manner, that international bodies are willing to assert their influence—a process that some advocates of MPAs have expressed concern over since it may undermine wide commitment to ocean conservation and short circuit complex planning processes (Agardy *et al*. 2003). Recent studies question the long-term (fiscal and temporal) efficiency of centralized management compared to co-management regimes (Pomeroy in review). Experiences in the Florida Keys National Marine Sanctuary, Channel Islands, and Galapagos Islands have demonstrated that centralized management (and reticence to use human dimensions data) can foster controversies (Helvey 2004; Scholz *et al*. 2004; Suman et al. 1999). Fishing interests in these cases have commonly felt antagonized by and distrustful of the MPA planning process. They may resist the intrusion of government agencies into a realm of resource extraction (and management) that has historic precedents (Jentoft 2000). Centralized planning may not be sensitive to localized impacts of MPAs that may result in considerable socio-economic and demographic changes as witnessed in the Mediterranean (Badalmenti *et al*. 2000; Salmona and Verardi 2001). On the other hand, national institutions may, in fact, feel threatened by co-management or bottom-up management regimes since they question government authority to manage resources.

Institutional fiscal and technical limitations represent other important limitations of centralized management. MPA planning and monitoring can be both complex and expensive. Government agencies may not be able to attend to the important details of MPA design and management, especially when budgets are limited or cut (e.g. Brazil as described by Pinto da Silva 2004 or NOAA in the United States). Furthermore, there are considerable competing societal problems such as health, economic development and education that will frequently trump MPA considerations when budget priorities are developed. Lastly, centralized management regimes over large areas may overwhelm institutional capacity especially in the absence of clear incentives and wide variability in social conditions (Christie *et al*. 2005; Jones 2006).

Centralized management can be effective. In some highly autocratic countries, such as Brunei, centralized management is the only option for establishing MPAs, and has been done so successfully from a biodiversity conservation perspective. In many countries, consultative participation is required with ultimate decision-making and fiscal allocation decisions remaining with the government (e.g. Beatley *et al*. 2002 on the United States; Day 2002 on Australia). During the recent re-zonation of the Great Barrier Reef Marine Park (GBRMP), the Australian government implemented a comprehensive consultative process that generated an unprecedented 30 000 formally submitted comments that helped with the drafting (Fernandes *et al*. 2005). Their careful use of extensive public outreach, independent expert advice, and mapping technology resulted in a comprehensive re-zonation whereby 33 percent of the GBRMP is now in no-take status.

2.5 Private management

While not commonly practiced, MPAs can either be explicitly or *de facto* privately managed. Chumbe Island, Tanzania represents one of the best know examples of the former and has demonstrated considerable resilience in the face of some criticisms that highlight the privatization of what have historically been public resources (MPA News 2003b). Private entities and government tourism operations took over management and enforcement of other MPAs, such as Twin Rocks and Balicasag Island, Philippines, after established by community and local government entities, thus representing cases of *de facto* privatization (Christie 2004; Christie *et al*. 2002).

As highlighted by Riedmiller (in Salm and Clark 2000:265-270), the private sector can act efficiently and decisively. With the correct incentives, it will pursue ecosystem friendly MPA (and tourism) development. Private MPA management may serve as an important complement to community and government-led initiatives.

As with centralized management, private management tends to generate considerable controversies. This is particularly the case if the “social contract” established by a community-based MPA process is breached in which case compliance rates are likely to decline (Christie and Pollnac in preparation; Christie *et al*. 2002). Private management may also struggle to compete with the “subsidized management” of other MPAs that benefit from grants (Riedmiller 2000).

2.6 Summary

MPA management structures vary considerably. The choice of management systems is influenced by history, cultural norms, institutional strength, faith in science, goals, and influence by individual actors and projects. This section highlights the importance of context-appropriate management. More importantly, it suggests that each management system has associated pros and cons that must be matched with MPA goals. Careful attention to social dynamics surrounding an MPA will suggest when management strategies must change. Management scale will influence the degree to which an MPA, or network of MPAs, is able to address linked social and ecological goals. The means to effectively scale up from somewhat fragile traditional or community-based initiatives remains an area for careful exploration and documentation. There remains, however, considerable room for improving the understanding of MPA governance based on comparative field research. Most of the literature is either not peer reviewed and/or consists of individual case studies that are difficult to generalize to other contexts.

3. INTEGRATED COASTAL MANAGEMENT AND MPA EFFECTIVENESS

The goals associated with MPAs can often create conflicts among different interests, user groups, levels of government and national government agencies as seen in Belize, the Philippines and Indonesia (Cho 2005; White *et al*. 2006). Where competition for coastal resources exists, careful design and implementation of integrated coastal management (ICM) or more narrowly focused coastal resource management (CRM) schemes can help ensure continued benefits and sustainable management of coastal resources. ICM is a process aimed at guiding coastal area development in an ecologically sustainable fashion (Chua 1998; Cicin-Sain and Knecht 1998; Kay and Alder 2005; White and Chua 2004).

> "The essential elements of this management process are simultaneous integration and coordination on multiple levels, which can incorporate national and local government working together with community groups in an iterative assessment, planning, and implementation process…" (Christie and White 1997).

ICM should encompass coastal and upland areas, the uses of which can affect coastal waters and the resources therein. The ICM process tries to break down the barriers erected by traditional sectoral management of natural resources as well as the divide that exists among local government, national agencies, community groups, and NGOs (Christie and White 1997; Cicin-Sain and Knecht 1998; Courtney and White 2000; Kay and Alder 2005). ICM strives to improve and integrate the administrative, policy, and regulatory processes that affect coastal management (Figure 3.1).

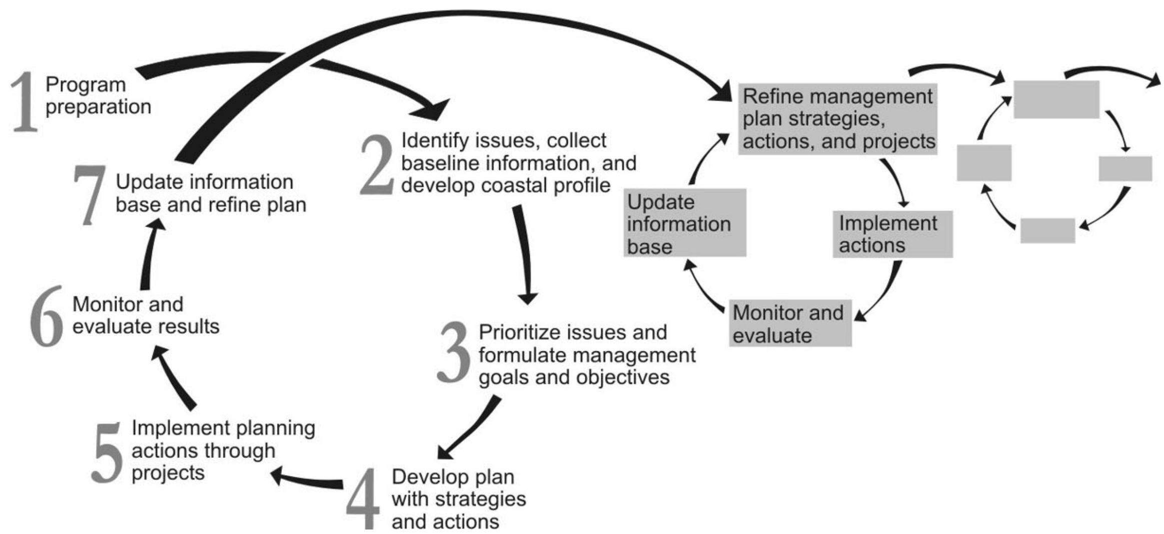

Figure 3.1 Cyclical ICM data collection, planning, implementation and monitoring process (White 1997; Olsen *et al.* 1998).

The need for ICM or CRM regimes beyond the borders of MPAs is especially important in tropical developing countries where MPAs tend to be small and implemented at the local scale, such as in

Philippines and parts of the Caribbean and South America (Balgos 2005; CRMP 2003; Salm and Clark 2000; White *et al*. 2005). In the case of the GBRMP and Belize, land-use patterns have had a considerable affect on coral reefs thus necessitating integrated management of coastal areas (Cho 2005). ICM is now widely practiced around the world, it is well established in countries like the Philippines and just beginning in Kenya and elsewhere (McClanahan *et al*. 2005). Each case demonstrates that the process of establishing ICM is a slow one requiring considerable patience, attention to process, and establishment of supportive governance frameworks (McClanahan *et al*. 2005; White *et al*. 2005).

MPAs can be one important management strategy within a larger area-wide coastal management framework with broader goals such as: maintaining essential ecological processes and life support systems, maintaining genetic diversity, ensuring sustainable utilization of species and ecosystems, watershed management and others. ICM may depend on a variety of management tools and approaches within the context of ICM as shown in Figure 3.2.

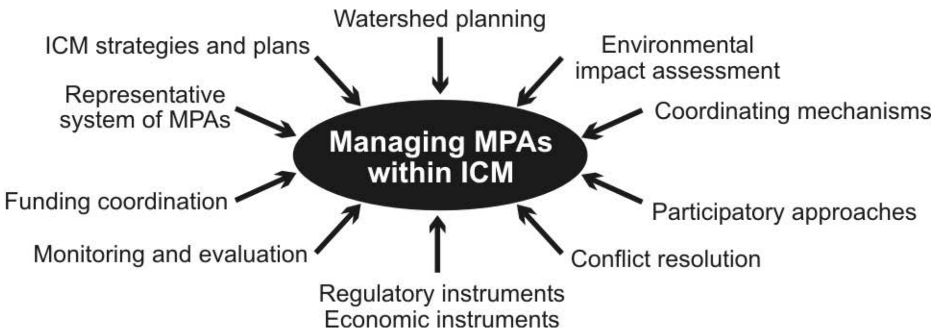

Figure 3.2 Tools to manage MPAs in the context of ICM (adapted from Belfiore *et al*. 2004)

Depending upon community needs and management concerns within the context of a larger ICM or CRM plan, MPAs can be designed and managed to accommodate various objectives and activities. Pursuing one benefit (e.g. sustaining biodiversity or fisheries production) therefore does not necessarily exclude pursuit of others such as revenue generation, tourism or other social benefits, and thus allows various management options. A typical ICM or CRM program will have a variety of interventions to address the needs of coastal and fisheries resources management as shown in Figure 3.3 (DENR *et al*. 2001).

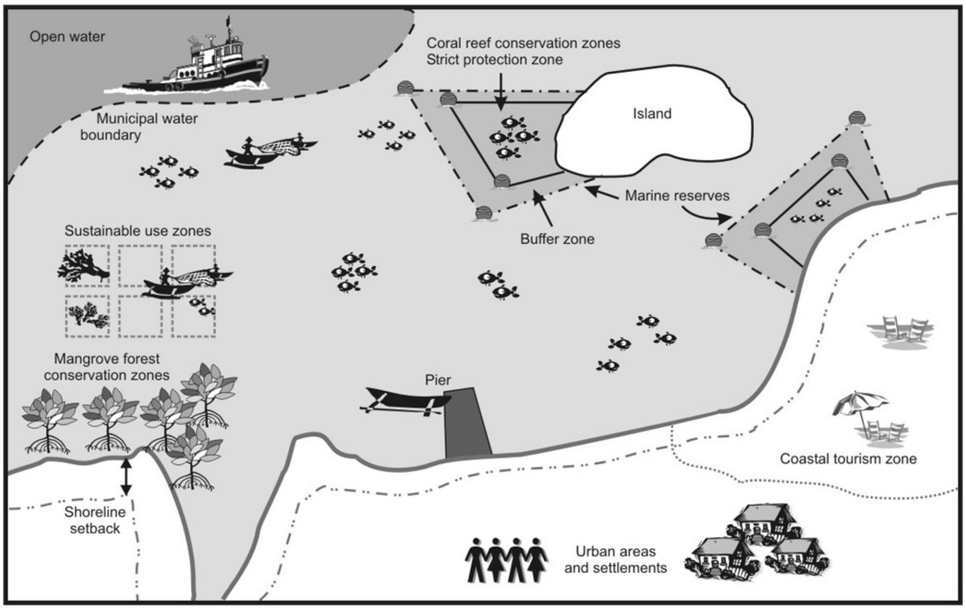

Figure 3.3 Municipal or city management area with various CRM interventions including MPAs in the Philippines (White *et al.* 2006).

The ICM program for Balayan Bay implemented by the Batangas Provincial Government in the Philippines provides useful lessons in addressing the long and short-term threats surrounding the conservation areas and sanctuaries found in the local government areas of jurisdiction within the Province. Several of the towns in the area, Mabini and Tingloy in particular, host a high diversity of coral and fish species. But the threats to marine diversity include land form changes, offsite pollution, incompatible land uses between towns, watershed impacts on coral reefs, sedimentation, foreshore developments, oil spills and destructive fishing. ICM provides for inter-municipal, inter-sector planning and coordinated actions to address these threats (Tongson 2004). It has been suggested that the effectiveness of small MPAs in the Balayan Bay area are severely compromised without being within an ICM planning and implementation process that addresses the primary issues external to the MPA management (Tongson 2004).

In addition to bringing ICM planning to a more local level, an MPA can serve as a learning area for the process. As one establishes and manages an MPA, the day-to-day conflicts of community development and natural resource protection provide opportunities to learn (White *et al*. 2002; DENR-CMMO 2003). The lessons learned are transferred to the policy debates associated with the larger ICM process. Thus the experiences gained at the local level provide feedback and reinforce the national or regional policy and planning processes.

A key lesson being learned in the Philippine context for MPAs is community involvement and ownership of the planning and implementation process as essential to success (Pollnac *et al*. 2001; White *et al.* 1994; White *et al.* 2002). The real stewards of carefully managed small areas of coral reef and shorelines are the local resource stakeholders (White 1988; Bolido and White 1997; Hermes 1998). Nevertheless, local resource stakeholders need substantial assistance and monitoring to become effective MPA managers. The process of involving communities in MPA planning and governance is described in Section 7.

In summary, the governance of MPAs cannot be isolated from the larger scale and broader management of coastal and marine resources. It is apparent in tropical developing countries such as the Philippines and Indonesia among others that small isolated MPAs will not be effective if they are not nested within broader area management programs that address external issues such as over fishing, pollution and others related to watershed management in shoreline areas (Belfiore *et al*. 2004). Research in the Visayas, Philippines in the vicinity of Bohol Island has shown that the increasing incidence of overfishing outside of MPAs is decreasing the viability of small marine sanctuaries where no fishing is allowed (Christie *et al.* 2002). This points to the need for larger scale management regimes following the principles of ICM and CRM as practiced in the Philippines and elsewhere. This also implies that nested governance structures must interface to support MPAs within the broader context of ICM. In the Philippines, where provinces and municipalities or cities are initiating ICM programs that include MPAs as a primary and more intense management tool, some of the threats external to MPAs are addressed (White *et al*. 2006).

4. EMERGING MPA NETWORKS

Two or more MPAs that complement each other form a network. It is recognized, as discussed in Section 3, that MPAs are generally more effective when implemented within the context of an ICM regime as possible through the governance system of a country. Equally, networking among individual MPAs and groups of practitioners is underway in some places. The Great Barrier Reef National Marine Park, considered a network of various zones, and the emerging networks of MPAs in Southeast Australia, the Mediterranean, the Red Sea and Gulf of Andean, Mexico, and Belize represent important examples (Badalamentei *et al*. 2000; Bezaury-Creel 2005; Cho 2005; Day 2002; Gladstone *et al.* 2003; MPA News 2003a and 2006).[5] The United States and the United Kingdom are striving to develop MPA networks, but have not made much tangible progress toward this goal (Jones 1999;

[5] While there is growing interest in MPA networks, there are almost no peer reviewed publications on these MPA networks that go beyond basic descriptive case studies to offer tested governance or institutional design principles for MPA networks.

NOAA 2006). The 33 MPAs (in 2000) in the European Union portion of the Mediterranean may represent a loose MPA network, although implementation is uneven with many MPAs not operational (Badalamenti *et al*. 2000).

The network efforts of Australia, Italy, Mexico and Belize are government-led efforts with considerable NGO assistance. All of these efforts have experienced some degree of controversy when user groups have expressed concerns over dislocation or networks that benefit certain economic groups (e.g. tourism over fishing interests in Belize described in Cho 2004). In the case of Belize or the Red Sea, it is unclear what principles or linkages justify characterization of these MPAs as a network (Cho 2004; Gladstone *et al.* 2003). Analysts of the Mexico case state that the process is necessarily a slow one that requires considerable capacity development (Bezaury-Creel 2005).

While typically designed and advocated for along ecological lines, we suggest that MPA networks can take various forms with both ecological and social goals. Botsford *et al.* (in preparation) review the ecological and fisheries aspects of such MPA networks. In addition, social MPA networks are being formed to facilitate communication of experiences and coordination of administration and planning. Both types of networks, social and ecological, should be integrated and coordinated to maximize their potential benefits (White *et al.* 2006).

The administrative and pragmatic advantages of an MPA network over MPAs that are randomly placed and not coordinated in any way might include knowing that the investment in the establishment and management of the MPA network is maximizing its potential return to local stakeholders. Also, in forming a network, an information base for the MPAs in an area is created that helps develop logical choices in how to expand MPAs effectively and how to efficiently manage them based on the network design. Finally, a network provides a rationale for individual MPA stakeholders or communities to coordinate with each other to share their experiences and to enhance efforts in managing and protecting their respective MPAs.

In developing MPA networks in the Philippines, several such social and information networks now operate in the country and are providing various benefits to the stakeholders and improving MPA management (Lavides and Tiburcio 2002). Processes that have led to good practices and scaling up governance derived from networking efforts are: (i) consensus building on common issues; (ii) information sharing and identification of core groups; (iii) institutionalizing mechanisms for administration; (iv) sustainable financing; and (v) adaptive management (e.g. performance and impact monitoring and incentive systems).

Social MPA networks are motivated by financial and administrative benefits since one of the major constraints to MPA sustainability is long-term financing. Local area networks in the Philippines are collecting user fees and receiving institutional support from their local municipality or city. Local government support also attracts private sector buy-in from tourist resorts, landowners, or others concerned about coastal protection. Recognition awards and tax deductions for contributions to MPA networks are options that can be used to stimulate network level collaboration.

Sharing of lessons learned in management through MPA information networks is another factor stimulating the formation of MPA networks, especially among practitioners who are connected through geographical proximity. Such a network operates along the shores of southern Cebu Island, Philippines, where more than 30 small MPAs are linked through information sharing, and implementation of a common monitoring database and management rating system for comparing results of their respective MPAs (Figure 4.1)[6] In this case, local communities that have endorsed the

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[6] The management rating system, described further in Section 7 below, is a simple system whereby governance of an MPA is rated according to a checklist of yes-no questions that determines its general level of management implementation and sustainability and is being applied in the Philippines per agreement among government and non-government organizations that are assisting with MPAs (White et al 2004).

stewardship of their MPAs are also encouraged if they see the linkage of their village life with that of their ecosystem stewardship role at a larger scale.

The Local Marine Management Area (LMMA) network is another example of a learning network that functions at both a national and international level in Southeast Asia and the Pacific (http://www.lmmanetwork.org/). It provides a means by which members can share experiences with MPA[7] implementation and develop a collective database. This network has spread rapidly in the last few years with foundation financial support. The most notable aspects of this network are its grassroots, practical goals that are developed by partner institutions. The LMMA network's vision is: "Healthy ecosystems and communities, abundant fish and other marine resource stocks, and sustainable fisheries utilization." The network strives for:

- Protected marine biodiversity.
- Sustainable development in coastal communities.
- Understanding of what communities are doing in managing marine areas.
- Understanding of ecological and socio-economic responses to LMMA implementation.
- Global awareness of the biological and social-economic science related to LMMAs coming out of Asia-Pacific."

(www.lmmanetwork.org/Site_Page.cfm?PageID=9)

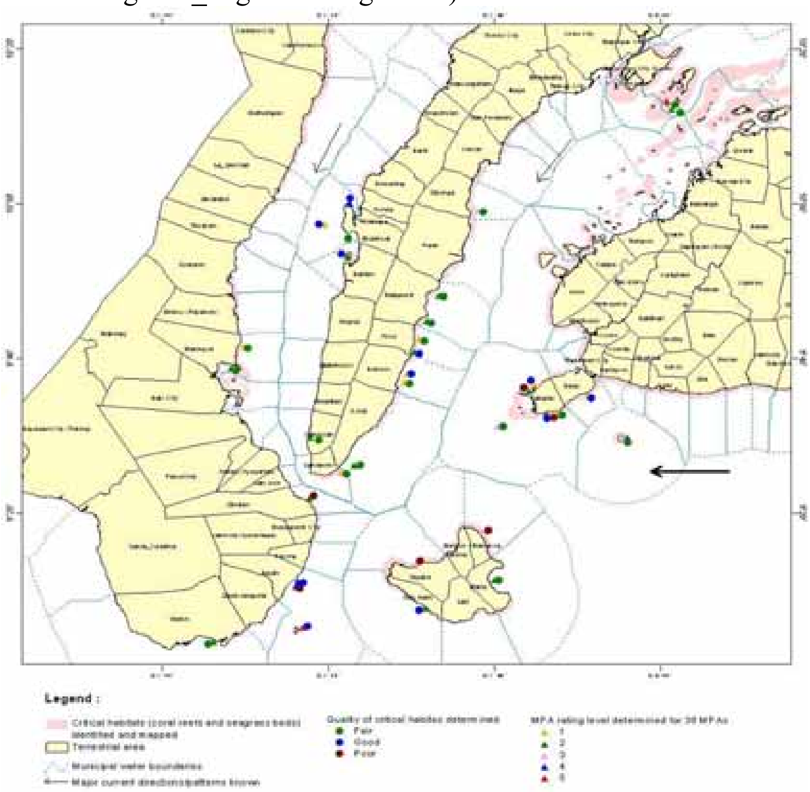

Figure 4.1 Requirements for an effective MPA network, Cebu Strait and surrounding areas (White *et al.* 2006).

The basic approach to improving the management of MPAs, identifying and planning for new MPAs and eventually forming a network of MPAs for a given planning area, as learned from experience in the Philippines and elsewhere is described in more detail in Section 7 below. In general, the sequence of information gathering, analyzing, planning, implementing, and then monitoring and evaluation is tested and effective and needs to be part of all programs. This is a general process utilized around the

[7] This network of practitioners chooses to use the term "Marine Management Area" to demonstrate that many areas in the Pacific, while not closed to fishing, are maintained and actively managed using spatial management techniques.

globe (Salm and Clark 2000). Such processes must also be done in concert with local governments and communities, depending on the legal mandate of the MPA in a particular country. In developing countries, several lessons learned that can guide assisting projects (foreign funded or otherwise) how to effectively assist with improving MPAs or forming MPA networks are (ADB 2003; White *et al.* 2005):

1. Most MPAs, once planned and operating, will need to strengthen their management body through a community level intervention that helps the management body develop and implement an MPA management plan together with the local or national government administration. This MPA plan may ultimately amend the local or national law that established the MPA with refined rules.
2. The project will need to identify partners working in the area who are assisting with MPAs or other coastal management activities and coordinate work accordingly. Assisting groups should make a strategic plan and agree on some common objectives that are consistent.
3. Each MPA that will ultimately be part of an effective network will require some level of assistance in some portion of its planning and implementation process. All successful MPAs in the Philippines have received assistance to help make them become sustainable in their own right.
4. Look at how complementation of each network partner can be facilitated to assist to their effectiveness and their biophysical contribution and potential.

4.1 Network conclusion

An MPA network, while frequently designed with ecological connectivity considerations in mind, is also a network of people managing the component MPAs, benefiting from the network and promoting the network's viability and longevity. Not just any collection of MPAs can be considered a network. An MPA network is a collection of MPAs that *interact* in some meaningful social and/or ecological manner to enhance fisheries and biodiversity conservation and associated benefits (Palumbi 2004). These networks require careful monitoring as is evolving in some contexts (MPA News 2003a).

5. LEGAL AND JURISDICTIONAL ISSUES THAT AFFECT MPAS

The legal and jurisdictional context in which an MPA functions will determine management feasibility in the long term in most cases. Consideration of the legal structures and institutional capacities should also shape the choice of MPA management framework as outlined in Section 2. Reinvigoration of traditional management rules as in the Western Pacific, allow these important traditions to survive today. The decentralized governance structure, encoded in the Philippines Constitution, 1991 Local Government Code, 1998 Fisheries Code, strongly suggests adoption of community-based and co-management frameworks. The United States federal consistency norms embedded within the United States Coastal Zone Management Act ensure each coastal state with a federally-approved coastal management plan access to federal funds for implementation *and* the assurance that the Federal Government will act in accordance with State Government plans. The United States National Marine Sanctuaries Act necessitates broad stakeholder consultation, but retains ultimate decision-making powers for the Federal Government.

Seminal works on common property (Ostrom 1990) and institutional arrangements (Sabatier and Mazmanian 1983; May and Burby 1996) suggest that principles for effective management of common property resources are discernable. Recently, attention to MPAs (e.g. Mascia 2000) has extended common property management principles to include marine resource management issues. Field research involving thousands of interviews in the Philippines, Indonesia and West Pacific Island states suggests that fair and effective law enforcement (Pollnac and Pomeroy 2005), knowledge of the law (World Bank 1999), and consistency between national and local laws and institutional goals (Lowry *et al.* 2005 and Eisma *et al.* 2005) are important to MPA effectiveness and sustainability. The differing mandates and "institutional cultures" of national governments, local governments and NGOs are not trivial matters. For example, the establishment of a National Integrated Protected Areas System

(NIPAS) in the Philippines has strengthened some protected areas, but seriously eroded management of well-known and successful MPAs such as Apo Island. The collection of divers fees that were to be used for local development projects, while potentially a strong incentive for MPA management, became controversial when national agencies failed to disburse these funds for years. Eventually, the issue was resolved, largely due to the effective lobbying by the MPA management board.

The importance of a clear legal mandate for a management board is central to success, as demonstrated in the early failures of Souffriere in St. Lucia (Siirila in Salm and Clark 2000). The subsequent clarification of the management board's roles and responsibilities and relation to agencies with formal enforcement capacity improved management. At the stage of a community-level process, the establishment of a municipal ordinance, or some similar legal instrument, is a critical step allowing for enforcement and sanctioning of violators if necessary. The clarification of the legal role of the core group, as discussed in Section 7, is essential as it may eventually come into conflict with some elected officials who may not favor MPA implementation for personal reasons (Christie *et al*. 2003a).

Well engrained, but diffuse, socio-cultural conditions affect MPA effectiveness. Impunity of influential entities that pollute the environment (Eisma *et al*. 2005) or manage destructive fishing networks can quickly undermine commitment to MPA management – an unfortunately common condition in many developing country contexts. Comparable widespread dynamics that undermine sustainable management exist in the developed world. While not illegal, unsustainable development of coastal areas in the United States (Beatley 2002; Montgomery 2003) and large-scale agriculture in Australia (MPA News 2002) threaten sensitive coastal habitats and MPAs. Stemming these intense development pressures with strong economic incentives remains a challenge largely ignored by most MPA legal frameworks. Such issues suggest, as discussed in Section 3, that MPA management must be effectively embedded within wider management systems such as integrated coastal management and ecosystem-based management.

At the national level, an executive mandate for a national MPA system (e.g. Presidential Order by President Clinton) can initiate considerable planning activity, but this momentum is lost when federal government policy and fiscal priorities change. The National Oceanic and Atmospheric Administration (NOAA) MPA Center, while tasked with facilitating a United States national MPA system, is repeatedly destabilized by fiscal cuts and lacks a strong mandate or suite of incentives to encourage policy development by other agencies. The current informal system of MPAs in the United States is disorganized involving a wide array of institutions. On the other hand, the GBRMPA has seemingly managed to balance executive authority with broad consultation in an effective re-zonation process (Day 2002; Fernandes *et al*. 2005; Kay and Alder 2005).

In summary, a few principles for effective legal and jurisdictional norms are emerging from growing MPA experience.

1. Nested institutional and legal (national to local) systems, if balanced and supportive of local initiatives, support MPA implementation. MPA management requires both upward (from local to national agency) and downward (from national to local agency) coordination and accountability (Lowry *et al*. 2005). Embedding MPA management within larger management systems designed to address larger sectoral and development processes will help address external impacts on MPAs.
2. Transparency, fairness and broad understanding of the law and enforcement support compliance and reduce conflict.
3. Clear identification of the role and responsibilities for formal and informal MPA management bodies is necessary.
4. The jurisdictional mandate should fit the institutional capacity of a management body. If necessary, there should be ongoing attention to the development of institutional capacity.
5. A consistent national mandate for MPA implementation with adequate resources for implementation can provide a supportive environment.

6. CROSS-CUTTING ISSUES AFFECTING MPAs WORLDWIDE

Emerging cross-cutting issues relevant to the themes of governance and enforcement involve matters of MPA objectives, scale, target setting and definitions of success. MPAs have multiple objectives to maintain and restore biodiversity, aesthetic, recreational, and fishery conditions. These objectives, while potentially complementary, may lead to conflict or at least trade-offs that must be carefully considered. The most commonly paired objectives are biodiversity conservation and fisheries sustainable management. Coral reef MPAs in tropical countries are frequently designed to meet both objectives. In some cases, this double objective has been met (Russ *et al*. 2005, Maypa *et al*. 2002). In other cases, objectives change, are unclear, or differ among constituency groups. Such dynamics delayed the establishment of the Florida Keys Sanctuary (Suman *et al*. 1999), complicated the California MPA network process (Helvey 2004, Scholtz *et al*. 2004), and eroded community support for small MPAs in the Philippines (Christie 2004). But maximizing fisheries and conservation benefits simultaneously with the same MPAs may, in fact, be unrealistic and result in collective action problems (Jones 2006).

Increasingly, and sometimes uncritically, arguments for larger scale interventions are made. Such arguments, while grounded in appropriate desires to maximize ecological function for MPAs, are not often realistic or grounded in careful analysis of institutional feasibility and incentives. The Large Marine Ecosystem (LME) movement, that proposes to manage systems at multi-national scales, is moving forward with little empirically-grounded understanding of what this model entails. This concern is not based on a denial of the importance of improving marine resource management, rather it is a conceptual one predicated on multidisciplinary analysis and pragmatic one based on a desire for increased MPA effectiveness. Notably, the argument for scaling up is rarely made by resource users or field personnel, who have a sense for what is possible, in developing countries. This suggests that LME or global MPA network proponents should proceed with caution or run the risk of a backlash that labels such efforts as an attempt to “lock up” resources or “edicts” from the developed world (while resource consumption continues to rise in the developed world). Finally unrealistic targets can drive a process in a manner that does not allow for thoughtful interventions (Agardy *et al*. 2003; Christie *et al*. 2005) and may result in implementation failure and eventual donor fatigue. While there is likely more than a bit of strategy associated with proclamations of MPA targets, ambitious goals will not likely be met (MPA News 2005). This is an important signal that should be carefully analyzed. The reason may not simply be that funds are lacking. In short, there is a need for more local initiatives (local and national governments) that are not dependent on targets or the driving forces of international organizations. Sustainability depends on more locally driven programs that have their own objectives and internal support systems. This will help minimize the problem of MPAs failing when outside entities and outside funding leave or decline.

With these cautionary comments in mind, some countries, like Australia and possibly the United States and European Union members, have the will, financial, and institutional capacity to embark on large-scale MPAs and should pursue their development with the standards of participation, transparency, and equity as guiding principles. The development of a United States-wide MPA network, to include large areas such as the Northwest Hawaiian Islands, is important and requires continued support in a manner that balances the interests of conservationists, fishers, and the public. Large-scale efforts should be pursued, but only with care and appropriate timelines, in developing countries.

Implementation of any MPA is a long term and complex endeavor. It requires cross-institutional collaboration in almost all cases. Technical assistance, education, and capacity development are clearly some of the cornerstones of developing effective MPA governance. In the most successful examples of MPAs (e.g. Apo Island, Tubbataha, GBRMP) long-term institutional support has been available (Arquiza and White 1999; Day 2002, Fernandes *et al*. 2005; White *et al*. 2002, 2005). Designing appropriate incentives for such long-term commitments between institutions is a particularly site-specific process. But field experience demonstrates that some factors are associated with developing such institutional commitments:

- constituency development (Olsen and Christie 2000) that can hold institutions accountable;
- long funding as with the United States Coastal Zone Management Act that provides federal funds to implementing States or development of endowment funds and user fee systems as with Tubbataha;
- acknowledgement of success and development of leadership (CRMP 2004; DENR *et al.* 2001);
- policy makers take on marine conservation and fisheries management as a serious issue through personal experience (e.g. President Fidel Ramos in the Philippines—a committed diver and supporter of MPAs)

Conflict is another cross cutting dynamic that can take many forms. The guidebooks for MPA planning generally highlight inter-resource user group conflicts that derive from competition for the same resources or spaces (Salm and Clark 2000; Sobel and Dahlgren 2004). Classic examples include conflicts between commercial and artisanal fishers or oil development and fisheries. Advocates of offshore MPAs are likely to come into conflict with distant water fishing fleets (Kaye 2004). Zonation schemes are one potential solution that has worked in locations with sufficient capacity for enforcement of detailed, spatially-explicit regulations.

Conflict can come in various, and complex, forms (Dukes and Firehock 2001). In the Philippines, conflict been tourism brokers and fishing communities has emerged after control of an MPA was usurped by powerful tourism interests (Christie 2004; Oracion *et al.* 2005). This sort of conflict may represent competition for marine resources (if divers remove resources), but also is generated from a sense among marginalized fishing communities that MPA rules are not equitable and that their traditional spaces and even MPA management efforts have been taken over by powerful interests (Trist 1999). When an MPA is established through a community-based or co-management framework, a social contract between agencies and stakeholders is created that empowers historically marginalized groups (like tropical artisanal fishers). Therefore, conflict can emerge if autocratic decision-making or selective implementation of regulations takes place (Eisma *et al*. 2005; Oracion *et al*. 2005; Neilsen *et al*. 2004). Conflict can also emerge between influential leaders. Such conflict can be particularly problematic for community-based initiatives that rely heavily on participation and buy-in from key community leaders (Christie *et al*. 2003a).

Some have suggested that conflict emerges based on ideological assumptions embedded within models such as ICM that may favour an influential and wealth sector (e.g. international tourism) over a marginalized one (e.g. reef miners) (Nichols 1999). Worldviews surrounding MPAs and appropriate goals vary between user groups (Christie *et al*. 2003b). While not empirically tested in various contexts, it is almost certain that influential donors, international NGOs, scientists advocating MPAs, and resource users have distinct worldviews and social constructions of the ocean (Steinberg 2001) that, unless accounted for in MPA planning and implementation, will likely result in conflict. Large portions of the recreational and commercial fishing industries of the United States distrust the intentions of conservationists and government regulators. They have been particularly effective with their efforts to derail MPA network establishment in California. Distrust seems to be generated from past antagonistic interactions, but also from fundamentally distinct worldviews (Scholtz *et al*. 2004).

Regardless of the source or scale of conflict, the general lack of formal conflict resolution mechanisms for most MPAs or training for managers and leaders is problematic. The LMMA network has identified this as a key issue for member MPA managers. Conflict resolution methods must be crafted to become context appropriate.

7. BEST PRACTICES IN PLANNING, GOVERNING AND ENFORCING MPAs

Planning and establishing an MPA cannot be separated from managing, governing and enforcing MPAs because the planning phase is ongoing and the establishment-phase of an MPA sets the stage for future success or failure. The bias of the following discussion is on community-based methods for governance of MPAs derived from the Philippines, but has wide relevance to many other developing countries.

The stages in the community-based approach described below occur somewhat sequentially yet several will also run concurrently. Though each MPA site and its management measures are unique, the techniques for encouraging community support and establishing and enforcing an MPA are widely applicable. Participatory approaches to improve community support for MPAs are described elsewhere (DENR *et al*. 2001; Wells and White 1995. The importance of community organization, community participation and public education in the successful examples of MPAs worldwide is well-documented (White *et al.* 1994; Walmsley and White 2003). This section adapts the principles applied in the Philippines and as described by other authors (Christie *et al*. 2003a; White 1988; Buhat 1994; Wells and White 1995; Salm and Clark 2000). The general process and activities essential for successful MPA establishment are outlined in Table 7.1.

Table 7.1 Phases and activities for MPA establishment and management within local government jurisdictions

Phases of coastal management*	**Stages and activities for MPA establishment and management****
1. Issue identification and prioritization, and baseline assessment	Recognition of a need and program preparation Integration with the community and assessment of issues 1. Stakeholder identification and analysis 2. Community organization and mobilization 3. Conduct of baseline studies 4. Information, education, and communication
2. Plan preparation and adoption	Definition of goals and objectives: Formation of the core group and development of the management plan 1. Formation of the core group 2. Definition of goals and objectives 3. Preparation of management strategy and action plan 4. Determination of reserve boundaries and zones
3. Action plan and project implementation	Implementation: Formalization of the reserve, implementing management strategies, enforcement and community strengthening 1. Formalization of the reserve through local ordinance 2. Implementation of strategies for managing the reserve 3. Enforcement 4. Permits and user fees 5. Strengthening of community involvement
4. Monitoring and evaluation	Monitoring and evaluation Refinement of the management plan
5. Information management, education and outreach	Review of status of MPA and its benefits Refinement of education program from experience Development of outreach program as appropriate

**Described in detail in Philippine Coastal Management Guidebook Series 1 and 3 (DENR et al. 2001) as the overall phases for coastal resource management planning and implementation.*

***These stages and activities are different from those prescribed under the NIPAS Act because of the focus on MPA within local government jurisdiction.*

7.1 Phase I: Issue identification and baseline assessment

The initial steps in developing an MPA involves site selection, size, justification for site choices and others that may or may not be controlled by the local stakeholder community. This process can either be community-based or top-down depending on the context and MPA goals. It may be a national government decision to select a remote site based on ecological criteria for example. Nearshore areas used for fishing will likely require a more participatory process. Once a commitment has been made to proceed with MPA establishment, there is a need to assess issues and collect baseline information using participatory and scientific methods so that results can be measured through time. Baseline information sets the stage for a well-managed MPA of all purposes and provides a means to begin education of stakeholders from the outset. It also clarifies priority issues that need to be addressed.

Issue identification and baseline assessment, if done in a participatory manner that fully engages the majority of stakeholders, will ensure better chances for successful implementation and long-term enforcement and compliance (Pollnac *et al*. 2001). But a key factor is that the affected community(ies) fully endorse and buy into the need for and management of the MPA. Several key activities at this stage include:

7.1.1 Community organization and mobilization.

This all encompassing process at a minimum includes: fielding community education and organizing staff in the MPA area, learning more about the stakeholder community and its "authorizing environment" (the social, economic and political context which determines the decision-making process) and determining the expectations of the stakeholders that will be ultimately be engaged in management or stewardship of the area.

7.1.2 Conduct of baseline studies

This will include compiling all existing data on the area but most importantly begin to engage the people at the site level together with outside professionals who may also have a long term interest in the management area. In the Philippines, a participatory coastal resources assessment process is often used that helps train local stakeholders in both baseline assessment and monitoring methods (Deguit *et al*. 2004). This stage may also develop an environmental profile for the MPA area and its surroundings as a preliminary management plan and as a source of educational material for a wider audience (Table 7.2). This process is described elsewhere in detail (Deguit *et al.* 2004; DENR *et al.* 2001).

Table 7.2 Key chapters in a coastal environmental profile.

- ♦ Introduction of the location, description of area, history and summary of issues;
- ♦ Physical features: land area, topography, hydrology, soil, land uses and climate;
- ♦ Natural resources and trends: mineral, forest, coastal (resource maps);
- ♦ Sociopolitical setting: political/administrative boundaries, demographics, public health and sanitation, settlements, infrastructure;
- ♦ Economic sector: fisheries, aquaculture, tourism, industry, agriculture, forestry;
- ♦ Institutional and legal framework: relevant laws, local/national government, NGOs, community organizations; and
- ♦ Management issues and opportunities: environmental, economic, political/institutional.

7.1.3 Information, education and communication (IEC)

The education process occurs throughout all stages of development and implementation of an MPA. Depending on the level of awareness and involvement of the stakeholder community, the IEC process needs to evolve and be responsive to the needs of MPA management. As an MPA matures, the topics for IEC may shift to learning the political process, funding options, management strategies, enforcement and monitoring, and then discerning lessons learned from experience. Based on various case studies, possible IEC strategies may include:

- Use non-formal methods that encourage participation, interaction, and personal contact that are gender-sensitive.
- Prepare a good map to help people relate to their areas of specific interest.
- Encourage local enthusiasm for the project by recruiting academics, divers, fishers, resort owners, and others who have personally noted changes in the quality of the habitat to share their observations and positive opinions about results.
- Organize cross-visits to successful sites for local leaders. Discussions with local leaders who have established successful MPAs are convincing.
- Use monitoring information as it becomes available to prepare education programs that describe the observed changes in ecology, biodiversity, and quality and quantity of fish stocks. Trends are very important to track over time.
- Refining knowledge of threats, use patterns in the area, and management options, is an important outcome of information and education activities of all key stakeholders.

7.2 Phase II: Plan preparation and adoption

Participatory, fair and transparent plan preparation leads to stakeholder compliance because they have a "stake" in the plan; real education takes place during this process and time is not as important as a good plan that is accepted by the stakeholders, both private and public**.** A first and crucial step is the formation of the core group. The core group should be considered as an "anchor" that is directly interested and committed to planning, implementation and management of the MPA. In countries where planning and management are strictly government functions, the core group may be less important, but can still serve an important role to link government management with the stakeholder sector that might not uniformly support the goals or existence of the MPA.

The preparation of a management plan must include definition of goals and objectives, preparation of management strategies and actions, determination of MPA boundaries and zones, determination of management procedures and many other decisions that are basic to an effectively managed MPA (Table 7.3). The key again is participation in the decision process so that enforcement over time is not an uphill battle. These guidelines are in agreement with those offered in other sources (e.g. FAO 2003).

Table 7.3 Sample outline of a site management plan in Philippines.

Chapter 1: Introduction (rationale, scope of plan, legal basis, overall goal, etc.)

Chapter 2: Profile of the MPA site or general area

- A. General information
    1. Location (technical description, size, map, etc.)
    2. Facilities (physical structures present in the area)
    3. Current uses/activities in the area
    4. Policy review
- B. Biophysical condition
    1. Habitat condition (condition of coral reefs, seagrasses, mangroves, etc.)
    2. Resource and resource use map (site map within larger municipal/city jurisdiction)

C. Socioeconomic condition
   1. Immediate community (all potential beneficiaries or users of area)
   2. Issues and concerns
   3. Resource value estimates

Chapter 3: Goals and objectives for MPA management

Chapter 4: Management interventions (each with strategies and activities)

A. Habitat management (required)
B. Management zones—spatial allocations and regulations (required)
C. Constituency building—community organizing and education (required)
D. Compliance and enforcement (required)
E. User fee system (optional)
F. Alternative/supplemental livelihood program (optional)
G. Shoreline or foreshore management (optional)
H. Solid waste management (optional)
I. Others

Chapter 5: Implementing structure

A. Management board, committee or council (members and positions)
B. Duties and responsibilities (specific roles and functions)
C. Organizational chart
D. Budget for each management intervention or by regular line items

Chapter 6: Monitoring and evaluation

A. What will be monitored (reef substrate cover, fish stock, socioeconomics, etc.)
B. Methods to be used
C. Institutional and scheduling arrangements (who will do it, how often, etc.)
D. Budgetary and equipment requirements
E. Reporting and feedback mechanisms (schedules, formats, to whom, etc.)

Annexes:

A. Data figures and tables, maps
B. Monitoring and evaluation forms
C. Photographs
D. Ordinance

The Philippines is probably ahead of most countries in terms of encouraging a high level of participation in the planning phase for an MPA. Although not a rapid process, it has ensured better compliance in both local government and national MPAs and minimized the need for active law enforcement in many instances. The management plan for the Tubbataha Reef National Marine Park was developed over a ten-year period. This period allowed various seemingly unsolvable resource use conflicts to be resolved so that management could proceed with a strong mandate from both the government and stakeholder community (Arquiza and White 1999; White *et al*. 2002). In fact this park now has relatively little threat from illegal fishers from within the Philippines but is still threatened occasionally by illegal foreign fishers that require enforcement surveillance that is generally beyond existing capacity and outside the influence of local stakeholders.

Much of the planning process focuses on determination of use zones within an MPA. In many countries the placement of no-take zones and their boundaries must be highly sensitive to local use patterns and stakeholder preferences to improve chances for adequate compliance. Thus much effort must be placed on determining boundaries so that they do not cause undue conflicts for potential compliance later on. In the Philippine case of many small MPAs with no-take zones, an important lesson learned is that the need for zoning and what type of zones to be implemented, should be established before the community has agreed on the final sanctuary (no-take) boundaries and before the sanctuary is legislated through a local or national government ordinance or law. Once consensus on resource uses and guidelines for uses, zones and their boundaries is reached, a final plan and ordinance can be drafted and passed. Table 7.4 indicates compatibility and restricted used within potential zones of a typical MPA in the Philippines.

Table 7.4 Compatible and restricted activities within potential management/use zones for different types of MPA in the Philippines (White *et al*. 2006).

Type of MPA	Typical Management Zones	Activities/Uses Allowed	Activities/Uses Prohibited
Strict sanctuary[1]	No entry	None	All
Marine sanctuary[1]	No-take or "sanctuary" (core) zone	Regulated swimming and diving, anchoring on mooring buoys, research	Fishing or extraction of any kind, anchoring, boating, dumping
Marine reserve[2]	Sanctuary, no-take (core) zone	Regulated swimming and diving, anchoring on mooring buoys, research	Fishing and extraction of any kind, anchoring, boating, dumping
	Traditional use (buffer) zone	Same plus limited and specified traditional fishing and boating	Illegal and specified legal fishing methods, anchoring, dumping
Marine park[2]	Sanctuary, no-take (core) zone	Regulated swimming and diving, anchoring on mooring buoys, research and education	Fishing and extraction of any kind, anchoring, boating, dumping
	Traditional use (buffer) zone	Same plus limited and specified traditional fishing and boating	Illegal and specified legal fishing methods, anchoring, dumping
	Education and/or recreation (buffer) zone	Regulated swimming and diving, anchoring on mooring buoys, research, education, and/or recreation activities	Same

[1] *Typically contains only one zone where all extraction or collection is prohibited.*
[2] *Typically contains more than one use/activity zone.*

7.3 Phase III: Action plan and MPA implementation and enforcement

The action plan is crucial to long-term governance of an MPA because it contains the strategies for encouraging compliance through law enforcement, threats and sanctions as needed, ongoing education, various means of observation and monitoring among others. The development and implementation of an action plan depends on institutional capacity (e.g. presence of reliable local government, community groups, coast guard, etc.), resources for enforcement and human capacity—do law enforcers or local police know laws and how to collect evidence, for example.

Implementation refers to several key steps: formalizing the MPA, implementing management strategies, enforcement of regulations and strengthening the community by implementing the key recommendations of the management plan. The process leading up to full implementation could take 1 to 2 years or more depending on the institutional capacity of the management body. And, given that many MPAs, both large and small and local and national are not well managed, a key link to improved management is the planning and preparation process leading to implementation.

Strategies for managing an MPA that combines objectives of both fisheries management and biodiversity conservation are varied and include the following among others:

- Demarcating use zones according to use patterns and the objectives of management as noted in Table 7.4;
- Regulation and control of fishing gear inside and adjacent to an MPA and in relation to the use zones of the area as determined in the management plan (gears that are permitted in particular zones or totally banned in the Philippines are indicated by White *et al*. 2006);
- Placement of permanent mooring buoys to prevent bottom habitat damage, especially in coral reef and other fragile environments;
- Designation of boat trails or travel-ways for heavily visited areas;
- Establish regular embarkation points to control access to sanctuaries;
- Various approaches to enforcement inside and outside of the MPA such as:
    a) Development of support within stakeholder community;
    b) "Sea watch" or "bantay dagat" groups, in case of Philippines, organized and deputized for coastal law enforcement activities;
    c) Enforcement through peer group pressure and local incentives and disincentives;
    d) Use of regular government police and enforcement channels depending on their availability and ability to assist;
    e) Use of effective but appropriate penalties with law enforcement;
    f) Use of local government budgets and local police as possible;
    g) Ongoing education programs to inform stakeholders of illegal activities;
    h) Formation of support networks to reinforce good practices at local level;
    i) Provision of small incentives to local enforcers in form of insurance, stipend, equipment as appropriate for an area and institutional setting;
    j) Collection of fines that are shared with the law enforcers;[8]
- Permits and user fees for access to resource areas for tourism and/or fisheries uses under local MPA jurisdictions or government (Table 7.5);
- Strengthening community and local government involvement;[9]
- Promotion of ecotourism ventures that support MPA protection (Flores 2001);
- Providing positive feedback to management bodies through visitors and monitoring activities as discussed below; and,
- Development of partnerships with neighbouring MPA programs through networks or partnerships with long term assisting organizations such as NGOs, local or foreign donors and others.

[8] In El Nido, Palawan, Philippines, a municipal ordinance allows 50 percent of the administrative fine to be awarded to the apprehending team and 50 percent to a trust fund held under the municipal treasury but earmarked for coastal management activities.
[9] Strengthening community involvement is extensively covered by White *et al*. 2006 and Deguit *et al.* 2004.

Table 7.5 User fee system for the Tubbataha Reef National Marine Park, Philippines.

The Tubbataha Reef National Marine Park (33,200 hectares) is located off Palawan Island in the Sulu Sea. The Park is managed in accordance with the NIPAS Act, which requires the creation of a multi-sectoral governing body (or PAMB) to ensure the implementation of the site management plan. However, government funds to protect and manage the Park have always been insufficient.

Despite the premium quality and popularity of Tubbataha for scuba diving, its biodiversity value has been grossly underestimated. To enhance the Park's recreational value and at the same time maintain its ecological integrity, the Board, in cooperation with the diving community and other stakeholders and NGOs, developed a user fee system that would best capture and monetize the recreational benefits from tourism. A willingness-to-pay study in 1999 showed that an average diver was willing to pay $41 per visit. Using these results, a two-tiered pricing scheme was developed whereby local divers pay $25 and foreign pay $50 for entrance. The collection system is managed by the Tubbataha Management Office under a park superintendent and is consistent with the government's guidelines on determining fees in protected areas (DENR-DAO 2000-51).

The Park has generated a total income of Philippine Peso (PHP) 9.3 million (approximately US $186 000) from diving fees since 2000. In 2004, an income of PHP 2.5 million (approximately US $50 000) from entrance fees and fines was enough to cover 41 percent of the annual core costs of PHP 6 million to protect Tubbataha. The experience shows the importance of adopting a business approach to instituting user fee systems for long-term sustainable financing of MPAs while being careful not to compromise the long-term benefits from biodiversity.

Source: Tongson and Dygico (2004).

Strategies to improve compliance are numerous and widespread and vary with the local and national legal and institutional system, culture, current practices and more. While some models suggest that the certainty and severity of sanctions are the most important variables to determine rule compliance (reviewed in Kuperan and Suitenen 1998), empirical research demonstrates that legitimacy of regulations (partly derived from mutual respect between resource users and regulators), peer pressure, and participatory co-management processes are critical variables that also improve compliance rates (Honneland 2000; Kaplan 1998).[10] However, strict and equitable legal enforcement is needed, especially for flagrant and repeat rule violators (Kuperan and Sutinen 1998). Without consistent and fair enforcement, compliant behaviour among others is eroded. A model that is promoted in the Philippines along with more participatory approaches is that effective enforcement must be "swift", "public" and "painful" (DENR *et al.* 2001). This does not imply cruel or inappropriate punishment. This is especially important in areas where illegal fishing practices are deeply engrained into the local psyche of fishers and usual education and conciliatory approaches are not effective. In northern Bohol Island, after more than 100 arrests were made in one month and given appropriate (not long) sentences, the incidence of use of explosives for fishing declined to almost zero from a very high incidence (Christie *et al.*, in press).

[10] However, enforcement agency legitimacy was not a consistent predictor of compliance in the study by Kuperan and Sutinen (1998) of Malaysian fishermen.

7.4 Phase IV: Monitoring and evaluation

MPA case studies from many countries emphasize that monitoring MPAs should be repeated at regular intervals throughout the management process (Pomeroy *et al*. 2004; Wells 2006; White *et al*. 2004). Assessing key biological and governance indicators begins with baseline studies. Increases in fisheries stocks and diversity both inside and outside of no-take reserves confirm the value of conserving the stock within the MPA. Changes in a standard list of governance indicators will also reveal how well the MPA is being managed. The results should be conveyed to the communities; positive results can be celebrated and negative results evaluated to identify management problems.

It is important to identify indicators for measuring progress toward the objectives of the MPA management plan early in the management process. Once such indicators are determined, such as changes in fish diversity, size of individual fish, percent live coral cover or another habitat or ecological indicator, it is important that these parameters are monitored using standardized methods as described in one of numerous manuals. In the Philippines, the book *Coral Reef Monitoring for Management* (Uychiaoco *et al*. 2001) and the MPA report guide (CCEF 2005) are used as a standard guide for MPA monitoring when coral reefs are the primary habitat and ecosystem of concern. Indicators for improved management and enforcement such as administrative processes, community support, marker buoys and signs in place, and others can be measured and monitored by applying the MPA management rating system that is part of the MPA report guide (shown in Table 7.6. Pomeroy *et al*. 2004) and is another international monitoring guidebook.

Table 7.6 MPA rating system for municipal/city MPAs.[11]

MANAGEMENT RATING This simple rating system is dynamic and is not a definitive statement on the status of any MPA rated. *Put a check mark ( ) in the box provided if the criterion is fully satisfied or accomplished.* Date of survey: ___________________________________		
Level 1: MPA is initiated - Passing (Year 1 since legal establishment) (1-6 points)		
1a	MPA concept accepted (MPA started through local initiative or social acceptance sought through public consultations by external groups. Consulted members of affected stakeholders: fishers, other resource users and social groups, both men and women.)	
1b	Site surveyed using standard/accepted methods with baseline assessment complete, preferably conducted in a participatory process (Reports completed on fish abundance, coral cover and profile on community and coastal management.)	
1c	Site selected (Site chosen based on baseline assessment results and public consultations.)	
1d	Education program raising awareness about MPA functions and benefits started (Conducted a series of public education activities.)	
1e	Management body membership tentatively determined (Management core group starting to conduct regular meetings with proper documentation.)	
1f	Preliminary management plan drafted	

[11] A slightly modified form is used for NIPAS declared MPAs that reflect their national status (www.coast.ph).

Level 2: MPA is established - Fair (Year 1 or 2 since legal establishment) (16 points required)		
2a	Community acceptance gained and documented (Documented through public consultation documents, e.g. community resolution and/or signature campaigns.)	
2b	Ordinance passed and approved by the local government (Ordinance should be well-drafted and enforceable and should be consistent with the concepts of sustainable use and equitable sharing of resources.)	
2c	Management body formally organized and recognized (Management group has legal mandate and is recognized by the local government)	
2d	Management plan adopted by community and local government (Management plan initially implemented and endorsed by LGU/PAMB.)	
2e	Management activities started (Conducted initial MPA activities such as: installation of enforcement support structures, patrolling and surveillance, apprehension of violators, etc.)	
2f	Biophysical monitoring includes local participation (Locals were trained to do biophysical survey using standard/accepted method.)	
2g	IEC activities conducted to raise understanding on MPA rules and regulations (MPA rules and regulations disseminated using appropriate and practical means to target all direct users and other stakeholders; initial stakeholder knowledge assessment conducted.)	
2h	Anchor buoys, marker buoys and/or boundary markers installed	
2i	MPA rules and guidelines posted at strategic locations	
2j	MPA outpost or other structures constructed (Guardhouse and/or other MPA-related structures constructed.)	
Level 3: MPA is enforced - Good (Only applies for 2 years or older) (24 points required)		
3a	Education program sustained public awareness and compliance (A long-term IEC program exists and is currently being implemented in support of enforcement and the general MPA objectives.)	
3b	Regular biophysical monitoring measuring habitat condition and changes conducted (Documented surveys conducted at least once annually using standard/accepted method.)	
3c	Collaborative patrolling and surveillance conducted by mandated enforcement group and local community volunteers (Fish wardens on rotation assigned to guard and patrol the MPA, day and night with assistance from local community volunteers.)	
3d	MPA billboard signs, boundary markers and anchor buoys maintained (Funds allocated for maintenance of enforcement support structures. May be part of the municipal CRM budget.)	
3e	Management body active (Implements the management plan; coordinates enforcement activities; members attend meetings regularly; coordinates and participates in regular monitoring activities.)	
3f	Budget from local government or from other sources allocated and is accessible for MPA management (There is a legal document by the local government or an agreement with the private sector allocating budget for MPA management.)	
3g	Fishing effectively stopped inside of sanctuary zone (No fishing-related violations/apprehensions reported in the sanctuary for the past year.)	

3h	Illegal and destructive fishing reduced outside of MPA (Violations/apprehensions reported within 500 m from the MPA boundary was reduced by 50 percent for the past year.)	
Level 4: MPA is sustained - Very good (Only applies for 3 years or older) (30 points)		
4a	MPA management plan updated in a participatory process (Management plan amended with the participation of various stakeholders: fishers, resort and diveshop operators, LGUs, other resource users, both men and women.)	
4b	Annual biophysical monitoring and feedback of results supervised by the managing body and implemented for 2 years or more (Documented surveys using standard/accepted method. Reports are available.)	
4c	Budget from government or from other sources allocated and was accessed for 2 or more consecutive years (There is a legal document made by the local government or an agreement with a funding group allocating budget for MPA operations; financial report available.)	
4d	Management body trained and capacitated to run the MPA independently (Management body supervises management activities [implementation of plans, enforcement, budgeting, monitoring and evaluation] and coordinates activities with partners.)	
4e	Enforcement system fully operational (Enforcement group with mandate and workplan; enforcement support structures maintained and patrolling activities sustained over the years.)	
4f	Illegal and destructive activities stopped inside and within the vicinity of MPA (No violations/apprehensions reported inside and within 500 m from the MPA boundary in the past year.)	
4g	Environment-friendly enterprise and/or user fees collected as a sustainable financing strategy (Sells environment-friendly products/goods to tourists; imposes collection of user-fees; etc.)	
Level 5: MPA is institutionalized - Excellent (Only applies for 4 years or older) (40 points)		
5a	Information and education program on MPAs maintained over the years (Information dissemination activities sustained according to long-term IEC program.)	
5b	Ordinance passed by the Provincial Government giving MPA stronger political support (Gives MPA institutional support to strengthen enforcement and collaboration.)	
5c	Management plan refined for adaptive management (Incorporates further refinements after gaining much experience and lessons to improve management strategies.)	
5d	Management plan incorporated in the Municipal Government development plan (MPA incorporated within the long-term LGU area-wide development plan.)	
5e	Evaluation of impacts on ecology and socioeconomics conducted and feedback of results completed (Assessment of resource status and long-term trends conducted. Analysis of change in local economy and long-term trends of user groups conducted. Reports of these studies have been completed and reported back to stakeholders.)	
5f	Revenues from enterprise and/or user fees sustained and accounted for (Existing sustainable financing mechanisms are well-managed and well-documented; financial reports easily accessible.)	

5g	Management body capacitated for financial management and fund sourcing (Management body is well-trained to manage funds effectively [facilitates proper handling, wise use and proper documentation]. The members are also trained to seek for financial assistance [formulated and submitted proposals].)	
5h	MPA emphasizes on public education and is being used as a study tour site; residents advocate for MPA (After much experience, members are ready to share lessons and impart knowledge. Presence of an identified group that conducts tours and is capable of giving talks on MPA. Paper/s written on their success stories published.)	
5i	Expansion strategies or enhancement programs initiated (MPA coverage is expanded, e.g. from a sanctuary to a park, or scope of conservation activities is heightened, e.g. coral reef restoration, re-seeding of clams, etc.)	
Total points accumulated:________		
♦ Total possible points: 40 ♦ All points are cumulative. ♦ Points from higher levels can be used to satisfy lower rating levels.		
Name(s) of assessor, position, and affiliation:		
Contact information (phone, fax, email, postal address):		

The process of developing the MPA Rating System shown in Table 7.6 highlights the lessons learned from MPA governance in both community-based and national MPA models in the Philippines. Five stages of MPA governance emerged from the Rating System: initiation, establishment, enforcement, sustained management and institutionalization of the MPA. The activities or processes that must be successfully accomplished to achieve a given level came to be seen as the essential ingredients to successfully managed MPAs. But since the process of initiating, establishing and managing a given MPA will vary from one site to another for multiple reasons, the Rating System is designed to allow points to accumulate from higher levels to satisfy lower levels. Thus, the enforcement phase (level 3 requiring 24 points) can be accomplished with points from levels 4 and 5 as well as from levels 1, 2 or 3. This gives the system some flexibility to work in the field and makes it less rigid than a strictly step-by-step system that might miss variability from site to site.

Experience from hundreds of small MPAs in the Philippines suggests that assessment and monitoring include:

- What information about habitat conditions, activities, and program achievements is needed?
- When should information be collected as baseline for later comparison?
- Who needs the information and will use it?
- How will the information be used?
- Who will generate the various types of information?
- What are the procedures for collecting, storing, retrieving, and analyzing the data?
- What qualitative and quantitative information can indicate improvement in the environment, the people's awareness about their environment and the socioeconomic condition of people?

Pomeroy *et al*. (2004) is the most advanced effort to encourage widespread monitoring of MPA socioeconomic, governance and biophysical factors. This methodology has now being implemented and tested in 18 MPAs around the world and initial results suggest that this generic guidebook should be adapted to local contexts and follow-up capacity development is necessary (Pomeroy *et al*. 2005). These monitoring and assessment tools, utilized primarily by MPA planners with resources users, are what may be considered mandate responsive tools. Their purpose is to monitor progress and assist management. Mandate independent monitoring and evaluation is also important and relies on distinct, multidisciplinary research methods such as surveys, in-depth interviewing, participant observation, and habitat and fish surveys. Mandate independent research is intended to explore the overall appropriateness of MPAs as biodiversity or fisheries management tools and explore, in a rigorous manner, the complex social and ecological dynamics associated with MPAs (Christie *et al*. 2003c). If done properly, it can provide additional feedback to resource users, practitioners, policy makers and donors.

In summary, there is always a need for a simple but effective monitoring program that involves local stakeholders. Planners, local communities, user groups, NGOs, academics and the private sector should be involved in the participatory monitoring and evaluation of a project since all will share in the responsibility for implementing the plan and reaping the benefits (White *et al*. 2006; Pomeroy *et al*. 2004). Such monitoring should also be complemented with careful, and constructive, evaluations using rigorous social and natural science methods.

7.5 Phase V: Information management, education and outreach

The monitoring and evaluation process described above should feed into the information management, education and outreach. The data collected through monitoring is often the best information to develop education materials and to provide feedback on the status of the MPA to stakeholders (Pomeroy *et al*. 2004; Scholtz *et al*. 2004; White *et al*. 2006).

Balicasag and Apo Islands MPAs in the Philippines are cases where the data from monitoring the habitat condition over a 20-year period has been relevant to management in several ways (Christie *et al*. 2002). First, the changes and improvements resulting from the management are well described and second, this data has come to be of extreme interest to the local community residents. People living on the islands want to know the outcome of their protection and management activities. The result of the monitoring and evaluation tell this story in detail and motivate improved management actions through time. In addition, once the MPA rating system for municipal and city MPAs came into effect in 2003, these MPAs not only showed high ratings but used the feedback from the rating survey to improve certain aspects of governance not addressed previously (White *et al*. 2004).

Local MPA education plans and programs can evolve from the results of monitoring and evaluation that in turn raise public awareness. Another form of education that is increasingly being used to enhance awareness among MPA managers and stakeholder communities is that of cross visits. Apo Island, Philippines, for example has been the host of hundreds of study tours from other parts of the country and also from other countries in Asia (Vogt 1997; Russ *et al*. 2004). These experiences have inspired many other similar MPAs in the Philippines and supported and challenged the management team operating on Apo Island. This management team is both comprised of local community members, the local and national government, and academe.

7.6 Summary—Best Practices

It is apparent that a well-managed MPA requires an adaptive management approach. The best way to portray the process is through the traditional planning cycle steps listed in Table 7.1 above that continue to operate through time, not ending on any of the five basic steps. The best practices of day-to-day implementation of a successful MPA cannot be easily separated from the participatory planning, implementation and enforcement process that leads directly into management and continues with periodic monitoring and evaluation. Thus, the one major "best practice" that should be gleaned is that a well-managed MPA is always refining its management through planning and testing of strategies that may or may not be appropriate, many of which are discussed briefly above.

8. RECOMMENDATIONS FOR TECHNICAL GUIDELINES ON MPA PLANNING AND MANAGEMENT TO BUILD SUSTAINABILITY

Key aspects of successful MPAs, in all their forms in the various situations noted in this overview, that are considered essential for achieving long-term implementation and benefits from MPAs are as follows. They are phrased as provocative questions given that any array of prescriptions would not likely effectively respond to the diversity of MPA contexts and objectives.

- Community preparation: Does the community of stakeholders and the local and national government sense a need for and understand the process of implementing the MPA?
- Resource assessment and mapping: Has the area been assessed and mapped so that everyone concerned knows the location and condition of resources and the potential boundaries for an MPA?
- Identification of key trade-offs and potential conflicts: Have real and potential trade-offs and conflicts been identified in an open and participatory manner?
- Stable and functional core management group: Has a functional core group that represents various stakeholder groups been formed for identified and empowered that can manage the MPA at the appropriate local level?
- Clear goals and objectives: Are the objectives for management clear to all the stakeholders and generally agreeable to the majority of the affected stakeholder community members?
- MPA boundaries and zones: Are the boundaries in accordance with the habitat assessment and are the boundaries and zones sufficient for management goals? Are the boundaries widely agreed upon by key stakeholder groups? Are the boundaries clearly marked and/or known to stakeholders?
- Management strategies for implementation: Are the strategies within the capacity of the institution responsible for implementation and reflected in the law legally supporting the MPA? Are consistent laws in place from the local to the national levels that support MPA implementation?
- Law enforcement and monitoring: Is a group assigned to watch the MPA, monitor all activities, collect fees, and assess changes in the marine environment on a regular basis? Have incentives for compliance such as user fees, peer monitoring groups, local government taxes and support, or others been incorporated into the management of the MPA?
- Distribution of economic benefits: Are mechanisms in place to ensure that benefits from the MPA equitably distributed and consider compensation to those user groups most affected by MPA establishment?
- Ongoing education: Does the education program address the needs of the community and stakeholders so that benefits and trade-offs are highlighted and that questions regarding the need for the MPA are addressed? Are appropriate education strategies used such as peer sharing, cross-visits, materials in local language that are culture sensitive?
- Co-management in place: Are the appropriate government agencies supporting the MPA together with the nearby communities and stakeholder groups in a mutually beneficial manner and in relation to the national government? Are conflict resolution mechanisms in place?
- Institutionalization: Are formal and non-formal institutional mechanisms in place that distribute MPA management across relevant organizations? Are incentive (and sanction) structures in place that encourage long-term buy-in?
- Monitoring and Evaluation occurring: Have baseline data on the condition of the habitat and the status of management, been updated and changes noted? Has this information been incorporated into a standard database for comparison in the future? Has this information been incorporated into

an education program for the community and local and national government? Have local residents been involved in monitoring and evaluation?

- Long-term planning: Does a realistic long-term plan for the institutionalization, financing, and implementation exist?

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3. Coastal resource management planning. 94 p.
4. Involving communities in coastal management. 84 p.
5. Managing coastal habitats and marine protected areas. 106 p.
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BACKGROUND PAPER 5

THE LEGAL FRAMEWORK FOR MPAs AND SUCCESSES AND FAILURES IN THEIR INCORPORATION INTO NATIONAL LEGISLATION[1]

by

Tomme Rosanne Young, J.D.[2]

Summary

The development and implementation of protected areas legislation applicable to marine and aquatic areas has been strongly promoted in recent years as a potential tool for protection of marine resources and the sustainability of their development.

Over the centuries, however, uses of the oceans have dramatically increased, as has the nature of those uses and their impact on the marine environment. These factors have engendered a strong activism in favour of the creation of marine protected areas (MPAs), including some calls from some sectors for high levels of immediate protection throughout the world's oceans. The scientific, community, logistical and financial elements of successful regulation are often not well understood. These are significant variations from the factors underlying the creation of terrestrial or freshwater protected areas, suggesting at minimum the need to separately consider MPA options and experiences, rather than simply relying on the approaches used for terrestrial protected areas (PAs).

The terms of reference for this paper call for an elucidation of the legal framework applicable to MPAs, and providing examples of countries' successes and failures in adopting and applying legal protections. Its secondary objective is to provide a basis for initial discussions in the Food and Agriculture Organization of the United Nation's (FAO) process in preparation of draft guidelines on the design, implementation and testing of MPAs.

The author has been instructed to focus only on the legal framework, and not to overlap with other information papers, including those on "*Best practices in governance and enforcement of MPAs*" and "*Social, economic and institutional considerations in the design, implementation and success of MPAs*." Given that it is functionally and analytically impossible to discuss any legal framework or consider its adequacy and coverage without consideration of socio-economic, institutional, governance and enforcement factors, the following discussion should not be considered a complete legal analysis of the MPA legal framework, but rather an elucidation of existing documents and experiences, their legal sufficiency and their potential impact.

After a discussion focusing on (i) terminology; and (ii) a general summary of the legal processes by which protected areas and relevant legal frameworks are adopted, this report describes

(1) the overall international framework of binding and non-binding laws and instruments relevant to marine protected areas, and their role in sustainable use of marine resources, considering:

- the nature of each individual instrument's relevance to marine protected areas;
- a collective consideration of "gaps" in the overall framework; and

[1] This paper was produced for the FAO Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations (12–14 June, 2006).

[2] The views expressed in this paper are solely those of the author, Tomme Rosanne Young, Consultant, International and National Marine Law and Policy, Tomme.Young@gmail.com.

- currently recognised inconsistencies and "controversies" within the framework.

(2) brief exposition of experiences relating to the development of legislation to implement MPA objectives at national, bilateral and multilateral levels. This discussion will include

- national implementation through various kinds of legislation;
- bilateral and regional agreements that develop multilaterally-recognised MPAs;
- geographic-based conservation systems undertaken through Regional Fishery Management Organizations (RFMOs);

It will identify issues and controversies for each body of information, and will be taken from a range of cases involving developing and developed countries from different regions of the world.

(3) an extraction of useful legal options that have been used or proposed for addressing MPA development, identifying the essential components of such options and any difficulties encountered with the legal options used and how these difficulties could be avoided. This discussion will be focused through the objectives of MPA creation, and will consider

- effective legal options for achieving those objectives;
- the most important areas in which guidance can provide assistance to the legal work involved in MPA development and implementation.

(4) Lessons and recommendations for the process of developing the Proposed Draft Guidelines, based on case examples and research into the practical impacts of the legal/legislative processes described above, including

- "guidance on best practices," based on analysis of legal options described under (3) above, and their use and implementation of MPAs and
- "warning of potential problems and hazards" based on difficulties encountered with the legal options (and other legislative experience) and the author's suggestions about how these difficulties could be avoided;
- the usefulness and essential features of processes for developing effective legislation or regulations for MPAs; and
- an examination of the "causes of success and failure."

(5) Conclusions, specifically providing suggestions regarding topics to be included in a technical guideline, as well as a starting point for discussion of some of these points.

In presenting these issues, this report assumes a general definition of MPA which includes both formally recognised 'protected areas' and other kinds of 'geo-located marine conservation measures' in oceans. It notes that a working definition of MPA could provide a basis for focusing the scope and research of the Guideline process, and that by the time the Guidelines are completed, it will be important to have considered the definition in a more detailed way.

The MPA issue faces very different legal and practical challenges depending on the location of the proposed MPA – which of the legally designated ocean zones (territorial sea, Exclusive Economic Zone (EEZ), Outer Continental Shelf (OCS), high seas and 'the Area') is involved. Similarly, The World Conservation Union's (IUCN) Protected Area categories have proven to be very useful in legal and legislative work (and technical guidelines) regarding terrestrial protected areas, and may provide a framework for MPAs as well, although they may require adaptation to the marine biome.

With regard to the international framework, the report describes numerous international and regional instruments relevant to MPAs. However, few of these documents actually create MPAs, and at present, there is little guidance within these instruments regarding how MPAs could be created, standards for their creation, and other factors.

The international framework's impact, however, differs in its relevance to MPAs within national control (terrestrial sea, EEZ and OCS), as compared with the high-seas and The Area, which outside of national control:

- *Within national seas*, the international framework does not *require* the creation of MPAs, although it does (directly or indirectly) include MPAs and geo-located measures among the mechanisms that can be used to achieve the countries' commitments regarding conservation, preservation and sustainable use of living resources and/or biological diversity. In this connection, the international framework provides many bases of legal support to each country's development of MPAs, and their recognition and acceptance/compliance by other countries.

- *In the high-seas and The Area,* international forums have direct oversight and control. This means that the creation of MPAs in these areas will have to be undertaken through international agreement. Significant international attention is currently focused on these issues, particularly on the possibility of creating one or more international instruments clarifying the processes and standards for international designation of MPAs in the high seas.

At the national level, much of the current MPA work, particularly in developing countries is focused in territorial seas. Increasingly, however, countries are recognising the importance of applying a rationalised set of geo-located protections to their Exclusive Economic Zones (EEZs). As in all legislative development, the key elements of national MPA laws of all types include institutional development and mandate, clarification of relevant procedures (designation of MPAs, licensing and other decision-making, etc.), ensuring that all relevant civil protections and human rights are respected, clearly enunciating the requirements and restrictions imposed by an individual MPA or generally relevant to all MPAs, adopting effective enforcement and administrative measures, and providing a legal basis to enable MPA administration to meet its financial and logistical needs.

Legislative development is not a 'cut-and-dried' process, but rather depends on situational (social, political, institutional, etc.) factors and objectives. In addition, however, it is essential to recognise that the application of these legal measures will be different in oceans than on land, and also will be subject to different practical requirements depending on how far the MPA is from the country's ocean baseline and what capacity the country has to regulate, oversee, implement and enforce legislation in deeper, more remote ocean areas.

1. INTRODUCTION

The development and implementation of protected areas legislation applicable to marine and aquatic areas has been strongly promoted in recent years as a potential tool for the conservation and sustainable use of marine resources including halting the decline in species populations (including the collapse of fisheries) and destruction of critical habitats. Biodiversity objectives would further focus on the desire to ensure that a representative selection of marine ecosystems is conserved, and (known and unknown) species extinctions. In both cases, MPAs are intended as an element of the underlying concept of the sustainable use and development of the natural resources of the seas.

Conservation and sustainable use of biodiversity and natural resources involves a combination of elements, including political will, social/economic acceptance, and enforcement capacity, as well as legislation and institutional development. Without the first three elements, the adoption of legislation will be relatively ineffective to achieve conservation and sustainable use objectives, no matter how strong and binding the legal provisions are. However, where relevant political, social, and practical factors are supportive, implementing/supporting legislation must still be crafted to address these mandates specifically, if it is to be an effective and useful component of the overall process.

This paper, then, cannot provide a template or recommendation for an MPA legislative regime, but provides only one element in that creative process – a description of the legal/legislative tools available and experiences to date. It will provide ideas about how legislation can be developed to address particular political/social objectives, respond to implementation/enforcement problems, and provide a mechanism for integrating a variety of rights and policies. This paper does not, however, address those connections as they are covered in other resource papers provided for the workshop.

One caveat should be given at this point: This research focuses significantly on recent examples. Governmental options regarding marine conservation have been evolving quite intensively over recent years, reflecting newer views on both the objectives and methods to be used. However, like all legislation, MPA laws often require many years after adoption, before necessary legislation and institutions are in place, much less until it is fully implemented. The author's analysis with regard to best practices, warning signs and elements of success, is thus necessarily based on her experience.

1.1 Organisation and objectives of this report

The terms of reference for this paper call for an elucidation of the legal framework applicable to marine protected areas (MPAs), and providing examples of countries' successes and failures in adopting and applying legal protections. The author has been instructed to focus only on the legal framework, and not cover issues assigned to other information papers, including those on "Best practices in governance and enforcement of MPAs," and "Social, economic and institutional considerations in the design, implementation and success of MPAs," neither of which are available to the author at the time of the final revision of this paper. This discussion should therefore not be considered a complete legal analysis (which must consider practicalities and objectives) of the MPA legal framework, but rather an elucidation of existing documents and experiences, their legal sufficiency and their potential impact.[3]

At the same time, recognising that the audience of this paper is not primarily legal experts, it will not discuss or analyse the underlying legal issues themselves, but will focus on *describing* the legal tools, experiences and needs. Its goal is to provide succinct information into the FAO's process in preparation of draft guidelines on the design, implementation and testing of MPAs (the "proposed Draft Guidelines"). Given the potential importance of MPAs as fishery management tools, this paper focuses to some extent on that role, while addressing the legal aspects relevant to the entire range of objectives to be served by the creation of MPAs.

After a discussion focusing on (i) terminology; and (ii) a general summary of the legal processes by which protected areas and relevant legal frameworks are adopted, this report describes:

- The overall international framework of binding and non-binding laws and instruments relevant to marine protected areas, and their role in sustainable use of marine resources.
- A brief exposition of experiences relating to the development of legislation to implement MPA objectives at national, bilateral and multilateral levels, identifying issues and controversies for each body of information, from a range of cases involving developing and developed countries from different regions of the world.
- An extraction of useful legal options that have been used or proposed for addressing MPA development, identifying the essential components of such options and any difficulties encountered with the legal options used and how these difficulties could be avoided.
- Lessons, recommendations, possible "best practices" and "warning of potential problems and hazards" for the process of developing the Proposed Draft Guidelines, based on case examples and research into the practical impacts of the legal/legislative processes described above.

[3] Given that the author cannot avoid being guided at some level by her experiences in national, regional and global framework development, it is possible that socio-economic, institutional, governance, and enforcement factors impact her statements in this paper. In particular cases she will mention such issues, presuming that they will be covered in other papers.

Each of the above discussions will include suggestions regarding topics to be included in a technical guideline, as well as a starting point for discussion of some of these points.

1.2 Basic terminology and report coverage

Legal systems depend on the existence of a clear understanding of the terms being used. In some instances, terms are generally understood to have a particular meaning that is sufficient to address the particular issues and objectives addressed in the framework. In other cases, an existing instrument may sometimes be used to provide a uniform understanding of the terms of the law, which is appropriate to cover those issues and objectives. Where neither of these exists, it may be necessary to specifically adopt agreed definitions or interpretations, to ensure that the legal framework will have a consistent and usable meaning. Often such specific definitions are adopted on an instrument-by-instrument basis, and later reconciled, whether by agreement or by comparison.

Although a complete set of relevant terminology has not been agreed, two widely accepted existing terminology systems – the zonal designations in the United Nations Convention on Law of the Sea, and the IUCN Categories – may provide a basis for development of agreed terms and concepts.

1.2.1 Delimitation of ocean zones

The international regime of oceans, centring around the UN Convention on the Law of the Sea (UNCLOS)[4], is based on a zonation of the ocean and the seafloor. There are many zone designations, the major elements of which are described below (all of which are based on determination of a 'national baseline' (or 'archipelagic baseline' in relevant situations) through a specified process):

The territorial sea: Extending up to 12 miles past the national baseline (a line generally determined based on the low water line as marked on charts of shoreline areas within national territory[5]), as well as any internal waters and archipelagic waters (where relevant), each country's territorial sea is considered as any other part of its sovereign territory;[6]

The contiguous zone: In a 12 mile 'zone adjacent to the territorial sea', Coastal States may exercise limited powers conferred under UNCLOS, including the right to "exercise the control necessary to… punish infringements… committed within its territory or territorial sea";[7]

The exclusive economic zone (EEZ): the area extending from the outer boundary of a country's territorial sea to a maximum of 200 miles from the national baseline. The specific delimitation of its EEZ must be determined by the Coastal State.[8] Within these confines, the State has particular rights and jurisdiction "governed by the relevant provisions of this Convention"[9];

Special sub-categories for delimitation: UNCLOS also identifies a few other ocean areas, such as "straits used for international navigation";[10] "archipelagic waters" and "internal waters";[11] "enclosed or semi-enclosed seas",[12] which are primarily included for purposes of delimitation and for clarification of rights of innocent passage. Although these designations sometimes give rise to particular glosses on the application of various provisions, they are included within the general concepts of territorial sea, contiguous zone, or EEZ.

[4] UNCLOS's functional/operational provisions are discussed in Part III of this report.
[5] UNCLOS Arts. 7 and 47.
[6] UNCLOS Art. 2.
[7] UNCLOS, Art. 33.
[8] States may (and some have opted to) designate EEZs smaller than authorized under UNCLOS, or choose not to designate any. Recently some States and commentators have interpreted Part V to enable a similar approach regarding the substantive content of the EEZ declaration, i.e. in declaring its rights over an EEZ, a Coastal State may choose to accept only a part of the rights and jurisdiction authorized under Part V.
[9] UNCLOS Art. 55.
[10] UNCLOS, Arts. 34-45
[11] UNCLOS, Arts. 46-54
[12] UNCLOS, Arts. 123-124

The outer continental shelf (OCS): the seabed extending from the territorial sea to a distance between 200 and 350 nautical miles from baseline. The exact configuration is carefully delimited in UNCLOS, based on a number of factors, including the submerged geology of the continental margin.[13] A country's rights in its OCS focus on the exploitation of mineral and non-living resources as well as the sedentary living resources on or in the seabed;[14]

The 'high seas': UNCLOS uses this term to include everything that is not within any countries exclusive economic zone, territorial sea, internal waters, or archipelagic waters.[15] As such, it may be narrower than the concept that is typically used in other agreements – "areas beyond national jurisdiction" (discussed below);[16] and

The seafloor beyond national OCSs (known in international policy circles, rather opaquely, as "The Area"): The "Area" is defined in UNCLOS to mean "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction," and is generally thought to include all areas outside of national OCSs (which, as noted above, need not be formally declared).[17]

International objectives with regard to conservation, and legal mechanisms for their implementation will necessarily be different, depending on which of these primary zones is involved.

1.2.2 Protected areas terminology

A second useful framework is the IUCN Protected Area categories (the 'IUCN Categories') are set forth in the 1994 *Guidelines for Protected Area Management Categories* published by IUCN's World Commission on Protected Areas (WCPA). Given its objectives, this paper does not attempt detailed or comprehensive treatment of the categories, but offers a summary supplemented by Annex 1.

The categories were originally intended as a tool for enabling more effective implementation of protected area laws, and management of the protected areas themselves. They have since been recognised as an important mechanism for the development of international and trans-boundary collaboration, and the sharing of information. As a consequence, they have recently been utilised by United Nations Environment Programme (UNEP) and the World Conservation Monitoring Centre as the basis for their work in developing and analysing an international list of protected areas. They have also been recognised in work under several international agreements, including the Convention on Biodiversity (CBD), the World Heritage Convention, and the Ramsar Convention. As further discussed below, there have recently been calls for further evolution of the IUCN Categories to enable their application to protected areas in the marine biome.

The seven IUCN Categories specifically recognise that a protected area may be created for only one particular objective, although also for multiple objectives:

Category I.A Strict Nature Reserve/Wilderness Area (Science/Research)*:* PAs managed for scientific and research purposes;

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[13] If the edge of the continental margin (as technically defined in UNCLOS) is less than 200 nm from baseline, then the OCS can extend 200 nm. If the actual continental margin extends more than 350 nm from baseline, the country's OCS (the area over which it will have undisputed dispository rights) will extend only to 350 nm. If the continental margin is less than 350 nm, but more than 200 nm from baseline, the country's OCS will follow the continental margin. UNCLOS Art. 76.

[14] Specifically, "*Mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil.*" UNCLOS Art. 77. The country's powers include the construction of pipelines, artificial islands, etc. Rights in the OCS do not confer on the coastal state any power or right with regard to the waters or airspace above the OCS

[15] UNCLOS Art. 86. As noted below, this designation includes waters above the OCSs of Coastal States.

[16] The regime for the high seas (rather than of the seafloor) addresses the issue (and relatively unbounded rights of each country) of laying submerged cables. *Id.*

[17] Art. 2 and Part XI. Article 77.1 specifically states that the country's OCS rights apply irrespective of the existence or lack of a national declaration. However, each state is called to map its OCS on or before 2009 (pursuant to Art. 76.4, extended from 1999). If mapping does not occur, however, this does not affect the country's right to the OCS; however, if any legal question arises, the tribunal deciding the issue will determine the 'map' of the area (for purposes of such decision), presumably based on the standards set out in Article 76.

Category I.B ***Strict Nature Reserve/Wilderness Area (Protection)****:* PAs managed for wilderness protection purposes;

Category II ***National Park****:* PAs managed for ecosystem protection and recreation;

Category III ***Natural Monument****:* PAs managed for conservation of specific natural features;

Category IV ***Habitat/Species Management Area****:* PAs managed for species/habitat/ecosystem conservation through management intervention;

Category V ***Protected Landscape/Seascape****:* PAs managed for landscape/seascape protection and recreation; and

Category VI ***Managed Resource Area****:* PAs managed for sustainable use of natural ecosystems.

Appendix 1 to this Report provides IUCN's full description of each category. The description includes the definition, management objectives, selection guidance, and organisational responsibility.

1.2.3 Defining MPAs – for purposes of the draft guidelines

Recent attempts to specifically define "marine protected area" for purposes of global discussions have not yet been completed. Existing definitions have been challenged in a variety of ways. One of the obstacles to this effort has been the goal of having a single definition, applicable to all areas from intertidal to the high seas, for all purposes.

This paper does not attempt to develop a definition, but presents the two primary definitions considered in recent international negotiations, and identifies some issues for discussion.

Existing definitions

Two starting points for a working definition of MPA have been IUCN (the World Commission on Protected Areas, and the 5th World Parks Congress) and the Convention on Biological Diversity (in the context of its development of its Programme of Work on Marine Biodiversity). Although neither is formally accepted in international processes, both definitions have been heavily negotiated, and represent a useful starting point.

The existing IUCN definition of MPA has not been fully utilised in the IUCN category system. It takes a relatively simple approach:

> *"any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."*[18]

Work under the CBD has provided a more detailed and somewhat broader definition in connection with its Programme of Work on Marine Biodiversity, which reflects some of the uniqueness of MPAs:

> *"any defined area within ... the marine environment, together with its overlaying waters and associated flora, fauna and historical and cultural features, which has been reserved by*

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[18] This definition was adopted by the IUCN General Assembly in 1988, and reaffirmed and amended in 1994. IUCN General Assembly Resolutions 17.38 (1988) and 19.46 (1994). Since its adoption, a variety of aspects of this definition have been challenged, so that at least one alternative definitions have been proposed, replacing the phrase, "*any area of intertidal or subtidal terrain*" with "*any area which incorporates subtidal terrain*". Proposed at the 5th IUCN World Parks Congress in 2003, see "Emerging Issues" – a declaration of WPA-5. The objective of this amendment relates to ensuring that UNEP/WCMC's statistical evaluation of the number of MPAs would not be inappropriately skewed by including coastland PAs which include intertidal, but no fully submerged, terrain.

The IUCN Category System also suggests some elements of a definition. IUCN's World Commission on Protected Areas (WCPA) – the Commission charged with the development and refinement of the IUCN Category system – defines a "protected area" as "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."

legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings."[19]

This latter definition has the additional merit of having been discussed and negotiated by an intergovernmental forum consisting of representatives of sovereign nations. It is notable, however, that the CBD Parties could not agree on this definition as a part of the Programme of Work, ultimately relegating it to a footnote so that the significant efforts of their negotiations would not be lost.

Issues to be considered in adopting a definition

At the opening of the Guideline-development process, it may not be necessary to engage in a detailed word-by-word negotiation of a "legal" definition, however, some general agreement as to the scope of the concept will help in the design of the guidelines and in focusing the work. At this point, it may be useful to adopt an interim definition, and consider some issues that will be relevant to the coverage of the proposed Draft Guidelines, and the eventual negotiation of the final definition.

The differences between the IUCN and CBD definitions cited above, for example, may suggest some possible concerns. For example,

- The IUCN definition is defined by its submerged "terrain" where the CBD definition may apply to *"any defined area within ... the marine environment,"* thereby including fishery-related zones that do not specifically include the sea-floor.[20]
- The CBD definition also contains stronger language recognising varying levels of protection, noting that an area that *"enjoys a higher level of protection than its surroundings"* can be considered an MPA, even where its operation is in the form of resource management, rather than specific 'protection' of any or all components of the area.

A number of other questions, which are more fully described in other sections of this paper may also be relevant to the definition process. For example,

- *Protecting only a particular depth or other volume*. New proposals, particularly in areas beyond territorial seas, are increasingly limited to particular depths (e.g. "the ocean depths below 1000 metres in depth," or "the surface and first XX metres of depth in a particular area", or "all oceans within XX metres of any face or incline of a particular seamount," etc.);[21]
- *The delimitation between 'marine' and freshwater:* Many countries must engage in a significant coverage question relating to whether freshwater and brackish-water areas are considered MPAs, and if not, what is the division between them;
- *Recognising the legal difference among ocean zones.* There are very significant legal and practical differences among MPAs in territorial waters, MPAs in EEZs, and those in areas beyond the EEZs, as well as differences where a protection applies to submerged terrain (seabed beneath territorial seas, OCS and 'the Area.') In particular, it is currently very difficult to determine what might constitute *"legislation or other effective means"* with regard to the high seas and the Area. Hence, it may be useful to consider the possibility of varying the definition for each maritime zone.
- *Nature of protection:* In a number of instances, protection of species of limited biogeographic ranges may often operate to create a *de facto* protected area – a practice that might be utilised

[19] CBD Conference of the Parties, Decision VII/5, at note 11.

[20] Noting that there are various types of submerged lands, this point may be particularly important, where, for example, the area in question involves waters considered to be in the 'high seas' but submerged terrain that is a part of a country's OCS.

[21] Only the first of these examples have been formally adopted by any document reviewed by the author (discussed in III.B.3, below). However, the author has participated in negotiations and discussions proposing or considering all of the above options. Both the CBD and IUCN definitions speak in two dimensional terms ("any area") suggesting that an MPA should protect it's the entire column within the designated coordinates from substrate to overlying air space.

in the context of an MPA.[22] Similarly, particularly where full biological data is not available, the range of alternate approaches to formal legislative protection may require fuller examination.

- *Competence/capacity for implementation and enforcement:* This issue, addressed in another paper, is essential to successful MPA legislation and affects both definition and legal issues.
- *Socio-economic and political support, custom and practice:* This issue, addressed in another paper, is also critical to successful MPA legislation, and may affect definition and law.

Obviously, the foregoing are not the only definition questions that should be considered, but may provide a starting point for discussions. A related question – the designation of standards for MPAs creation[23] – may also impact and be impacted by the definition question. More comprehensive international work on this issue is presently commencing without specific mandate,[24] indicating that a need for some definitional work may be somewhat urgent.

1.2.4 Defining MPAs – working definition used in this paper

For purpose of this Report, the author has adopted a working methodology (and informal scope) that attempts to include (or at least survey) all types of geo-located protections within the scope of its analysis of the legal development of MPAs. For purposes of this study the author has surveyed a wide range of individual measures directed at specific activities, uses and biomes, as well as more general conservation measures.[25]

However, it is clear that for purposes of allowing legal discussion to go forward in a way that is not meaningless, the term "marine protected area" cannot be synonymous with "marine regulation," despite the fact that the Workshop tentatively used a very broad initial working definition of "marine protected areas as fishery management tools."[26] The Workshop's definitional decision is based on other practical factors, however, when applied to this report, such a definition would mean that all marine instruments or regulations of any sort, except those that are global in scope, are "MPAs as fishery management tools."[27]

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[22] For example, the protection of tubeworms, which are believed to be endemic only to hydrothermal vents, might operate to protect such vents without necessitating the adoption of a protected area based on the coordinates of each vent field.

[23] Recent ongoing efforts for the creation of MPA designation standards at international, collaborative and national level. These efforts include work under the OSPAR and HELCOM conventions, and refer to similar guidelines developed in other forums, including CCAMLR, the Barcelona Convention, and the WHC. These standards discussions include both scientific and political concerns (See Korn, H., et al, Platzoeder *The United Nations Convention on the Law of the Sea and Marine Protected Areas on the High Seas"* In Proceedings of the Expert Workshop….. Vilm. 2001, considering whether the site can be protected under existing instruments, before designating it as an MPA, as a last resort.

[24] The CBD considered this in its most recent COP, and several international meetings on this point are planned. See, generally CBD-COP decision VIII-24, para. 29 *et seq.* Other detailed work has been undertaken for IMO's PSSA process.

[25] Given that the author was instructed to review and consider legislation and legal instruments at the national regional and global levels, it is not possible to make any claim that this review comprehensively covers all 'geolocated regulatory marine measures' at any level. However, the breadth of legislation that has been collected and briefly reviewed in the preparation of this report is demonstrated by Appendix 2.

[26] See, Key Points from the FAO Workshop on the Role of MPAs in Fisheries Management (Rome, 2-4 June 2006).

[27] Essentially, all regulation of marine areas is geographically bounded by the specific jurisdictional boundaries of the regulating entity (except where the regulation is global in scope). Thus for example, a country's national legislation is bounded by the outer limits of its territorial sea, contiguous zone, EEZ, and/or OCS as relevant; measures adopted by an RFMO or Regional Seas Convention are bounded by the instrument's jurisdiction. Virtually every marine regulatory measure limits or restricts activities in some way. Virtually no provisions are written to eliminate controls or allow indiscriminate activities that may cause destruction. Taken together, these facts would make all marine regulatory provisions (except those that are completely international) 'MPAs as fishery management tools' under the interim definition.

For this reason (and based on instructions and terms of reference)[28] this paper will not attempt to apply a single generic term for all of the different kinds of legal measures that would be encompassed by the current working definition. Consequently:

- This paper will use 'marine protected area' to refer to permanent designations of particular areas as MPAs (or using another term or concept recognised as a reference to "protected areas," such as park, conservation area, nature reserve, wilderness area, protection zone,' 'sanctuary,' species management area' or 'protected landscape'). In general, it will assume that an MPA is documented by a formally agreed measure of some sort, whether in law, as a 'soft' or voluntary code by a governmental or other organisation, or otherwise agreed.
- It will use the term "geo-local (or "geolocated") protective measure" when speaking of activities that are more generally thought of as 'natural resource management,' when those activities are specifically bounded zones within a larger jurisdictional area (i.e. where the limit on the measure is smaller than the entire geographical area under the relevant governmental or intergovernmental entity's jurisdiction.[29]

2. INTERNATIONAL LEGAL FRAMEWORK

The terms of reference for this paper, call for a review of the overall international framework of binding and non-binding instruments relevant to MPAs, and their role in sustainable use, considering:

(a) a very brief summary of the nature of each individual instrument's relevance to marine protected areas (*i.e.* not the entire scope of the instrument or the framework it creates[30]);
(b) legal/legislative gaps in the overall framework's provision for MPAs; and
(c) currently recognised inconsistencies and controversies relating to MPAs.

Parts 2.1 and 2.2 summarise of the primary relevant international and regional instruments and bodies, noting only their direct relevance to MPA issues, including their ability to support geolocated marine protective measures, as well as the particular gaps and controversies relevant to them.[31] Part 2.3 considers these same points across of the overall international legal framework.

2.1 International and regional agreements and processes

With the objective of identifying relevant instruments at the international level, and highlighting their "relevance, gaps, and inconsistencies," this analysis is divided into four categories – marine agreements, conservation (biodiversity) agreements, integrating instruments and processes, and regional instruments related to marine resource management/protected areas.

2.1.1 Marine agreements and processes

Marine law is often a relatively independent area of law. Particularly at the international level, marine lawyers work in separate courts, negotiations and academic institutions and publications, with

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[28] Following submission of the rough draft of her report, the author was instructed not to look at general marine conservation and sustainable use laws, but instead to focus on specific measures directed at marine protected areas. As a consequence, this paper limited the scope of its discussion to a range of measures that is significantly more limited than the current working definition of "MPAs as fishery management tools."

[29] If an entire ocean, for example, is covered by a particular measure, it seems inappropriate to view that measure as 'special protection.' Similarly, one who lives in a country in which it is illegal to steal generally does not consider himself to be specially protected against thievery.

[30] The Specialised Bibliography, lists numerous papers providing varying descriptions, and legal and non-legal opinions concerning the scope and broader conservation elements of these instruments.

[31] This summary follows and is based on a review of relevant international instruments listed in Appendices 2 and 3, including both binding and non-binding (conventions, protocols, declarations, guidelines, principles and other instruments). Only a few (thought to be the 'most relevant' instruments) have been summarized below.

relatively little input from other fields, including environmental law. Marine instruments are often relatively comprehensive in coverage, sometimes without significant recognition of other instruments.

United Nations Convention on the Law of the Sea

The UN Convention on the Law of the Sea (UNCLOS) is a detailed and well accepted Convention comprehensively addressing the use and conservation of the ocean and its resources. UNCLOS embodies the traditional notion that some ocean areas are under national jurisdiction or oversight, while others are beyond the control of any single State – open to all States, whether coastal or land-locked. Beyond the limits of national EEZs and/or in *the Area*, UNCLOS recognizes "traditional high seas freedoms" (of navigation, overflight, cable laying, fishing and scientific research, etc.). Within EEZs, it recognises various levels of national controls, but imposes limitations on each coastal state's rights to restrain reasonable use of ocean areas within their jurisdiction.

(a) Relevance to marine protected areas

UNCLOS's primary obligations relating to conservation and management of oceans and the marine environment (and/or living resources)[32] balance the "freedom of the high seas" (in particular regarding high-seas fisheries) with the shared obligation of all countries to protect against the destruction of marine species and ecosystems, and the collapse of shared fisheries. Parties have specific obligations to protect the marine environment, to conserve natural resources, and to cooperate with other States for conservation purposes.[33] The provisions setting out these obligations include references to the declaration of specific areas in which certain activities (fishing, shipping, activities causing pollution, marine research) may be prohibited or restricted, for the purposes of marine resource protection, conservation and/or restoration. These provisions are different, for each category of ocean zone.

- Territorial seas: UNCLOS does not specify particular requirements applicable to each country regarding conservation of its territorial sea. Each country has full sovereign rights over its territory, and UNCLOS presumes they will use these powers to control, protect, conserve and restore the marine resources and ecosystems within their Territorial Seas. It does not require MPAs, but notes States' authority to create and enforce them.[34]
- EEZs: UNCLOS mandates are much more strongly expressed with regard to the EEZ. States are required to control the 'allowable catch of the living resources' within their EEZs, and prevent 'over-exploitation' by imposing conservation and management measures (including through RFMOS and other organizations).[35]
- OCS, UNCLOS does not specify conservation obligations, presumably again because the OCS remains within the sovereign jurisdiction of the coastal state.[36]
- High seas: All waters beyond the EEZ, (including the water column above the OCS) are governed by more specific international environmental requirements. All States (individually or

[32] Terminology can sometimes be confusing. UNCLOS uses the two primary terms – "marine environment" and "living resources" (sometimes referred to in slightly different ways, such as "natural resources, whether living or non-living") – but does not define either term. Informal and intermediate definitions and examination of usage have given some indicators of possible definitions. For example, the ISA Assembly has stated a definition of "marine environment" and "serious harm to the marine environment," in its July 2000 *Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area.* It is not clear whether the various chambers of the UNCLOS Tribunal, and/or plenipotentiary representatives of its members will adopt these definitions, however, so they must be thought of as "interim." These various sources suggests that "living resources" may be comparable to the CBD term "biological resources," in some cases, but is often used in a more limited way – to describe commercially utilized resources (especially fisheries), where "marine environment" is given a very general meaning – essentially equivalent to "the ocean and submerged geography."

[33] UNCLOS, Arts. 61, 118 and Part XII, especially Arts. 192 and 237.

[34] UNCLOS, Arts. 21 & 22. Similar power to regulate is specifically specified for other special areas within territorial seas. *See, e.g.* Arts. 42.1 (straits used in international navigation), and 54 (archipelagic waters).. Although required to allow 'innocent passage' (UNCLOS Articles 17-26), states can designate shipping lanes, which may also support these purposes.

[35] UNCLOS, Articles 58 and 61-68.

[36] UNCLOS, Part VI, Articles 76-85.

in cooperation with others[37]) must protect and preserve "rare or fragile ecosystems," the habitats of "depleted, threatened or endangered species" and "other forms of marine life."[38]

- The Area UNCLOS created a special regime applicable to the seabed beyond national OCSs, which was quickly supplemented by a new sub-agreement (the Part XI Agreement). UNCLOS gives the International Seabed Authority (ISA) responsibility for management and disposition of the mineral resources of The Area, empowering and mandating it to take measures to ensure effective protection of the marine environment, including flora and fauna, in connection with the various uses of the seabed beyond OCSs.[39]

Perhaps most important, the Convention requires other States to promote compliance with measures for marine conservation, whether they have been developed by a single state, a small group of States, an RFMO or other international cooperation mechanism, or the entire global community.[40]

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

UNCLOS is intended to be an evolving framework, which will continue to develop as necessary to address needs, usages, and other changes. This suggests that every aspect of oceans and of the protection, preservation, sustainable utilisation and restoration of the marine environment is covered by UNCLOS's general provisions and the general obligations of parties.

However, on some issues UNCLOS provides a more specific detail, providing a 'regulatory' level of guidance, sufficient to enable immediate implementation measures. Where this level of detail is not provided, the UNCLOS framework is designed to enable the international community to develop it through mechanisms such as national implementation, regional cooperation, soft-law and voluntary principles, and/or international negotiations, both binding and non-binding. Some of the issues on which UNCLOS provides little or no guidance or direct provision include:

- protected areas in the 'high seas'; and
- conservation and management of the living resources of The Area.[41]

Although these matters are within overall scope of UNCLOS, the lack of specifics has been noted. International policy developers are currently considering whether there is a need to address them with negotiated policy instruments at this time, and if so, what type and level of documents are needed.

(c) Currently recognised inconsistencies and "controversies"

With regard to the application of UNCLOS to MPAs, the United Nations General Assembly (UNGA) has been active through a working group on conservation of the high seas (discussed in 2.1.3 below). It has also been proposed that this issue should be a part of the wider consideration currently being given to the creation of a new 'implementation agreement" under UNCLOS.[42]

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[37] UNCLOS, Articles 117, 118, 193, 194.4 and (viz RFMOs) 118 (final sentence), 119.1(a) and 119(b).
[38] UNCLOS, Articles 192 and 194.5
[39] UNCLOS, Articles 145, 208, and others.
[40] UNCLOS, Part VII, Section 2, Articles 116-120.
[41] Although giving the ISA a clear mandate relating to the "marine environment," however, neither UNCLOS nor the Agreement Relating to the Implementation of Part XI of the Convention (the "Part XI Agreement) specifically discuss any particular responsibility relating to benthic marine life of the Area. Hence, it is not clear who is responsible for these resources, nor which elements of UNCLOS's regime shall apply to them.
[42] The relevance of MPAs to this process was discussed in detail in CBD COP-8 and the Ad-hoc Working Group on Protected Areas held in preparation for that meeting. See CBD COP decision VIII-24 at para 42.

UN Agreement for the… Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks ("Fish Stocks Agreement" or "FSA")

This Agreement aims primarily at applying natural resource management to the objective of ensuring the "long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks through effective implementation of the relevant provisions of the Convention."[43]

(a) Relevance to marine protected areas

In conjunction with its basic mandate, the FSA expressly calls for "conservation and management measures[44] to ensure the sustainability of covered species stocks. It is generally assumed that the direct or indirect designation of special areas in which activities are controlled is one of the potential measures that may be relevant. [45]

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

Within the scope of its mandate, the FSA does not appear to have any primary gaps regarding its conservation objective. However, recently some authors have claimed that its mandate is too narrow, and recommended reopening the negotiations for the purposes of amending the FSA to cover all fisheries in the EEZs and beyond.[46] Given that the FSA has only been in force for three years, and that its negotiations (particularly its scope) were heavily negotiated over many years, this recommendation may not be workable,[47] but does suggest the level of urgency that some commentators place on international management of high-seas fisheries, in that they are willing to risk the FSA to achieve it.

(c) Currently recognised inconsistencies and "controversies"

Current discussions relating to high-seas and EEZ fisheries revolve significantly around the application of the concept of "precaution" to fisheries management, and the extent to which lack of knowledge can be used as a justification for failing to impose or enforce controls, or for setting high catch limits. The FSA requires both the use of best scientific evidence available[48] and the application of the precautionary approach[49] to protect biodiversity in the marine environment. Recent studies have begun to demonstrate the difficulties inherent in applying the precautionary approach to natural resource management decisions, and indicate a need for further international efforts to clarify its meaning in this context.[50] These studies note that the issue of what is 'precautionary' varies according to what kind of action is being taken,[51] so that the adoption of catch limitations will utilise the principle entirely differently from the designation of MPAs. In the context of protected areas, precaution is relevant across the range of the MPA processes – including the selection of proposed MPAs, zoning, planning, licensing/permitting, and other actions.

International Maritime Organisation and Associated Instruments

The International Maritime Organisation (IMO) is the repository and oversight body responsible for a number of specialised instruments primarily focused on shipping and traditional aspects of maritime

[43] FSA, Art. 2, and see Article 5.
[44] For these purposes, "conservation and management measures" means measures to conserve and manage one or more species of living marine resources that are adopted and applied consistent with the relevant rules of international law as reflected in the Convention and this Agreement. FSA, Art. I(b).
[45] FSA, Articles 5 (a), (b), (c), and (e); and see Allison, G., *et al.* (1998) restating in the marine context the general assumption of the relationship between PAs and conservation.
[46] *Especially,* Kimball, et al., 2005, *but see also* Thiel, H., 2003.
[47] Given the nature of scope discussions the FSA negotiations, it is likely that work on a broader instrument covering fisheries that are not "straddling or highly migratory" would have to be commenced under a separate instrument. Such an approach would have the value of keeping the FSA in force, and keeping its implementation on track, during the new negotiations.
[48] FSA, ART 5 (b) and (c)
[49] FSA, ART 5 (d). *See also* FSA, ART 6 and Annex II which contains a lengthy and detailed analyses of the manner in which precautionary concepts should be applied
[50] Cooney & Dickson, 2005.
[51] Id., and see Bartley, D.M. and D. Minchin (FAO technical Paper - T350/2); and Caddy, J., 1998.

law (such as the safety of human lives at sea, salvage, and piracy). Among its instruments, a number have focused on dumping and pollution issues and other activities and areas in which shipping and maritime traffic can have an impact on the marine environment.[52]

(a) Relevance to marine protected areas

Predictably, the IMO's approach to environmental protection includes many provisions for the designation of specific areas – including both areas which must be protected and areas which are specifically usable as dumping sites or for purging ballast. These designations may be useful, if they can be integrated into national and international processes of MPA creation.[53]

IMO's suite of geo-located protective measures include a range of different "special areas," within which particular kinds of discharges and emissions (oily wastes, "noxious liquid substances," garbage, and air pollution) are forbidden.[54] These provisions are rather narrowly focused.[55] A second type of measure, the "particularly sensitive sea area" (PSSA),[56] is much broader in scope, mandating that all vessels undertake a list of protective measures, whenever they are in an area that has been designated as a PSSA. Because the PSSA concept is not derived from a single instrument or specific international agreement, it has developed in a flexible, still-evolving manner.

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

As the IMO is not mandated to focus on marine conservation issues, it is probably inappropriate to speak of MPA-related "gaps" in its coverage. However, at present, IMO's focus on maritime traffic is not well integrated with other international marine law. For example, the IMO may chose not to grant Special Area or PSSA status to an EEZ area that a country has designated as an MPA.[57]

(c) Currently recognised inconsistencies and "controversies"

A number of countries have strongly promoted the use of the PSSA designation for conservation, including as a tool for protecting very large ocean areas. However, as demonstrated by recent proceedings in the IMO, [58] these proposals have been controversial for two opposing reasons. On one side, many commercial enterprises and their advocates note that the PSSA mechanism is still evolving, and its guidelines are in the process of revision/have been newly revised through an international process. As a consequence, the PSSA tool is still too rigid, and does not contain any basis for flexible application to individual circumstances of an area or activity. One the other side, it has been noted that the PSSA designation is not a mandate for conservation. However, if used in conjunction with other conservation systems, the PSSA might have a significant role in providing the linking/liaison mechanism between environmental/conservation action and IMO's shipping oversight.

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[52] *Specifically,* the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto ("MARPOL 73/78"); International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004, not yet in force); Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) (London, 1972); and particularly the IMO Revised Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas, IMO Assembly Resolution A. 982 (24) (Adopted 2005)

[53] The designation of dumping areas, ballast water purging areas, etc., can operate as a support to MPA objectives, particularly where the law specifically requires that these activities may *only* be undertaken in the designated areas.

[54] *See*, MARPOL 73/78, Regulation 10 of Annexes I, II, V, and VI. Some Special Areas are very large. For example, the Baltic, Black and Mediterranean Seas, as well as the Gulf of Aden, "Gulfs", Red Sea, "Antarctic Area, North West European Waters, and Oman sea have all been designated as Special Areas under this provision.

[55] At present, a separate "Special Area" designation must be separately proposed for each type of activity or discharge, even if they all cover the same area.

[56] The PSSA concept has been derived indirectly from multiple sources within IMO instruments, and has been specifically referenced in UNCLOS, Agenda 21 and processes under the CBD. Article 211 of UNCLOS is generally thought to reference the IMO system, especially MARPOL 73/78.

[57] *See* e.g. Chevalier, C. (2004) describing denial of PSSA status in connection with protection of the Mouths of the Bonifacio Strait.

[58] *IMO,* Western European Waters PSSA proposal (initially proposed 2003, reviewed by the legal commission 2005, reconsidered 2005).

IMO is currently re-developing guidelines for designation of PSSAs, under which PSSA designation will become less rigid, and thus more easily adapted to particular needs of individual areas.

FAO, and the Code of Conduct for Responsible Fisheries

The UN Food and Agriculture Organisation (FAO) has long recognised the intrinsic linkage between conservation and natural resource management, and the achievement of the Organisation's primary mandates relating to food, agriculture, fisheries, and forestry. Its work provides strong examples of the value of non-binding and voluntary instruments, including specifically the Code of Conduct on Responsible Fisheries (CCRF),[59] which focuses on the balance between "the biological characteristics of the resources and their environment and the interests of consumers and other users."

Although not binding, the Code has had a significant impact on the growing trend toward coordinated management and the promotion of sustainability in, fishing activities in all ocean areas. The CCRF does not specifically discuss geographic-based protections; however, it focuses on the needs for conservation, restoration and sustainable use of ecosystems, commercially-fished species, and species that are not commercially fished.[60] As noted, protected areas are thought relevant (and often necessary) to achievement of these objectives.

Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas

Designed to help prevent "re-flagging" vessels as a means of avoiding conservation responsibilities, the Compliance Agreement is intended to focus on compliance with "conservation and management measures." Its primary direct contribution to international conservation is the creation of a potentially valuable tool for enforcement. Specifically, it creates a comprehensive, centralized database on vessels authorized to fish on the high seas, called the Vessel Authorization Record (VAR). The VAR contains compliance information relating to fishing requirements, and may also potentially apply to MPAs.

International Whaling Convention

The International Whaling Convention (IWC) was originally created as a tool for management and conservation of whale stocks – i.e. as a single-genus sustainable use convention, essentially an RFMO.[61] The IWC has created two whale sanctuaries (single-species-oriented protected areas), covering very large areas.[62] Unfortunately, the effectiveness of these sanctuaries could not be well tested or analysed, since the IWC's natural resource management activities have been effectively curtailed by the lengthening "pause" in commercial whaling which began in 1985/86 and is now in its 21st year, thus becoming an effectively permanent moratorium on legal whaling in the high seas.[63]

Global Programme of Action for Protection of the Marine Environment from Land-based Activities

The Global Programme of Action for Protection of the Marine Environment from Land-based Activities (GPA) is a comprehensive, multi-sectoral instrument reflecting the desire of Governments to strengthen the collaboration and coordination of all agencies with mandates relevant to the impact of land-based activities on the marine environment, through their participation in a global programme. In

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[59] The Code "calls on States, International Organizations, whether Governmental or Non-Governmental, and all those involved in fisheries to collaborate in the fulfilment and implementation of the objectives and principles contained in this Code;" (adopted by the Rome Declaration on the Implementation of the Code of Conduct For Responsible Fisheries, FAO Ministerial Meeting on Fisheries Rome, 10-11 March 1999, para 2)

[60] CCRF Articles 6.1, 6.2 and 6.8. The CCRF also notes information sharing, and integration with other programmes and management planning, as critical elements of conservation. CCRF Articles 6.2 and 6.9.

[61] RFMOs are discussed in III.B.2, below. The author offers her apologies to anyone offended by the inclusion of whaling as a 'fishery,' but uses the term in its sense of 'commercial extraction of living resources,' not suggesting that whales are 'fish.'

[62] The Southern Ocean Sanctuary (SOS, established 1994), includes all ocean areas below the 60th-S parallel. The Indian Ocean Sanctuary (IOS, established 1979) includes the entire Indian Ocean, specified by 'metes and bounds.

[63] Although a few countries continue to engage in whaling pursuant to limited exceptions to whaling ban, including aboriginal subsistence whaling, whaling activities for scientific purposes, and activities within a country's jurisdiction. In its most recent meeting the International Whaling Commission adopted a resolution stating that the moratorium "was adopted as a temporary measure, and is no longer necessary." (IWC *St. Kitts and Nevis Declaration*, adopted by the 58th Meeting of the IWCommission, June 2006).

addition to pollution issues, the GPA also addresses physical alterations of the coastal zone, including the destruction of marine habitats. The GPA specifically discusses and encourages the recognition of protected areas,[64] and references the need for attention to 'areas of concern' within the coastal zone. It also notes the value of declaration of zones, including both zones that must be protected, and those that serve as the only permitted area for certain activities (e.g. dumping). The GPA encourages cooperation through international instruments and other mechanisms.

Labelling and certification

Up to now, the implementation of "dolphin-safe" and other kinds of certification have generally been undertaken through national law and commercial mechanisms. Currently various approaches have been examined for improving the reach of these measures, including the creation of a new international instrument, the Agreement for the International Dolphin Conservation Programme. One of the primary tools that is used in the certification of tuna and other commercially harvested living marine resources involves the certification of the fishery itself – in some senses, the creation of an MPA focused on restricting the nature of fishing processes, and in some cases the volume of fish taken. Certification approaches represent a relatively new potential mechanism that can be used with other tools and approaches to promote conservation and sustainable marine management.

2.1.2 Conservation and protected-area agreements

A number of conservation instruments are also directly relevant to the marine biome and MPAs.

Convention on Biological Diversity

The stated objectives of the Convention on Biological Diversity (CBD) are (i) conservation of biodiversity, (ii) sustainable use of components of biodiversity, and (iii) equitable sharing of benefits from use of genetic resources.[65] It includes both terrestrial and marine resources and ecosystems.

(a) Relevance to marine protected areas

Protected areas, broadly within the term "*in situ* conservation measures"[66] are specifically addressed under the CBD as a primary tool for ensuring that valuable biological resources are not lost to extinction through abuse, overuse, or unintentional neglect.[67] The CBD clearly emphasises that such designations are tools for such protection, rather than *per se* objectives that can be satisfied by simply gazetting the area as a "paper park."[68] The CBD envisions an integrated, comprehensive approach to conservation and sustainable use. Hence, Parties are required to prepare and update inventories of biological resources as a basis for planning and decision-making.[69]

The Convention's scope specifically includes marine areas within the limits of national jurisdiction, *and* also extends to processes and activities undertaken by a country or by persons or vessels under its jurisdiction in the high seas and the Area.[70] It has recognised marine conservation as a priority since its second year, when its Contracting Parties adopted the 1995 Jakarta Mandate on marine and coastal biodiversity, including the establishment of marine and coastal protected areas.[71] Most recently, the CBD's detailed programmes of work on marine and coastal biodiversity (adopted 1998 and 2004) and on protected areas (adopted 2004 and 2006) provide guidance to Parties in national legislation, as well as regional measures and actions in or impacting areas beyond national jurisdiction.[72]

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[64] GPA, §§ 152(d) and 153(a).
[65] CBD Article 1.
[66] CBD., Art. 8.
[67] CBD, Article 8
[68] CBD, Art. 8. For a discussion of the importance of a "system" of protected areas, as opposed to former "token" approaches, *see* Global Biodiversity Outlook (CBD, 2001) at 131.
[69] CBD, Arts. 6 and 8.
[70] CBD, Articles 4, 5 and 22.2.
[71] CBD COP-2, Ministerial Statement.
[72] CBD Decisions VIII-24, /CBD/COP/7/5 (2004) (Protected Areas – this decision specifically addresses MPAs both within and outside of national jurisdiction); VII-5, UNEP/CBD/COP/7/5 (2004) (Protected Areas. This decision incorporates and

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

Legally, the CBD is designed to operate through national implementation. As a result, its application through regional implementation mechanisms was strongly opposed early on, and even today is rarely directly addressed. Consequently, most CBD work on MPAs has focused on activities which a particular country may undertake. The Convention does not specifically discuss bi- or multi-laterally designated MPAs (or recommend mechanisms for the creation of) MPAs beyond national jurisdiction.

(c) Currently recognised inconsistencies and "controversies"

The primary MPA coverage issue for the CBD has been the relationship between the CBD and UNCLOS. Although the CBD specifically requires parties to "implement this Convention consistently with the rights and obligations of States under the law of the sea,"[73] the two international processes have an evolving relationship, particularly with regard to MPAs and other marine conservation issues. Most recently, in CBD COP-8, the Parties generally agreed that the primary international work on this issue will be ongoing through the UNGA (UNCLOS), with the CBD providing inputs and advice based on its specialised competence in the areas of conservation, protected areas, and biodiversity.[74]

World Heritage Convention

The World Heritage Convention (WHC), was created to ensure the protection and safeguarding of specific areas of 'international importance.' It is a list-based agreement in which sites are nominated (by or with approval from the government of the country in which they are located) to an international Commission which decides, based on detailed criteria, whether they may be added to the list of "World Heritage Sites." The Convention also mandates international oversight of listed sites (based on its Operational Guidance and other principles) to ensure that the area's condition does not decline. Originally, a country's incentive to list a site was partly financial – access to the "World Heritage Fund." Over the years, as inflation has decreased the importance of the Fund, a new incentive has taken its place: Once listed, a PA may use the World Heritage designation as a kind of certification or "brand," which has proven to increase the number of visitors to the site.

(a) Relevance to marine protected areas

Marine sites, particularly those in coastal waters or within relatively short boating distances of shore, have been designated as WH Sites. The most famous Marine WH Site is probably the Great Barrier Reef World Heritage Area in Australia, which is generally part of[75] the Great Barrier Reef Marine Park – and until this year, the largest MPA in the world.[76] The World Heritage Committee has drafted specific criteria for MPAs, although these criteria have not yet been formally adopted.

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

The main limitation of the WHC's coverage relates to its objectives. Specifically, the WHC is not a 'protected areas convention,' *per se*, but rather is designed to create incentives and mandates for a

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surpasses earlier work on PAs); CBD Decision VII-28, UNEP/CBD/COP/7/28 (2004) (MPAs). In 2005, a CBD Working Group began to try to address the question of marine protected areas. Although unable to resolve insoluble issues raised, the (partly) bracketed report indicated agreement regarding the urgent needs of coastal and EEZ areas. Report of the First Meeting of the Ad-hoc Open ended Working Group on Protected Areas, Annex 1, para. 1/1.l (Montecatini, 20 June 2005) UNEP/CBD/WG PA/1/6

[73] CBD Art. 22.2

[74] CBD COP Decision VIII-24 at 42.

[75] The exact boundaries of the Great Barrier Reef WH Site and the Great Barrier Reef Marine park are not the same. Approximately 10% of the WH Site is outside of the Marine Park area, and is managed by provincial authorities.

[76] The United States government has declared approximately 84 million acres comprising the remote "Northwestern Hawaiian Islands" and surrounding submerged lands to be a "national monument" under one of the United States's protected area legislative authorities. The area is said to be the largest MPA in the world. The United States did not cite particular threats as the reason for the designation, suggesting that its object is to protect a relatively pristine area.

specific type of protected areas – natural and cultural areas of international importance *that are or can be sites of tourism and similar uses*.[77] Hence, it is designed to address protected areas that will be used by the public. This means that, as a practical matter, the WHC mechanisms may not be meaningful for MPAs beyond the reach of tourist day-trips, nor MPAs intended to control commercial harvesting. In addition, the WHC is legally limited to the declaration of areas within national jurisdiction, and imposes numerous rights and responsibilities on the country or countries in which the WH Site is located. With regards to ocean areas beyond national jurisdiction, no country, organisation or other international entity is currently qualified or designated to act as the "country in which the Site is located" for these purposes.

UNESCO Convention on the Protection of the Underwater Cultural Heritage
Although not yet in force, this Convention is directed to protection of resources such as wrecked, vessels and other vehicles, as well as structures, artefacts, human remains, and prehistoric objects.[78] It also seeks to control salvage and other private actions involving such areas.

Agreement Concerning the Shipwrecked Vessel RMS Titanic
This new agreement (also not in force) is essentially a very specific variation on the UNESCO Convention on the Protection of the Underwater Cultural Heritage – focusing solely on protecting the wrecked Titanic in its final resting place at the bottom of the Atlantic.

(a) Relevance to marine protected areas

The RMS Titanic Agreement calls on Parties (individually or collaboratively) to take "all reasonable measures" to ensure that all artefacts recovered from the *Titanic* are conserved and curated, and to control or oversee the actions of vessels under their registry for this purpose.[79] It thus creates a kind of limited protected area on the seafloor, in which certain kinds of activities are restricted.

(b) Currently recognised inconsistencies and "controversies"

This RMS Titanic Agreement represents a new way to take conservation action in the high seas and The Area. Rather than holding a broad international negotiation (an expensive process that can take many years), the negotiations were limited – involving only the United States, United Kingdom, France and Canada. The Convention will enter into force after only two countries have agreed to and implemented it, however, its provisions are only binding on those countries which are signatories. In essence, the ratifying States agree that, they will consider the area to be protected area and govern their citizens and vessels accordingly. The Parties then hope and expect other Parties to subsequently join in these measures.

Convention on International Trade in Endangered Species of Fauna and Flora
Although not direct addressing protected areas or MPAs, the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) has relevance to conservation beyond national waters. Functionally, CITES combines properties of a conservation convention and an "international trade agreement," closely regulating international movement of endangered and threatened species, or their parts and derivatives (including commercial products). CITES focuses significant attention on the listing of protected species, and efforts (some geo-local[80]) to ensure their protection.

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[77] Although the text does not specify tourism or other use, it is only sites which have or hope for touristic visitation that are benefited by WHC designation. Generally, countries do not give international bodies powers to intervene in what would otherwise be a matter of national sovereignty, and commit to substantial externally overseen requirements, unless they can see some particular value to themselves.
[78] Underwater Cultural Heritage Convention, Art. 1(a).
[79] Agreement Concerning the Shipwrecked Vessel RMS Titanic, Article 3.
[80] *See, eg.,* the CITES "Significant Trade" processes for, for example, sturgeon and paddlefish. To date, no geo-local arrangements have been proposed under this mandate relating to ocean areas.

(a) Relevance to marine protected areas

CITES specifically requires Parties to monitor and regulate the movement of species that are "introduced from the sea" (beyond national jurisdiction).[81] Implementation of this provision demonstrates some of the problems involved in implementation of geo-located resource management requirements, since this provision can only be implemented by knowing (or accepting the vessel operator's statements about) where the species was harvested.

(b) "Gaps" and limitations of coverage of marine conservation and MPAs

Within the past five years, the CITES COP has listed a number of nationally and internationally fished commercial marine fish species as needing trade control (CITES Appendix 2). CITES's parties have specifically recognised that these listings will only be a positive contribution to sustainable ocean management, if there can be a high level of cooperation among parties and with FAO.

Convention on Migratory Species

Like CITES, the Convention on Migratory Species (CMS) focuses on the listing of particular species (or groups of species), in this case focusing on those that are both migratory and endangered. The primary requirement imposed on Parties with regard to these species is to take measures to protect manage and conserve their habitats.

One mechanism used by CMS is the development of specialised agreements (sometimes non-binding) among the Range States of a particular listed species, under which they agree to management plans for the species' protection. Several of the Agreements developed to date address ocean species, including the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS);[82] the Agreement on Small Cetaceans of the Baltic and North Seas (ASCOBANS);[83] Trilateral Wadden Sea Collaboration,[84] the Memorandum on the Conservation of Sea Turtles of the Indian Ocean and South East Asia,[85] and the Agreement for the Conservation of Albatrosses and Petrels (ACAP).[86] Most relevant to this paper, the habitat focus of these instruments, coupled with the development of plans of action ('management plans') for the entire species range (often a single geographic region or sub-region), enables a kind of action that operates in coordination with other more formal geographic protections. This can enable coordination among countries and among sectors within each country, and typically embodies kinds of flexibility and awareness of use-related requirements that is sometimes missing in other kinds of marine protected areas.

2.1.3 Integrating instruments and processes

At some levels, international efforts have been ongoing to attempt to better reconcile the various marine interests and concerns relating to management of the natural resources of the marine realm.

UNGA Ad Hoc Informal Open-ended Working Group and Other Processes

Presently, processes under the United Nations General Assembly (UNGA) are being undertaken, and offer some hope for further development and integration among the international instruments described above, and a more effective basis for integrated national action, regarding conservation in the marine biome and the creation of MPAs. Up to now, the most important of these processes have been the non-binding discussion processes under UNCLOS, known as the United Nations

[81] CITES, Articles III.5, and IV.6.
[82] Monaco, 1996, entry into force 2001.
[83] (opened for signature at the UN HQ New York) 1992, entry into force 1994.
[84] Formerly, "Wadden Sea Seals Agreement," (1978) currently functioning under a broader "Administrative Agreement" among the three range states, adopted and in force as of 1987.
[85] Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (2001).
[86] Capetown, 2001, entry into force 2004.

Intergovernmental Consultative Process on Oceans (UNICPO), which has given priority attention in most of its sessions to matters relating to the implementation of Article XII of UNCLOS, including to the further development of MPA rules.

In 2005, however, at its special session to commemorate the twentieth anniversary of the signing of UNCLOS, the United Nations General Assembly adopted a comprehensive resolution on Oceans and Law of the Sea that called again for States to protect the environment and its living resources,[87] and to achieve the World Summit on Sustainable Development (WSSD) 2012 target regarding the need for representative networks of MPAs. A more concrete expression of this resolution is found in a General Assembly cross-cutting Working Group which is expected to enquire into "issues relating to the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction."[88] This process specifically called upon to address the issues of marine conservation and MPAs, across a range of international and regional binding and non-binding instruments and processes (including UNCLOS, CBD, and FAO) and to integrate with other 'soft processes, such as UNICPO.

In light of its central role in addressing these issues and the paramount role of UNCLOS in this connection[89] (recognized by other bodies, including the CBD, which has adopted a decision regarding its participation as an information provider in this process[90]) this process will be overseen through the General Assembly itself, creating a level playing field for the discussion of the range of issues and positions currently promoted through a variety of international forums. It will, to some extent be guided by existing UNGA resolutions promoting conservation, including through geo-located protective measures.[91] Following its initial meeting, this Group's Co-chairs, recognized that certain options and approaches relating to the possible establishment of marine protected areas in the high seas, might promote these objectives. This suggests that MPA issues may be included in discussions of the need for an implementing agreement under the United Nations Convention on the Law of the Sea.

Agenda 21

Agenda 21 (a non-binding document, sometimes called "Earth's Action Plan") identifies a full range of issues that must be addressed in a globally and locally integrated or interrelated way, in order to ensure the health, stability and sustainability of the ecosystems, species and the global environment. These principles are directly applied to the conservation and management of the oceans in Chapter 17, which calls on States to co-operate with regard to the protection and restoration of endangered marine species and the preservation of habitats and other ecologically sensitive areas.[92]

Declaration of the World Summit for Sustainable Development

In 2002, the WSSD recognised that the ocean-related objectives of Chapter 17 are still largely unmet, and that the needs discuss in it are now critical. Accordingly, its Plan of Implementation includes a number of specific time bound commitments, including "the establishment of a representative network of MPAs" by 2012.[93] States are called on to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in the high seas; and to develop new approaches and tools to establish marine protected areas consistent with international law and based on scientific information." The WSSD targets on marine conservation and the network of representative protected

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[87] UNGA Assembly Resolution n° A/57/L.48
[88] Established by the General Assembly, the Group met from 13 to 17 February 2006, and follow-up meetings are expected, either directly or through the "consideration of the need for an implementing agreement under UNCLOS," mentioned in text.
[89] General Assembly resolution 60/30
[90] CBD Decision VII-24, para 42. (2006)
[91] General Assembly resolution 59/25;paras 66-69, and especially para. 71.
[92] Agenda 21, ¶ 17.46.
[93] WSSD Plan of Action, ¶ 31. Other key commitments of this section include the restoration of fisheries to maximum sustainable yields by 2015; and a significant drop in the rate of species extinction by 2010. The importance of a "system" of protected areas, as opposed to "token" approaches, is discussed in the Global Biodiversity Outlook (CBD, 2001) at 131.

areas have been recognised by an overwhelming majority of the instruments (both global and regional) described in this paper, and are providing a basis for coordination among them.[94]

2.2 Regional instruments

An extensive range of legal instruments address marine issues relevant to MPAs at the regional level. The number of available instruments is so great, in fact, that it is not possible to address them all in this paper.[95] Consequently, the following discussion discusses only a few documents and categories of documents, to provide examples of particular types of regional instruments, based on their objectives with regard to geo-located conservation laws. It is meant to be illustrative of the manner in which it can address the range of variation in regional instruments and their provisions. It begins with a summary of two overall categories of instruments – the 'Regional Seas Conventions' and the 'Regional Fisheries Management Organisations. Thereafter, it briefly considers MPA components of in three regions – the Antarctic, European waters and the Pacific islands.

2.2.1 Regional Seas Conventions

The UNEP Regional Seas programme is intended to foster regional co-operation on behalf of the marine and coastal environment. It has supported the development and adoption of nine "regional seas conventions" and various protocols under each, is active in four other regions, and has entered into partner programmes with two pre-existing regional agreements relating to oceans.[96] Regional Seas (RS) Conventions, although often structurally similar, are individualised particularly in their various protocols (where MPAs are typically addressed). Most RS Conventions operate through Action Plans, which serve as "prescriptions for sound environmental management" and mechanisms for promoting co-operation.

The Regional Seas programme is a vehicle for synergies, as it provides a means for regional groups to facilitate effective implementation of the multilateral environmental agreements (MEAs) by the countries that are parties to the regional seas agreement. The Programme has recently become a platform for inter-regional coordination, as well.[97]

2.2.2 Regional fisheries management instruments and organisations

Regional Fisheries Management Organisations, although long in existence, have taken on a new character in the provisions of UNCLOS which recognise them[98] and in the role contemplated for them in the CCRF. RFMOs are expected to establish conservation and management measures to facilitate joint assessment of stocks and ecosystems, and ensure that the biodiversity of aquatic habitats and ecosystems is conserved and endangered species are protected.[99] For many RFMOs, the designation of controlled zones and similar mechanisms have been utilised toward these purposes. RFMOs and fishing fleets have the primary current and potential responsibility and opportunity to exert oversight and management beyond the easy reach of land-based coastal services. Others have addressed these matters without formal instruments, either coordinating with other bodies or through more flexible (planning and scientific research) mechanisms. Some have not addressed it at all.[100]

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[94] *See, e.g.* Expert group on outcome-oriented targets for the Programmes of Work on the biodiversity of Inland Water Ecosystems and Marine and Coastal Ecosystems (Montreal, October, 2005)

[95] The list provided in Appendix 3 includes a number of regional marine governance instruments of various types. Although offered as 'complete,' this list is constantly changing.

[96] The full list of Regional Seas Conventions and protocols and Partner Conventions can be found online at http://www.unep.ch/seas/main/hconlist.html.

[97] As reported in the RSP website, the Parties to the Antigua Convention are developing coordination with the Wider Caribbean RSC. Another cross-continental cooperation is developing between the Abijian and Nairobi Conventions.

[98] UNCLOS, Articles 117 and 118.

[99] CCRF., 7.2.2(d)-(g) and 7.3.2.

[100] A number of existing works summarise the texts (contents and powers) of RFMOs (see e.g. Kimball, L., 2000), although none to date have analysed the legal issues or examined the contents of their proceedings and practices to determine what those provisions have meant in practice and how they are being applied.

2.2.3 Practical examples from three regions

The following summaries (the Antarctic, Europe, and the Pacific Islands) exemplify the variation among regional approaches to MPAs. Regional experiences demonstrate the manner in which existing international instruments can operate in an integrated fashion.

The Antarctic Treaty System

The creation of marine protected areas under the Antarctic Treaty System is most specifically discussed in the Convention on Conservation of Antarctic Marine Living Resources (CCAMLR) Commission. CCAMLR recognises two types of MPA – Antarctic Specially Protected Areas (ASPAs) or Antarctic Specially Managed Areas (ASMAs),[101] as well as a third type of *de facto* MPAs:

- ASPAs are conservation-focused, designed to protect outstanding environmental, scientific, historic, aesthetic or wilderness values, as well as scientific research. Designation is based on the nature and value of the area and resources – as (1) wilderness areas, (2) representative areas, (3) "areas with important or unusual assemblages of species," (4) areas which are "the only known habitat of a species," and (5) other areas protected for their outstanding environmental, scientific, historic, aesthetic or wilderness values, or for scientific research.[102]
- ASMAs, by contrast, are focused on species or area sustainability. An ASMA may be declared wherever a limitation or control is needed (including in congested areas, or to minimize cumulative environmental impacts). ASMAs are integrated management/zoning areas.
- CCAMLR's limitations on 'new and exploratory fisheries' (NEFs)[103] create a third *de facto* geo-located protection. Although NEFs may be applied by species, it is also possible to designate an area.

Procedurally, the CCAMLR operates through the CCAMLR Commission, a body composed of representatives of all original Parties (automatically) and all Parties that subsequently accede to the Convention (by vote of the current members). The designation of ASPAs, ASMAs and NEFs are all considered to be 'matters of substance';[104] hence, such a designation may be created only by consensus of all members of the Commission (that is, a proposal to designate an area will pass so long as no Commission Member objects). The primary legal difference among the three options relates to their permanence. NEFs are actually a two stage process – a fishery is declared "new" and then becomes "exploratory," after these designations, catch limits and other factors are annually re-defined.

European Regional Instruments

A variety of different regional instruments and processes govern European ocean areas, which seek to operate synergistically, despite legal and procedural difficulties.[105] Europe's Members have adopted many different approaches to conservation, requiring serious networking and cooperation.

One critical element of European regional cooperation in MPAs is found in the Natura 2000 programme. The European Union's (EU) 25 members and a number of other countries, which have formally committed to complying with key EU regulations, comprise the vast majority of the continent. Hence its coordinative framework can provide a strong basis for norm development and

[101] Protocol on Environmental Protection to the Antarctic Treaty (Madrid, 1991), Annex V. ASPAs and ASMAs are not mutually exclusive. An ASPA may easily be a 'zone' within a broader ASMA.

[102] Annex V. § 3.2. ASMAs include areas (1) needing strict protection; (2) exemplifying major ecosystems; (3) with important or unusual assemblages of species (including native birds or mammals as well as fish); (4) considered the only known habitat of a species; (5) of outstanding value, (6) set for scientific research, and (6) containing outstanding geological features.

[103] Created by CCAMLR Conservation Measures 21-01 and 21-02 (Adopted by the Commission in 2002).

[104] CCAMLR Commission Rules of Procedure, Rule 4 (a).

[105] *See, e.g.* the OSPAR, Barcelona Convention, and several RFMOs, as well as ACCOBAMS, ASCOBANS, Trilateral Wadden Sea Collaboration, and other agreements.

networking across the entire region, including between and among other regional programmes in the area.

Natura 2000 is focused on creating a "coherent network of protected areas," including both Special Protection Areas (SPAs) under the Birds Directive,[106] and Special Areas of Conservation (SACs) under the Habitats Directive.[107] Protection of marine biological diversity is expressly made part of this programme. Natura 2000 has created a strong motivation to meet relevant targets. [108] Although work in the marine area has been somewhat slow at times, many countries have taken very strong affirmative steps toward meeting these targets in that biome. [109]

Beyond Natura 2000, which promotes individual countries to take action, regional processes also promote joint and collective action under a number of different instruments and processes, using mechanisms that vary greatly. The most active declaration and protection mechanisms in this region are found under the Barcelona Convention and its "SPA and Biodiversity Protocol", whose Parties are specifically authorised not only to act individually (as to areas within their jurisdiction)[110] but also to declare MPAs collectively (as to areas that cross national boundaries or are outside of national jurisdiction,[111] but within the scope of the Convention). Parties can create Specially Protected Areas within their territory by adding them to the list of Specially Protected Areas of Mediterranean Importance (the SPAMI list).[112] Beyond their territory, a broader evaluation is necessary. The SPAMI process is also a vehicle for coordination of Mediterranean MPAs.[113]

By comparison, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) has focused its attention on MPAs declared by Parties individually, with guidance regarding "necessary measures to protect [and] conserve marine ecosystems,"[114] as well as "means, consistent with international law, for instituting protective, conservation, restorative or precautionary measures related to specific areas or sites or related to particular species or habitats."[115] Although these discussions are currently ongoing, such means have not been developed as yet. Some current proposals have focused on areas that are fully or partly beyond national jurisdiction – whose formal designation through OSPAR will require a consensus decision.

Coordination among the European instruments is a very important concept. All of these instruments are independent, with independent governing bodies, however, there is a high level of integration of their activities. Although legally important, most instruments seek to promote coordination through COPs or similar processes.[116] This may be partly facilitated by the overlap among members of these instruments, and the fact that most European regional instruments are observers in each other's

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[106] EUROPEAN UNION, EU Birds Directive (79/409/EEC of 2 April 1979). Although focused primarily on birds, this document includes provisions for the protection of 'habitat species', and the designation of habitat areas for protection.

[107] EUROPEAN UNION, European Directive on the conservation of natural habitats and of wild fauna and flora (the "Habitats Directive" 92/43/EEC of 21 May 1992). This document focuses on the creation of a coherent network of protected areas.

[108] Natura 2000 sites were to have been identified by 1998. Several states failed to propose sites within this time. For example, after the deadline had passed without any German site proposals, the European Court of Justice found Germany to be in contravention of the Directive.

[109] Germany, following the ECJ censure, notified the EU of 10 new areas, totalling approx. 31% of the German EEZ. Together with the existing nominations of the states in the country's territorial sea, approximately 38 % of the total German marine area will eventually be under direct protection. Discussed in Natura 2000 materials provided by Henning von Nordheim of the Bundesamt for Naturschutz, and found online at http://www.habitatmarenatura2000.de/en/intro.php

[110] Primary responsibility for "ensuring consistency of proposed protection and management measures, as well as the means for implementation" rests with the party or parties who propose the area for listing. SPAMI Protocol, Arts 9.3(a), and 9.5

[111] No part of the Mediterranean is more than 200 nm from a shore or island, and few countries have declared EEZs, covering the full range of EEZ authorities. Consequently, one cannot easily predict marine jurisdiction in the Mediterranean. Proposals have been made to develop a GPS-supported formal map showing full range of the Sea's jurisdictional coverages.

[112] SPA and Biodiversity Protocol of the Barcelona Convention, Art. 8.2.

[113] *Id.* Articles 3.2 and 3.4.

[114] OSPAR, Art. 2.

[115] OSPAR, Annex V, Art. 3. Annex V has not been adopted by all 16 OSPAR parties as yet.

[116] OSPAR's coordination provisions are very strong. *See* Annex V, and OSPAR's 1992 Agreement on the Meaning of Certain Concepts (calling for coordination with other instruments, and 'separate but coordinating' work with RFMOs).

processes.[117] Most of these instruments maintain databases or other resources regarding species, ecosystems and geographic areas protected under their respective systems. Formal or informal MPA designation under one instrument may be given special consideration by others whose geographic coverage includes all or part of the MPA. For example, most areas declared as PSSAs by IMO are also Special Areas under European treaties. Other synergies have sometimes been proposed.[118]

[South] Pacific Regional Instruments

Coordination among instruments is a more direct objective of the Pacific Regional Environmental Programme. Originally created as a vehicle to enable small island countries in the South Pacific to share expertise, actions and results in the fields of environment and pollution issues, the South Pacific Regional Environment Programme's (SPREP's) continuing mandate "to promote co-operation in the Pacific region and to provide assistance in order to protect and improve its environment and to ensure sustainable development for present and future generations" has expanded and improved over the years since its creation. SPREP's approach to coordination at the regional level is much different from that of the European instruments, in two ways. First, in initial conception as a 'regional environmental programme', SPREP has found it easier to shape its mandate based on member's needs and desires for coordinated action. In addition, over the years since its creation the Programme has become the repository of other instruments (the Apia and Waigani Conventions), and involved in a broad variety of other region-wide actions.

As a consequence of this integration, SPREP's proposed involvement in MPA creation may be more integrated from the outset. Rather than having different protections developed by different sectors and later negotiated among them, the SPREP approach suggests that at least some of the relevant sectors will be involved in negotiations and programmatic development from the beginning. SPREP's provisions for conservation are thus much more focused on an 'ecosystem approach' which integrates social and economic issues with conservation concerns from the outset. Moreover, the Pacific Islands represent one of the few areas in which one can consider a 'community' (rather than a commercial sector) to be directly interested in the broader reach of oceans. Hence, it is not surprising that community decision-making is strongly integrated in SPREP's objectives and *modus operandi*.[119]

2.3 Overall gaps, and controversies in the international framework[120]

The completeness of the current international framework as described above, has been the subject of long discussions and debate, and will be further considered in international processes. These discussions have different impact and relevance to different ocean zones, given that, for example, the central issues of MPAs in the high seas (legal coverage and mechanisms) are well decided for waters and submerged lands under national control, but undeniably unclear and controversial for other areas.

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[117] *E.g.* Observers to OSPAR include Secretariats of ASCOBANS, Arctic Monitoring and Assessment Programme (AMAP); Helsinki Commission, Barcelona Convention; Trilateral Wadden Sea Secretariat the Cooperative Programme on … Long-Range Transmission of Air Pollutants in Europe (EMEP); EEA (ASMO only); IOC; IAEA; International Commission for the Protection of the Rhine against Pollution; ICES; IMO; NAMMCO; NEAFC; North Sea Secretariat, OECD, and UNEP.

[118] For example, in 2003, ASCOBANS proposed to alter its geographic coverage to match that of the OSPAR region. (That proposal was referred for further study). *See also*, Kimball, L., 2005, noting without citation that the OSPAR Commission has recently written to the North East Atlantic Fisheries Commission (NEAFC) regarding the possible protection of cold-water coral reefs on the western slopes of the Rockall Bank, and elsewhere in the OSPAR region. It is not clear what the legal nature and source of this 'writing' might be.

[119] Although giving "considerable attention" to coastal and marine environments, which it notes are the 'dominant ecosystems of most SPREP members, it is notable that to date, SPREP's work has not as yet specifically focused on MPAs. However, it is clear that MPAs created by SPREP member countries are guided by the Noumea Convention. (Article 14).

[120] This section examines legislative gaps, inconsistencies and controversies, and does not consider the issues of implementation/governance, decision-making, and socio-policy, to be considered in other papers. Based on requests to avoid 'purely legal issues' and focus on questions of legislation of relevance for discussion/decision by non-lawyers, this section will not discuss the broader range of still unresolved legal issues relating to oceans and international conservation instruments, such as the legal status of marine jurisdiction (currently under continuing negotiations in numerous international forums), the extent of application of customary international law and international common law to these issues, the responsibility for development of consistent interpretation of overlapping provisions, and the ISA's ability/authority to redefine its mandate to include non-mobile living resources of the Area.

2.3.1 Impact of the international framework on MPAs in the high seas and the area[121]

Recently numerous experts have considered the question of 'gaps and inconsistencies in the international ocean regime concerning MPAs and conservation in the high seas and The Area.[122] These discussions have focused on two primary questions: (1) Is there sufficient international law to support the creation of MPAs in the high seas and in The Area? (i.e. Are there gaps in the international framework?), and (2) What mechanisms or methods can be used for creating MPAs?[123]

Coverage of the Framework

In the high seas, three types of legal coverage issues should be examined relating to the international framework – *substantive coverage*, *geographic coverage*, and *political coverage*.[124]

(a) Substantive coverage

Substantively, the primary provisions of UNCLOS, the CBD and other international instruments are sufficiently broad and comprehensive to encompass the creation of MPAs in the high seas or The Area. Coverage discussions instead focus on the need for additional detailed (regulatory-style) provisions to guide/mandate legal and practical actions relevant to MPAs, whether defined as such or in more general terms (measures for protection of the marine environment, *in situ* conservation, etc.). At the global level, instruments and processes have not yet been able to agree on such detail with regard to MPAs *per se*. Specific powers do exist, however, which might enable the layering on of additional protection for particular areas have been specified in some existing geo-located provisions (*i.e.* areas already subject to limits on maritime transport, mining and mineral-related operations, fishing, other use of marine resources, protection of particular species and habitats, and/or possible enforcement tools). As noted above some regional documents have begun to coordinate in this way.

Regarding specific issues, two primary areas relevant to MPAs in the high seas are currently perceived to be unaddressed within the international framework–

1) rights and responsibilities relating to the living resources of The Area,[125] or
2) declaration of protected areas in either the high seas or The Area.

Other open questions have been identified regarding the ability to develop legally valid criteria for site identification with regard to largely unexplored high-seas,[126] and the extent and nature of possible enforcement of MPA provisions in high seas and Area.

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[121] The high-seas and Area represent one element of the concerns of this paper, but are not the primary focus of this report or of the planned meeting. Accordingly, these issues are only briefly summarized in this paper.

[122] See, e.g. Kimball, *et al.,* 2005; Herriman, *et al*., 2002; Baker M., and de Fontaubert, A.C., 2001; Young, T., 2003, and Young, T., 2005.

[123] A third question (actually the first that must be considered) – the necessity of MPAs or other geo-located protections in the high-seas is a scientific, policy and socioeconomic question, rather than a legal one.

[124] To date, although a full legal analysis of these issues is still needed, a number of authors have provided initial analyses of one or more of these points, based on the texts of the various instruments and decisions of the Parties.

[125] Many of these issues are couched in terms of the "genetic resources of the Area," based on Article 15 of the CBD. This issue is not further discussed below. These matters are currently the subject of ongoing and difficult negotiations under the auspices of the CBD, (*See, generally,* CBD COP VII/19, UNEP/CBD/COP/VII/19, at part D) and have only a limited relevance to MPAs. Existing international marine law does not appear to address these issues. For a detailed analysis, *see* Young, T. 2004 "An Implementation Perspective on International Law of Genetic Resources: Incentive, Consistency and Effective Operation," in *Yearbook of International Environmental Law*, (Oxford Univ. Press), (general analysis, but mentioning marine matters), and Young, T., et al., 2006, in *Covering Access – Addressing the Need for Sectoral, Geographical and International Integration in Implementing the ABS Regime* T. Young, ed. (IUCN, 2006) (specifically addressing marine resources).

[126] Information deficiencies extend beyond the fact that over 90% of ocean areas have not been studied or even surveyed. For example, efforts to declare hydrothermal vents as MPAs must find a way to address the fact that vent fields are not permanent phenomena. Although the length of their continuation is not yet known, it is clear that they have a potentially predictable life

(b) Geographic coverage

Geographic coverage (the ocean areas to which each instrument applies) is usually specified in each instrument's text. UNCLOS, for example, is generally intended to cover all oceans, including enclosed and semi-enclosed seas. Some instruments (e.g. the FSA and Part XI Agreement) apply only beyond national jurisdiction.[127] Others (e.g. the CBD, CMS, IWC) focus on each country's use of its powers to regulate activities of its citizens and of vessels in the high seas.

Coverage at the regional level is more complex. Coverages sometimes overlap, while many other ocean areas may not be covered by relevant regional instruments.[128] Where a variety of regional instruments operate in generally the same area, their coverage areas typically vary from one another, so that a rather complex overlay pattern may emerge, creating geographic loopholes of various types.

(c) Political coverage

The most significant gap in the substantive coverage of the international regime of oceans is that of the political status of the instruments themselves. The most comprehensive legal instruments and frameworks relevant to high seas conservation (e.g. UNCLOS, the CBD, and MARPOL, and some other IMO instruments) have not been ratified by the United States, for example. Each global instrument is supported by a different mix of Parties (e.g. the United States has ratified the FSA, even though it has not ratified UNCLOS). Many regional instruments have been acceded to by only a small number of countries within the region.[129]

The patchwork of geographic and political coverage can operate as a restriction on action. Each instrument is entirely separate and cannot formally integrate. Coordination among instruments regarding a particular area can thus be difficult.[130] Consequently, although the substantive coverage of the international regime of oceans is clearly broad enough to support creation of high seas MPAs, guidance and some mechanism for coordination/integration of existing instruments seems essential. Where countries are not party to particular agreements relating to actions on the high seas, only a small number of principles of international customary law apply.[131]

(d) Other gaps

Like all international legal frameworks the international regime of oceans faces perennial problems regarding enforcement, implementation and coordination. These issues can have a very serious impact on MPA proposals, which depend on a high level of compliance across the range of users and potential users of the area. Few international instruments function to promote compliance or implementation.[132]

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span. Particularly in areas beyond national jurisdiction (in which protection must be negotiated internationally) it may not be worth the effort to protect such areas.

[127] The FSC includes a few provisions applicable within the EEZs of member states.

[128] *See* Kimball, L. 2000, which provides illustrative maps of the metes and bounds of most RFMOs, *and see* Appendix 3.

[129] In some cases, countries outside the region are allowed to accede to particular regional instruments.

[130] As noted above, for example, the IMO has so far refused to grant PSSA protection for the mouths of the Bonifacio Straits in the Mediterranean, despite acceptance by the countries with jurisdiction over the area. Chevalier, C., 2004.

[131] These principles are codified in UNCLOS as 'freedoms of the high seas' – a concept which imposes few restrictions on countries and vessels who use the high seas (for any purpose) in a peaceable manner, without endangering other vessels, installations or owned property, and without committing acts of violence or piracy. International customary law recognises a number of elements that have been codified in UNCLOS, however, many provisions of UNCLOS (including those relating to conservation and sustainable use) address 'new' issues not formerly a part of international maritime law, and thus not yet recognised as international customary law. MPAs and other geo-located protection provisions are among the latter.

[132] The WTO is the most successful example: WTO parties agree to abide by its tribunal, and the sanction of restricted or curtailed trade with other members – which does not require an enforcement body – is a strong disincentive. CITES has had similar success, using a similar disincentive (restricted species-related trade with CITES Parties, and international censure through public opinion). Lacking self-enforcing sanctions, other (voluntary) tribunals have been less effective.

Procedural issues – methods and mechanisms

With the exception of the Mediterranean, it appears that current global/regional provisions for creation of MPAs and permanent geo-located protective measures in areas beyond national EEZs can only be adopted by consensus.[133] This statement was disputed in the workshop, however, as currently written, it continues to reflect the results of the research for this report (including following the workshop).[134] To the extent true, this statement suggests that there may be little procedural or political difference between creating a binding framework before declaring a high-seas MPA and just negotiating a new instrument for each new protected area.[135]

Other options for the development of MPAs include:

- development of non-binding instruments (voluntary protections);
- layering various kinds of specific protections by different global and regional instruments and entities so that they all apply to the same geographically defined zone (cumulative protections); and
- agreement by individual countries to bind themselves to MPA designation immediately (incremental protections).

Under the third option Parties create an instrument that is only binding on them (its signatories). Signatory countries agree to require their citizens, entities under their jurisdiction, and vessels under their registry to comply with the protective measures for the designated area. This mechanism may be undertaken (i) by agreement among like-minded countries (even if only a small number of countries participate), without formal adoption by an international forum or negotiation, or even (ii) by declaration of a single country. Some of the CMS instruments appear to utilise this approach (ACAP and the various instruments governing marine turtles). Similarly, the four States that developed the RMS Titanic Agreement, are taking this approach, hoping that other countries will join in future.[136]

2.3.2 Gaps in the framework relevant to national MPA activities[137]

No global or regional instrument reviewed for this report *requires* that countries adopt MPAs or any other geo-located protective measures. However, many of these instruments (both global and regional) strongly *authorise* or *enable* countries to take such action, if they decide to do so in the exercise of their sovereignty.

More broadly, countries *have* firmly committed to:

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[133] The CCAMLR Commission also acts by consensus, however, the rules leave open the possibility that, in future, the Commission may not include all Parties to the Convention.

[134] Other participants in the workshop reminded the author of numerous RFMOs whose decisions are made on non-consensus bases (i.e. some decisions may be adopted by such RFMO over the objection or opposition of some Member countries). Following the meeting, the author researched the specific RFMO documents mentioned with a focus on this point. With the caveat that not all RFMOs allow members of the public to have access to their governing documents (including rules of procedure), the author searched for such power. No RFMO that she found *both* empowers its governing body (COP, MOP, Annual Meeting, etc.). to adopt specific provisions for long-term geo-located conservation measures (although this is a matter of interpretation, and can only be known by studying decisions taken by the governing body), and operates by non-consensus process with regard to those decisions. It is noted that this issue requires more detailed study, which should be commissioned through FAO or another body that has access to all relevant documents, to confirm or refute this initial conclusion.

[135] The development of site identification criteria will have a different role in international process than at national level. At national level, site criteria are often adopted to enable an administrative body to designate sites without returning to the legislative body. This result is unlikely in international law, particularly where sovereign rights (high-seas freedoms) are involved. Recent proposals focus on the creation of a high-seas MPA framework, either as a new and separate instrument in the form of an amendment to existing instruments. *See, e.g.* Kimball, et al., 2005. Presumably under these approaches, each MPA would be a protocol or formally adopted document under such a new framework. It is not clear how the framework would shortcut the negotiation and adoption of such individual documents.

[136] The Titanic Agreement will enter into force once two countries have ratified/acceded to it. This has not happened as yet.

[137] Please note that this section only examines the gaps in the international framework relevant to national legislation. National implementation experiences and issues are discussed in Part III of this paper.

(i) adopting appropriate measures for the protection, conservation, preservation and sustainability of the biological resources within their territorial seas, EEZs and OCSs, and

(ii) ensuring that the persons, entities and vessels under their jurisdiction comply with measures of other countries and international bodies, regarding other countries' territorial seas, EEZs and OCSs, as well as the high seas and the Area.

While many commentators view MPAs as an essential part of achieving these international objectives,[138] the decision about whether they are necessary rests with the country itself. Since each country's MPA decisions are matters of national sovereignty, the international framework's provisions for national MPAs focus on facilitating national implementation – on providing guidance and assistance, rather than imperatives. Legal gaps in coverage arise where international concepts are not clear, particularly as to matters affecting national rights or the relationship between countries, or between any country and the international bodies relevant to oceans and conservation.

Substantive legal coverage

Generally, the international framework recognises and supports States' sovereignty, and the shared objective of protecting the marine environment and resources within their jurisdiction. It is generally left to each State to decide whether it achieves these objectives through the use of MPAs or through other means. The exception to this generality is the WSSD Plan of Implementation which specifically calls for MPAs. Still open legal/systemic issues concerning the international framework's relationship to national MPAs, include:

- Rights of a State that has not asserted an EEZ, or has asserted partial EEZ powers and duties;[139]
- Protection of waters above a country's OCS, and/or the nature of the (horizontal) jurisdictional boundary between the OCS and those waters.[140] (Obviously, each country has the best access, knowledge and incentive to control and protect the waters above its own OCS).

Responsibilities of foreign citizens, entities and vessels

The most important contribution of the international framework to national MPA development and implementation is the fact that each country and its citizens and vessels must comply with requirements of other countries. UNCLOS's strong provisions for 'innocent passage' through waters under national control or oversight are balanced by provisions (also very strong) that countries must require compliance with other countries' regions' measures for protection of marine resources, including MPAs, restricted-use areas, shipping lanes, ballast water discharge zones (or prohibitions) or facilities. This should enable countries to take action against foreign citizens and vessels for conservation violations, and to demand that the country with jurisdiction over the defendants should support and enforce those actions. These provisions have been applied through the International Tribunal on Law of the Sea (ITLOS), as well as in national courts, and could well be applied to MPAs.

The primary gap in this connection is the lack of a reliable penalty/incentive system that can be applied where the violators' country will not take action or submit to the jurisdiction of the ITLOS. Ultimately, the resolution of this problem may require additional legal instruments, however, the primary obstacle preventing such action is probably political.

[138] Allison, G.W., et al. 1998.

[139] For the present, it is common to consider these areas to be part of the regime of the high seas. Scovazzi, T., 1999, Chevalier, C., 2004.

[140] Although the OCS is fully controlled by a single State, the superadjacent waters above it are part of the high seas and therefore under the control of all States. OCS rights consist solely of "the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil." UNCLOS, Article 77.

Guidance for the creation and implementation of MPAs
The international framework also provides mandates for the creation of guidance documents, technical assistance and other mechanisms which can share experiences, new concepts, best practices, and other tools.[141] Such mechanisms can support integration and synergies among international instruments (which, as noted above, is very difficult at the global/regional level) through national implementation. Unlike formal decisions of Conventions and other instruments, guidance principles and other tools can (and will usually be required to) be developed with the goal of synergistic implementation and compliance of as many relevant instruments as possible. At present, many international processes call for such guidance, suggesting that this issue is not really a gap, but rather an 'as-yet-uncompleted mandate." For example, OSPAR has undertaken serious work toward the creation of guidelines and an implementation plan for the identification and establishment of MPAs throughout its coverage area.[142] In the early steps of implementing these decisions, OSPAR has already compiled lists of threatened species and habitats.[143] These documents have been discussed in other bodies' international meetings as possible starting points for the development of global guidelines and standards.[144]

Networking
Increasingly, international processes provide significant forums for networking of technical and administrative experts, sharing experiences, needs and requirements.[145] These provisions also promote cross-border coordination and the development of informational databases, analysis of broader issues such as representativity and the need for a network of protected areas. In particular, Agenda 21, and especially the targets and objectives stated in the WSSD Plan of Implementation are directed towards networking national efforts that contribute to international environmental objectives. In this connection, there are several possible gaps, such as the needs for:

- official mapping of biomes and spatial distribution factors, as well as of geo-located protections, and providing a basis for integrating national measures into such mapping process; [146]
- guidance for biome-specific application of the precautionary principle in the context of geo-located conservation measures,[147] and
- mechanisms for the involvement of stakeholders in marine resource management decisions.[148]

These issues continue to be difficult and somewhat controversial in many biomes and frameworks, and generally require specific provisions for application in each.

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[141] *See, e.g.* CBD-COP Decision VIII-24, paras 29-34 and 38 (2006).
[142] OSPAR Strategy on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area. IMO has also adopted, and is revising Guidelines for the identification and Protection of Special Areas and Particularly Sensitive Sea Areas. Resolution A. 720(17).
[143] Id at Paragraph 2.2, *and see* 2004 Initial OSPAR List of Threatened and/or Declining Species and Habitats (adopted in OSPAR 2003 and updated in 2004), Reference Number: 2004-06.
[144] Meeting documents, CBD Ad-hoc Working Group on Protected Areas, Montecatini Italy, November, 2005.
[145] Programmes of work under the CBD and CITES, and operational guidelines under the WHC provide detailed examples of the manner in which they can contribute to the international process, and to synergies among international instruments.
[146] *See, e.g.* CBD-COP Decision VIII-24, para 44(c) (2006).
[147] *See* Korn, H., S. Friedrich and U. Feit, *Deep Sea Genetic Resources in the Context of the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea.* (BFN – Skripten 79, 2003), proposing that "The new user of a resource has to prove that the intended uses will not cause severe damage to the resources." This approach appears to have as its inception, the precaution language from the Code of Conduct on Responsible Fisheries (Section 7.5): *If a natural phenomenon has a significant adverse impact on the status of living aquatic resources, ... [and] where fishing activity presents a serious threat to the sustainability of such resources, States should adopt conservation and management measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impact.* (CCRF, § 7.5.5, slightly reorganized). However, as shown in Cooney, R., 2005, the actual meaning and application of this language is particularly difficult in the resource management process and needs further elucidation.
[148] Often, a large percentage of the primary users of marine areas (beyond those closest shore) have little tie to the country.

3. NATIONAL LEGISLATION FOR MPAs

Under the Terms of Reference (TOR), the next tasks of this Report focus on national legislation authorising the creation and operation of MPAs. The TORs envision two parts of this work – (i) brief exposition of experiences relating to the development of legislation (at national and regional levels, including RFMOs) to implement MPA objectives at national, bilateral and multilateral levels, and (ii) discussion of useful legal options that have been used or proposed for addressing MPA development. Owing to the limitations in the size of this paper, and the substantive difficulties involved in presenting legislative experiences in a way that ensures their usefulness, [149] the author has decided to merge these two elements. This section provides a single discussion of national legislative measures and systems, illustrated with examples from the author's review of national legislation undertaken in the preparation of this Report. [150]

This discussion will be focused through the objectives of MPA creation, and will consider:

- effective legal options for achieving those objectives; and
- the areas in which guidance can assist the legal work of MPA development.

The contents of this section are strongly guided by the author's belief and experience that legislation must be crafted to the particular situation of the individual country (or other jurisdictional unit that will adopt the law), and that it is not productive to adopt specific generalisations about what all countries should do to maximise legislative effectiveness. Hence, these examples are offered to provide some object-oriented basis for the development of legal guidance, rather than as "models."

3.1 MPA legislation – crafting a system to address national needs

At the national level, legislation for the development of MPA systems is or should be a relatively straightforward (although certainly not simple) task. The primary obstacles and challenges of MPA creation and implementation are practical in nature; hence, legislation can be a tool to enable action, to eliminate impediments, or to clarify rights and interests, but cannot bring about conservation or protection of anything.

The process of drafting and negotiation of natural resources and conservation legislation is highly individualised. Among the more than 200 national governments on the planet, it is not possible to find two that are sufficiently alike for purposes of national legislation. Hence, no matter how common the topic is, one will usually find many very different approaches among functionally effective national systems. This can create a problem for the development of guidelines.

Moreover, successful development and implementation of a law is rarely linked to textbook perfection of its drafting. Instead, functional and effective legislation is "situational." The difficulty is not in being able to draft proper legislative provisions, but to design legislation that addresses national needs, requirements and problems, and can operate effectively. In drafting or negotiating MPA legislation, success depends on how completely the drafter understands five factors:

(i) What is required (by national law and under international commitments)?

(ii) What is desired by the body seeking to adopt or propose the legislation?

(iii) What particular problems with current law or related laws have been noted?

(iv) What stakeholders are involved, and what interests or incentives might apply to them?

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[149] The concept of "legal case studies" is highly complex, owing to (i) the number of factors (political, practical, social and economic) and sectors whose input re-shapes legislative situation, (ii) the time between drafting and final implementation, and (iii) the difficulty in measuring progress and/or ascribing particular results to particular legislative choices.
[150] See Specialised Bibliography and Appendix 2.

(v) How do existing relevant agencies and authorities function, and what factors appear to increase their effectiveness within the system?

The challenge for the draftsman of MPA legislation is not in perfect drafting of 'model' legislation, but in discerning what is needed, and crafting the relevant instruments so that they address these five factors, operate in an integrated manner that is consistent (both internally and with other laws), and (where possible) can adjust or evolve to address needs that are found by experience, newly arising problems, and alterations in the physical area involved.

3.1.1 National commitments and obligations

Although, as noted above, international law does not impose specific obligations on a country to create MPAs, several instruments require them to take measures to protect, preserve, conserve and/or ensure the sustainability of marine natural resources, and to ensure that persons, entities and vessels under their jurisdiction comply with measures adopted by other countries. While many commentators view MPAs (and other geo-located conservation measures) as essential for achieving these international objectives,[151] the decision about whether they are necessary rests with the country itself. Accordingly, international law provides guidance rather than imperatives regarding MPAs.[152]

UNCLOS's ocean zones, and its provisions regarding the rights of countries within those zones, are very important to national legislative development. These provisions clarify the rights a country may take with regard to these zones, however, but do not require that a country accept or exercise all of these rights. For example, many countries have chosen to formally adopt only a limited set of rights and responsibilities in their EEZs – i.e. creating only a "fisheries zone"[153] or an "environmental protection zone"[154] rather than a full "exclusive economic zone." Some do not extend to 200-miles. [155]

With regard to their marine resources, including resources of the OCS, it is important to distinguish between countries' powers and their duties. Powers (including the right to exert controls on the taking of biological and mineral resources) are not mandatory. Duties, however, *are* generally mandatory. The UNCLOS and CBD mandates to promote conservation, preservation, protection and/or sustainability of marine resources are duties. In choosing how to meet this obligation, States' powers include the possibility of designating areas for protection (limited or complete) or for other purposes.

3.1.2 Legislative objectives

At the national level, the primary basis for action is the objectives and desires of government, and through it, of the people, often enumerated in formal policy. Typically, legislation is developed around one or a series of these objectives and needs. Protected Areas legislation, for example, may be spawned by intense interest in protecting a specific area or addressing a particular problem. By choosing to adopt a framework of legislation, however, the parliament may perceive one or more broader objectives, such as conservation, protection of threatened areas, tourism, etc. as pre-eminent.

In many cases, however, national legislative objectives have a 'second line' of basic conservation objectives, that specifically indicates their relationship to other national priorities. For example, protected areas law may be limited by the words "without causing undue interference in existing commercial operations" or "while recognising the special rights of coastal residents (or indigenous

[151] Allison, G.W., et al. 1998.
[152] Sometimes, countries create obligations which allow international entities to require MPA declaration and maintenance. For example, the Great Barrier Reef Marine Park in Australia is the subject of two international commitments – most of the Park is listed as a World Heritage Area under the WHC, and it is also a PSSA under the IMO system.
[153] *See, e.g.* ALGERIA, Legislative Decree of 28 May 1994, at Art. 6; SPAIN, Royal Decree no. 1315/1997, modified by Royal Decree no. 431/2000.
[154] *See, e.g.* FRANCE, *Zone de Protection Ecologique*, created by decree no. 2004-33 (J.O no. 8 of 10 January 2004, at 844, and CROATIA, Zone of Ecological Protection and Fisheries (3 October 2003).
[155] *See, e.g.* SPAIN, Royal Decree no. 1315/1997, cited above.

communities)" or "while recognising the interests created under pre-existing EEZ agreements." In some cases one or more particular concerns (either positive or negative) will predominate.

This is exemplified in Tanzania's Mafia Island Marine Park (MIMP). Although designated as a marine '*park'* a term which in Tanzania is integrally connected to tourism, at the time of its creation the MIMP's objective was not primary tourism. Commercial fishing, community participation, livelihoods and critical habitat protection are much more central to its creation and operations. Consequently, its (community) management processes focus on use issues, with notable success in addressing key abuses, to wit: Elimination of dynamite fishing; demarcation and implementation of a protection zone in Chole Bay; and a gear-exchange scheme to remove seine nets.[156]

3.1.3 Nature and source of particular problems or concerns

In most instances, countries will already have some legislation related to conservation and/or sustainable use in marine areas, but will have determined that it is not sufficient to meet their needs in the designation and implementation of MPAs or other geo-localised measures. Determination of the underlying cause of this conclusion, and the extent to which legislation can resolve them is one of the most difficult elements of legislative development. Typically, the nature of the problem can be:

- institution selection and organisation (the choice of agency/ies, ministry/ies or other legal units assigned to the task, the effectiveness of inter-agency collaboration);
- constitutional/procedural issues (mechanisms for due process, transparency, equal protection, and public participation, that balance governmental obligations regarding public resources to be met);
- empowerment (authorisation of appropriate persons or entities to oversee various aspects and/or to take necessary actions);
- structural concerns (ensuring that legal provisions are appropriate and acceptable under national legislative practice, and divide properly between primary legislation (statutes and ordinances) and secondary legislation (regulations and rules);
- jurisdictional issues (between MPA laws and other laws, ministries, or mandates);
- functional factors (capacity and empowerment of agencies, tools and mechanisms);
- finance (budgetary support, and supplementing it through fees and other sources); and
- evidentiary problems (standards of proof and documentation for administrative and legal actions, and the capacity of relevant officials to meet them).

Examples of legislation drafted to address these factors are found in a wide range of countries. Available literature does not provide a basis for determining if the change in legislation actually resulted in alleviation of the problem. Often, assumptions are made about the source of the problem without full investigation. For example, attributing a problem to the choice of the wrong agency may overlook the fact that the budgetary allotments are insufficient (so that any designated agency would be unable to fulfil the mandate), and that the country does not possess the necessary equipment or other capacity to implement existing laws. In many instances, the above problems will not be "solved" through legislation, although legislation may be one component of resolving the problem.

One useful example, however, is found in Germany. Prior to 2001, the selection of German MPA sites was legally possible only within the territorial sea, and the relevant decision rested solely with the states (Länder) responsible for the particular site. It was claimed that this structure prevented Germany from meeting its NATURA 2000 obligations in the marine areas of the German EEZ. In April 2002, the relevant law was amended, establishing a statutory basis for federal declaration, giving the German Federal Agency for Nature Conservation (BfN) within the German Environment Ministry (BMU) full

[156] From official website (http://www.mafia-island-tanzania.gold.ac.uk/ecology/) supported by the IUCNWCPA-Marine/WWF's MPA management effectiveness project (described at http://effectivempa.noaa.gov/sites/mafia.html)

responsibility for selecting, designating and managing EEZ protected areas.[157] Germany has now successfully designated MPAs covering far more than 10% of its territorial sea and EEZ.

3.1.4 Stakeholders and incentives

Natural resources management (NRM) and conservation are processes that involve both government and various non-governmental stakeholders. In many cases, NRM and conservation laws are designed to regulate and control commercial and other private use of resources. Given the expense and difficulty of patrolling and other direct oversight, it may be impossible to implement these laws through direct government supervision. The alternative would be to enquire into the underlying objectives of various stakeholder groups and to attempt to design incentives that encourage compliance.

This process may take the form of the development of, for example –

- tax benefits, streamlined processes for license renewal and other benefits provided to users who are able to document their compliance;
- certification systems that enable the user to get access to particular markets or buyers, or to obtain a premium price or other benefit; or
- voluntary codes, tied to clear promotional information explaining the benefit to the individual user, the stakeholder group or the wider community that will arise from compliance.

Another, less frequently addressed issue relates to the unintended or perverse incentive arising out of the designation of an MPA. Often, MPA designation is proposed as a tool to curtail certain activities that are harming particular feature – e.g. to prevent bottom trawling which is damaging cold-water corals. However, given that many such ocean features are not yet fully mapped, the designation of an MPA in an area already damaged may operate only as an added incentive to the fisher to find and exploit another cold-water coral site, before it can be officially identified and protected.

3.1.5 System design

One critical factor affecting legislative development is the design of the institutions and processes of MPA governance. This task involves a combination of factors, including integration of new concepts and structures with the functional approaches and systems currently in use. In this connection, it is essential to consider a range of relevant legal frameworks operating within the country, to determine how they function, how they collaborate with other sectors, how governmental responsibilities are divided, how conflicts between legislative enactments are resolved, and other questions.

Often one of the best tools for structural dev development is the comparison among natural resource administrative systems from various ministries. It may be useful to engage in significant research and analysis regarding institutions and systems operating in other sectors, to determine which systems function best, and attempt to identify the particular structural and other factors behind their success.

3.2 Guidance and experience with particular legal options and components

As noted, the actual drafting of legislation addressing MPAs or other kinds of geo-located measures is not unduly difficult or challenging. The greatest challenges of the legislative process are system design – (i) to address the five components described above in an integrated and internally coordinated manner; and (ii) to identify and respond to the unique elements of the marine biome (as compared with terrestrial ecosystems) which alter their administration; and (iii) to focus on outcomes.

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[157] GERMANY, Federal Nature Conservation Act (Bundesnaturschutzgesetz, BNatSchG), art. 38

In developing guidance for MPA legislation, it is necessary to consider a list of key legislative elements, and a range of options and of factors that might be useful in selecting among them, rather than promoting specific choices. The following sections discuss a number of key elements that must be considered in drafting national MPA legislation, and suggest some of the possible options for each element, illustrated with examples from national implementation. It attempts also to provide some ideas and suggestions regarding criteria that may affect the selection among options.

3.2.1 Institution(s): selection and authorisation

The nature of the institutions designated to manage MPAs, and the manner in which they operate or coordinate is obviously a key concern for any MPA framework. In identifying and addressing the causes of pre-existing problems or system failures, it is common to identify the institutional framework as the source of the problem. However, generalisations about these issues should be avoided, and institutional development should be guided by national situation and experiences.

Two primary institutional approaches are possible – (i) the development or authorisation of a single, unitary body with responsibility for MPAs (and/or other geolocated marine protective/conservation measures) or (ii) distribution of these responsibilities among multiple institutions. On the surface, this is a choice or spectrum running from maximising internal consistency (the unitary approach) and maximising expertise in management (allowing each agency to act in the areas in which they are expert). In fact, however, the choice will depend on many factors, including past experience regarding the effectiveness of inter-agency cooperation, the specificity of each agency's existing expertise on relevant issues, questions of continuity and many other political and social issues.

In practice, a truly unitary approach is almost impossible. Virtually all MPA institutions involve at least some level of distribution. For example, the Great Barrier Reef Marine Park in Australia, although primarily under a single relatively comprehensive governing framework still recognises the role of sectoral agencies.[158] In addition, although most of its area is under Commonwealth jurisdiction, some parts of the Park are specifically under jurisdiction of the State of Queensland.[159] These separate authorities are fully linked into the planning and management processes of the GBRMP, through a detailed regulatory system for the development, implementation and regular reconsideration of the GBRMP's Strategic Plan.

By contrast, in Tanzania, responsibility for the marine protected areas was contested between the Fisheries Division and other agencies responsible for protected areas and wildlife conservation.[160] In the end, although the initial marine protected area to be designated (The Mafia Island Marine Park) includes entire islands and many of its provisions focus on tidelands and other areas very near shore

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[158] Domestically, at the Commonwealth level, the GBRMP is governed by three laws addressed (only) to the GBRMP. (AUSTRALIA Great Barrier Reef Marine Park Act 1975; Great Barrier Reef Marine Park (Environmental Management Charge-Excise) Act 1993; and Great Barrier Reef Marine Park (Environmental Management Charge-General) Act 1993). Three Commonwealth regulations govern operational matters including management planning, permits, compulsory pilotage, mining/extraction restrictions, aquaculture controls, and general administration. (AUSTRALIA Great Barrier Reef Marine Park Regulations 1983; Great Barrier Reef Region (Prohibition of Mining) Regulations 1999; Great Barrier Reef Marine Park (Aquaculture) Regulations 2000). In addition to these, the GBRMP is also subject to more general Commonwealth laws of specific relevance, including laws governing biodiversity/species conservation, cultural heritage, pollution prevention, indigenous rights, and other ocean-based activities ("sea installations.") (AUSTRALIA Environment Protection and Biodiversity Conservation Act 1999; Environment Protection (Sea Dumping) Act 1981; Historic Shipwrecks Act 1976; Native Title Act 1993; Protection of the Sea legislation; Sea Installations Act 1987).

[159] *See,* AUSTRALIA (Queensland) Coastal Protection and Management Act 1995; Environmental Protection Act 1994; Fisheries Act 1994; Integrated Planning Act 1997; Marine Parks Act 1982 and Marine Parks Act 2004; Native Title (Queensland) Act 1993; Nature Conservation Act 1992; Transport Operations (Marine Pollution) Act 1995; Transport Operations (Marine Safety) Act 1994; Workplace Health and Safety Act 1995. All statutes referred to in this and the previous footnote obtainable from the GBRMPA website at http://www.gbrmpa.gov.au/index.html.

[160] TANZANIA, Marine Parks and Reserves Act, 1994 (Act No. 29 of 1994); *implemented by* Marine Parks and Reserves (Declaration) Regulations, 1999 (G.N. No. 85 of 1999); *and see,* Young, T., *Legal and Administrative Assistance Regarding the Management of Marine Resources and the Proposal to Establish and Manage the Mafia Island Marine Reserve* (FAO, 1991-92, two reports).

(and thus very similar to terrestrial PAs), the government chose to create a separate law and institution within the fisheries Division as the primary management body. This choice was apparently driven by a high level of operational (and legislative separation) among departments within the Ministry of Tourism, Natural Resources and Environment, and the Fisheries Division's existing expertise and involvement in the primary issues of greatest importance.

Legislatively, it will be essential to determine the limits of MPA jurisdiction (or the division of responsibility among relevant agencies) in a way that ensures that there are no unintended gaps in overall governance of marine matters, and that there is a basis for determining involved agencies' mandates in areas of overlap.[161] One approach to coordination involves the creation of one or more supervisory, advisory, or oversight bodies. Very commonly, such a committee may be created including a representative of the relevant sectoral and cross-sectoral governmental agencies. Difficulties arise in considering whether the members of the Committee are:

- specific individuals (ensuring continuity, but creating additional procedural problems when the individual moves to another ministry);
- specific, high-level officers, by position (theoretically ensuring that agencies' decision-makers are aware of MPA issues and inter-agency agreements, but practically making it difficult to have full attendance at meetings, due to the time demands on officials at this level); or
- designated by the head of each named agency (ensuring that each agency is represented at each meeting, but potentially limiting continuity and possibly also minimising awareness of the Committees actions and agreements by other agency members).

All of these options have been used in various legislative instruments,[162] however, it is not really possible to identify one approach as 'best.' Similar questions arise regarding the inclusion of the private sector and members of the public in such oversight committees. Here the main options are inclusion as full members, inclusion as observers, creation of a separate 'advisory committee' which reviews proposals and advises the oversight committee about them, or inclusion only through formal public participation processes. Here also, the selection of options depends on the national situation, with all these (and probably other) options having been adopted by various countries.[163] In many countries, oversight committees are also established at the local level, for each MPA.[164]

One final institutional point which must be mentioned is that of community management. A high-profile issue in other Protected-Area contexts,[165] community-management is a far more difficult concept for MPAs. Direct community management can be difficult, particularly as the distance between the MPA and the shoreline increases. In part this may reflect the complexity of the subject matter, the lack of relevant equipment, the need to address the interests of other stakeholders (fishing vessels from outside the area, the international nature of ocean governance, or other factors.

3.2.2 Procedures and civil protections

One of the most 'legal' areas of legislative drafting is the protection of the civil, human and procedural rights of people involved in or affected by the MPA. These issues are closely governed by primary and organic laws of each country, but are also generally based on internationally accepted principles such

[161] This latter need must generally be addressed by negotiation among the relevant agencies and their various instruments, rather than a simple statement in the new law that it predominates over all other laws on these issues, given that this provision is often found in all legislation, wherever an unresolved problem of gaps and overlapping mandates exists among ministries or agencies. See also *Legal and Administrative Assistance* (1991-92), cited above.
[162] See, e.g. TANZANIA, Marine Parks and Reserves Act, 1994 cited above, and related reports; SEYCHELLES, Fisheries (Amendment) Act, 2001 (Act No. 2 of 2001).; Maritime Zones Act, 1999 (Act No. 2 of 1999); Environment Protection Act 1994 (Act No. 9 of 1994); and Young, T., *Legislation and Institutions for Marine and Terrestrial Biodiversity Conservation and National Parks in the Seychelles* (FAO, 1992-93)
[163] *See, e.g.* SEYCHELLES, Proposed Marine Conservation Act, 1994 (creating a separate committee with advisory powers)
[164] TANZANIA, Marine Parks and Reserves Act, 1994 cited above, and related reports
[165] *See* documents of the 5th IUCN World Parks Congress (2003). http://www.iucn.org/themes/wcpa/wpc2003/index.htm.

as the rights to "due process of law," "equal protection under the law," transparency, and public participation. In addition to protecting the rights of those affected by the MPA, these principles also protect the more general right of citizens to expect their country to protect natural resources, obtain a fair return from their use, and use those proceeds fairly for legitimate governmental purposes.

Key elements of the legislation will include detailed and transparent processes and standards for

- Identifying, declaring and implementing MPAs;
- Addressing the possibility of de-commissioning MPAs where significant national interests require, or where the site conditions change, due to human factors (such as global warming), natural conditions (such as the end of the 'life-cycle' and eventual disappearance of a protected hydrothermal vent), and unexplained problems (such as coral bleaching).
- applying for and obtaining concessions and licenses;
- ensuring appropriate public involvement in relevant decisions; and,
- protecting the civil rights of stakeholders and others impacted by MPA decisions, by providing rights to
    - appeal or challenge decisions;
    - contest enforcement actions; and
    - have access to information, decisions and discussions.

In addition, it is necessary to address more specific protections and concerns regarding the livelihoods and other interests of marine communities and/or traditional users of the resources. Legal problems in these cases include a limited risk of challenge under the WTO, and potential prevention or delaying of commercial use where the local or traditional communities bring action.

Increasingly, the role of the public in legislative drafting is difficult and controversial. A number of options for public participation exist. While relatively straightforward in developed countries, these processes present greater difficulty in developing countries, where affected communities may also be the ill-equipped to participate in governmental meetings. A detailed example of the application of participation mechanisms in a developing country's MPA process is found in Tanzania's Mafia Island Marine Park, where large multi-day public meetings were held bringing together all relevant government agencies, commercial stakeholders, NGOs, parliamentary representatives, scientists, and a "representative" selection of representatives of local communities.[166]

One of the most important components of public participation is the identification of a representative list of local residents, and assistance in their participation. In the Tanzania example, it was noted that geographic representivity (representatives, including village chiefs, from all affected islands) was not the only important factor. It was also important to get the views of local fishermen, women's collectives who earned money by collecting, drying and selling octopus, entrepreneurs who were collecting and burning coral for lime production, and other groups. Local and artesanal fishermen who did not live within the marine park area (from mainland communities) were also represented. As a consequence of this breadth, many particular kinds of assistance were needed to enable participation, including language assistance, opportunity to ask questions on a one-on-one basis, and special encouragement to each group to provide their own perspectives, even when it differed from those of higher level local officials.[167] Standards for determining whether a meeting is 'representative' and for ensuring that all views are heard require different processes and more detail in these situations.[168]

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[166] *Described in* Coughanowr, C., M. Ngoile & O. Lindén, "Coastal Zone Management in Eastern Africa Including Island States," in Ambio, v. 24, n. 7-8 (1995); Andersson, J., and Z. Ngazi, "Marine Resource Use and Establishment of a Marine Park," in Ambio, v. 24, n. 7-8 (1995).; and Young, T., (1991-92), footnote 149, above,

[167] This need was extremely important with the women's collectives who were relatively shy about expressing their positions.

[168] Young, T., "Legislative proposal Regarding the Management of Marine Resources in the Proposed Mafia Island Marine Reserve and Provision for Future Additional Reserves" (FAO, August 1992)

In developed countries, participation provisions often result in significant change to operational parameters, sometimes creating *de facto* partnerships between government and stakeholders. For example, Australia's GBRMP Authority, in light of its symbiotic relationship with touristic service providers, has adopted a "Marine Tourism Contingency Plan," which "recognises that environmental incidents, such as cyclones and oil spills, which severely degrade the quality of a tourism site may damage not only the reputation of the Great Barrier Reef but the health of the marine tourism industry." Under this plan, the Authority assists with temporary relocations for affected tourism operations, to ensure that they do not suffer economic hardships during recovery

Another key public participation issue relates to stakeholders from outside of the country. In many countries, the main fishing interests operating in the EEZ are foreign nationals and/or vessels operating under foreign flags. Many (perhaps most) of these vessels or individuals are acting under specific governmental agreements and/or licenses. However, it is often difficult under national law to develop, adopt and enforce participation requirements to enable these stakeholders to protect their interests in national decision-making relevant to or affecting their activities in the EEZ.

Public participation requirements are starting spread to a broader variety of legal actions and decisions. Earlier, participation laws focused only on management plan development and hearings for licenses and variances. Increasingly, however, public comment and participation requirements are increasingly applied from legislative development through evaluation and closure.

3.2.3 Specific duties, restrictions, controls and processes

The enunciation of the particular required, prohibited, controlled, and permitted actions within an MPA is an interesting combination, linking technical/scientific/practical needs with legal concerns such as evidence, enforcement, and due process. Some of the most important technical-legal issues focus on the manner in which scientific and modelling data will integrate with protective measures. Regarding MPAs, this issue is most relevant to zoning and planning processes. Although some geo-located protective measures do not call for zoning (where strict measures apply fully throughout a precisely described area), formal MPA legislation normally either allows or requires zoning. In Canada, for example, one MPA law specifically requires that all MPAs must have at least one strict conservation zone and at least one sustainable utilisation area.[169] Effective zoning may also be created by 'layering' more specific geo-local protective measures, including requirements for integrated coastal and marine planning, and controls on fishing, pollution and discharges from ships, minerals exploration and species/habitat destruction.[170] There are several approaches to planning and zoning.[171]

There are also new approaches to focusing marine protective measures. For example, a 2005 decision of the General Fisheries Commission for the Mediterranean (GFCM), designed to prevent harm to the geological and biological structures of the seafloor, calls on GFCM Members to 'prohibit the use of towed dredges and trawlnet fisheries at depths beyond 1 000 meters.'[172]

Legislative draftsman focus greatest concern on the manner in which provisions will be enforced. For example, if enforcement will be based on visual, radar or satellite surveillance, the law must specify the requirements imposed on vessels and users (VTS) and specific statements about when and how one

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[169] CANADA, National Marine Conservation Areas Act, R.S.C. 2002, c. 18

[170] One example of all of the above within a single country is found in Canada. *See* respectively Oceans Act, R.S.C. 1996, c. 31, s. 4(1); Fisheries Act, R.S.C. 1985, c. F-14 (these provisions are not generally geo-located, however the wording of the legislation indicates that they may be applied in that way); Coastal Fisheries protection Act, , R.S.C. 1985 c. C-33; Collision Regulations, C.R.C. c. 1416, whale-strike reduction objectives described in *Transport Canada Press Release* AO17/02, Dec. 19, 2002, online at: http://www.tc.gc.ca/atl/marine/fundy_20021219.htm; Environmental Protection Act, 1999, R.S.C. 1999, Part VII, Div. 3; Shipping Act, R.S.C. 1985, c. S-9, *updated by* Canada Shipping Act 2001, S.C. 2001, c. 26 (in force as soon as regulations are adopted, expected 2006); *generally* (viz marine oil and gas exploration), Environmental Assessment Act, R.S.C. 1992, c. 37; Migratory Birds Convention Act, 1994, R.S.C. 1994, c. 22; *and* Species at Risk Act, R.S.C. 2002, c. 29. Although not stated directly, many of these laws appear to contemplate some implied vertical zoning (focusing protection provisions on activities affecting benthic or pelagic fish, for example).

[171] *See, e.g.* NEW ZEALAND, Guidelines for creation of MPAs, TANZANIA, Marine Parks & Protected Areas Act, 1993.

[172] GFCM, Report of the 29th Session, at page 38.

may enter an MPA, so that data from surveillance alone will be sufficient to create a basis for action -- a *prima facie* case which the vessel must disprove. It must also consider that some violators cannot be identified solely from surveillance data, and satisfy "due process" principles, including:

- ensuring that vessels have access to data about the restrictions and the restricted areas apply;
- identifying those vessels and users who may be exempt from these requirements (indigenous traditional fishermen, for example) and justifying those exemptions;
- ensuring that the shift of the burden of proof (requiring the user/vessel to prove that his action was legal, once the *prima facie* case is established) is valid and not a denial of civil rights;
- creating standards for the satellite evidence – requiring that it be is sufficiently detailed and clear to demonstrate not only location, but violation of the law, etc.

In many cases, the most effective draftsmen focus on what may be proven. For example, a prohibition on capturing marine turtles may be more difficult to enforce than one which punishes possession, sale, or purchase of marine turtles or their parts. The latter can be proven by illegal material found on the person, vessel, vehicle or private property, or on the market. By contrast, to successfully enforce a prohibition on capture, the arresting officers must have seen the actual capture. Similarly, in marine protected areas, it may be easier to enforce a provision limiting the possession of certain kinds of fishing equipment within an MPA than one which prohibits 'fishing in an MPA."[173]

3.2.4 Additional concerns in deeper water

Nationally and internationally, discussions are increasingly focused on the designation of MPAs in deeper waters (EEZs, the OCS, waters above the OCS, the high seas and the Area). For these zones, it may be necessary to develop new types of legal tools (hard and soft), based on different paradigms.

Within EEZs, a limited number of MPAs have been declared, but so far, most of these have been by developed countries.[174] It is not entirely clear why EEZ-MPAs have not generally been declared in developing countries, however the author suggests a combination of (i) lack of capacity/infrastructure to oversee/enforce, and (2) the fact that the prevailing administrative and legislative approach to MPA description does not appear to apply to deeper water. Specifically, in developing countries (and some developed countries as well), the primary model of the "Marine Protected Area" continues to be a watery version of the terrestrial protected area – the limits of the area, and of zones within it are platted on a map by "metes and bounds" descriptions, for example, and regulations apply to everything from the surface to the seabed. This is most operable where the protected area is near shore (perhaps to the limits of territorial seas) – that is, within the range of most current MPAs.

This point is partially demonstrated by examination of the implementation of Canada's two MPA laws.[175] The purposes underlying MPAs in the Oceans Act are generally focused on marine issues and sustainability concerns; by contrast, the purposes (and level of protection) of MPAs under the National Marine Conservation Areas Act have been described as "more analogous to that of a [terrestrial] national park (though not as complete)."[176] As such, the NMCAA's authority has been utilised solely within territorial seas, with the Oceans Act used for EEZ areas. Comparing these two as general prototypes with national MPA legislation from developing countries, it is clear that the

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[173] SEYCHELLES, Environment Protection Act 1994 (Act No. 9 of 1994); Proposed Marine Conservation Act, 1994; and Young, T., Legislation and Institutions for Marine and Terrestrial Biodiversity Conservation and National Parks in the Seychelles (FAO, 1992-93)

[174] *See,* CANADA, Oceans Act, R.S.C. 1996, c. 31, s. 4(1). Some of the more prominent such areas include the Bowie Seamount, the Endeavour MPA, including the Juan de Fuca Ridge (hydrothermal vents), and the Gully (a deep canyon area, habitat to many marine species, including whales; NORWAY, lophelia banks; PORTUGAL, Dom João de Castro Seamount in the Azores (*see* http://www.joel.ist.utl.pt/dsor/Projects/Asimov). In addition, the Seychelles has imposed stricter conservation/sustainability motivated controls on fishing in all its EEZ areas. (Personal communication with Randolph Payet, Ministry of Fisheries).

[175] CANADA, Oceans Act, R.S.C. 1996, c. 31, s. 4(1); and National Marine Conservation Areas Act, R.S.C. 2002, c. 18

[176] Breide, C., and P. Saunders, 2005, at 70.

developing country laws examined are similar in nature, objectives, terminology, approaches and mechanisms/methodologies to the terrestrial-protected-area approach of Canada's National Marine Conservation Act.[177] This suggests that developing countries may need assistance in legislatively identifying and addressing the aspects of MPA law and practice that are different from terrestrial PAs.

Some new approaches to deep water MPAs have been proposed, however. For example, in at least two cases, single-country MPAs have been proposed where the MPA boundaries include waters within the high seas (usually superadjacent to the country's OCS).[178] Another approach, described above, is the negotiation among two or more countries, who agree to consider an area of the high seas to be protected.[179] Under both of these options, the country or countries involved agree to recognise the designated area(s) as MPAs and to take legislative and other measures to require persons, entities and vessels under their jurisdiction to recognise the MPAs and comply with restrictions and regulations that will be developed. These measures do not, in themselves, place any obligation on other countries, persons and vessels, to recognise the MPA or comply with its terms. However, the designation may trigger the requirements of UNCLOS, which call upon countries to "refrain from unjustifiable interference" with marine conservation and other measures adopted by other States.[180]

3.2.5 Penalties, fees, assessments and other requirements

A problem common to many countries is the difficulty in assessing penalty and other charges to deter violators and to provide the level of funding needed to repair or compensate for the damage caused by violations. In many cases, fines and penalties can only be set by primary legislation, hence a long and complex legislative process will be necessary to revise these amounts. In some cases, fees for services, licenses and concessions can be set by the administrative body without going to Parliament, but this is not universally true.

Two primary related problems here are (1) ensuring that the penalties and assessments are large enough that they deter illegal behaviour, including by foreign persons or vessels whose financial resources are larger and might be undeterred by penalties directed at local users; and (2) creating a basis or standard for assessing local users at a different rate than that applicable to foreign users. Particularly, in the case of fees and assessments, there is a dual purpose – funding and compliance – and the need to ensure that the agencies' desire for funds does not lead them to issuing an unsustainable number of licenses.

Another essential legislative issue here relates to the assessment of the costs of remedy, or reimbursement of the value of harm, where a user or other person or vessel causes damage to natural resources. The actual decision to claim such amounts depends on a number of political and other factors, however, it is usually important for the law to enable such assessments. This will usually require the development of both a restoration-cost-based civil claim, and a criminal penalty.

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[177] *See,e.g.* SOUTH AFRICA, Marine Living Resources Act, Act18/1998, at §43 (authorizing only two-dimensional boundaries for MPAs, and prohibiting a full range of activities ('fishing, other biodiversity collection, pollution, construction or 'any activity which may adversely impact on ecosystems of that area') within any designated marine protected area.

[178] E.g. CANADA, proposal for the Grand Banks MPA (Breide, C., and P. Saunders 2005); UNITED KINGDOM, general discussion in DEFRA, 2004. In addition, some MPAs in the Mediterranean are believed by some to be 'high-seas' MPAs, because most Mediterranean countries have not adopted EEZs. (*See* Chevalier, C. (2004); *and* Scovazzi, T., ed., 1999).

[179] *See,* RMS Titanic Agreement and UNESCO Convention on the Protection of Underwater Cultural Heritage. One MPA, which may be considered to be a "high seas" MPA, is the Pelagos Sanctuary declared by France, Monaco and Italy (described in Notabartolo, G, 1999). This MPA is entirely within the area which would be included in the EEZs of those three countries, however. In addition, proposals by regional instruments and processes technically fall within this category, to the extent that the regional body seeks to apply its designations to waters outside of its members national EEZs and/or to seabed areas beyond national OCSs. A number of such proposals have been floated at recent OSPAR meetings.

[180] UNCLOS, Articles 117, 194.4.

3.2.6 Financial, logistical, networking and capacity issues

Finally, although no law can force budgetary allocations or obtain equipment or training, it can be an important tool in enabling them (or a difficult obstacle). In most countries, it is not reasonable to expect MPAs to be self-supporting, however, where permitted, legislation will usually include try to allow the MPA to retain amounts received from licenses, concession payments, compounded penalties, and civil awards for damage to the MPA. Sometimes mechanisms can enable direct donor assistance to be received and utilised by the MPA (otherwise allowed under general financial laws). [181]

In many cases, greater concern relates to the availability of equipment and manpower for particular purposes, especially patrolling (and/or apprehending violators) on the ocean. While some of these issues can be addressed by mandate to police and coast guard regarding their duties in enforcing these laws, such provisions cannot alter enforcement priorities, which may place greater emphasis on controlling smuggling or other criminal behaviour, above that of enforcing conservation laws. Alternatives exist, but are not always effective. The empowerment of MPA officials to engage in these activities will not overcome the lack of budget, the need to train these officials in evidentiary collection practices, and the need to address the risk that violators may be armed or violent.[182]

These issues have been confronted by the Seychelles in developing, adopting and implementing their national marine conservation regulations. Those measures include legally valid and effective authorisation to take appropriate action to oversee and enforce geo-local protection measures in its EEZ. Unfortunately, however, budgetary and other limitations have made these measures virtually ineffective in practice. The primary mechanism utilised to date has been apprehending Seychelles vessels returning to shore with unlicensed catches or species not found outside of controlled areas.[183]

Information exchange is essential, and often may occur through international instruments. These services can be thwarted by national legal provisions and processes. At the national level, for example, agencies often must obtain express high-level authority to share information (which might be a valuable commodity and sovereign property of the country). This approval can be so difficult and time consuming that it is ultimately not undertaken. Such provisions often need re-evaluation. At the same time, national legislation could incorporate key informational services created under national law. For example, the High Seas Vessels Authorization Record (HSVAR) database created under FAO Fisheries "Compliance Agreement," may be an important tool in licensing and other MPA implementation processes. [184] Similarly, the Clearinghouse Mechanism (CHM) under the CBD[185] can provide useful information on national and regional marine conservation activities and laws.

4. CONCLUSIONS: PROVIDING TECHNICAL GUIDANCE FOR MPA LEGISLATION

As noted above, a variety of legal and legislative issues can be usefully addressed in the Proposed Guidance, and in the process of its development. Issues have been identified, in many contexts.

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[181] In Tanzania, the Mafia Island Marine Park was able to overcome serious challenges arising out of budgetary shortfalls preventing the acquisition of equipment needed to patrol fishing in the area. Ultimately, NGO support and a positive collaboration with local residents and artisanal fishermen have yielded positive results. Source: official website (http://www.mafia-island-tanzania.gold.ac.uk/ecology/) supported by the IUCN-WCPA-Marine/WWF's MPA management effectiveness project (described at http://effectivempa.noaa.gov/sites/mafia.html)

[182] Incidence of substantial crimes involving the capture and sale of endangered species have been increasing, in part because these commodities are relatively high value, and the penalties are significantly less severe than those imposed for trafficking in drugs, for example. However, as this kind of crime becomes systematic and 'organised' the level of associated violence increases. *See,* IUCN Workshop on Species Trade Crimes, Cambridge, 2001.

[183] SEYCHELLES, Proposed Marine Conservation Act; and Young, 1992-3 cited in footnote 162; supplemented by Personal communication with Randolph Payet, Ministry of Fisheries.

[184] *See, e.g.* FAO Compliance Agreement, Circular State Letter (G/X/FI-30) August 2003, sent to all the States which had accepted the Agreement informing them of the entry into force, on 24 April 2003, of the Agreement and reminding them of their information sharing obligations. Article VI of the Agreement. Article VI of the Agreement requires Parties to exchange information on vessels they authorise to fish on the high seas, and obliges FAO to facilitate this information exchange.

[185] This constantly evolving database is intended to provide countries with a way to develop general knowledge of custom and practice of other countries, relating to, *e.g.* biodiversity conservation, integrated planning, and *in-situ* conservation.

4.1 Legal/legislative scope of the guidance

One initial issue to be addressed by the guidelines process with be the scope of the issues that will be covered by the Guidance – defining "marine protected area" for purposes of determining the scope of the Guidance (i.e. will the Guidance apply to areas which are formally created as "protected areas" or will it also discuss the use of other geo-located conservation measures, non-binding and/or voluntary measures?)[186] Another potentially valuable scoping and planning tool might be reconsideration of the IUCN Categories (Appendix I to this report), in terms of their use in the marine biome.

4.2 International legal mandate for MPAs

International law has two primary roles with regard to MPAs – addressing conservation beyond national control, and authorising national action.

Beyond national control – the high seas and the Area: Significant discussions are currently beginning in international forums regarding the creation of MPAs in these areas. Given that these areas are commonly held by all countries, formal designation of MPAs in these areas would be subject to international decision-making processes (international negotiations). Gaps in the international instruments and understanding suggest that the process by which such formal designations can occur will be developed through normal international negotiating processes, including possibly the current discussions on the development of an Implementing Agreement under UNCLOS.

Formal instruments, particularly at the regional level, create authority for designation of particular geo-located conservation measures, if adopted by consensus-based international processes. In addition, it is possible for countries to decide to act unilaterally (to formally announce their intention to protect an area of the high seas), however, they cannot formally bind other countries, unless those countries also formally take such action.

Within national control – territorial seas, EEZ and OCS: International law does not mandate the creation of national MPAs, but includes national commitments regarding conservation and sustainable use of marine biological resources and ecosystems (under various names). MPAs are thus a possible, but not a mandatory, means of achieving these broader aims.

For the Guidance, the most important legal elements regarding the international regime are:

- Listing, describing and suggesting the process relating to available options for States wishing to individually or collectively designate and implement MPAs in the various ocean zones.
- Specifying the legal rights and duties under the international oceans framework that limit the ability of any state or group of states to declare MPAs in the various ocean zones.
- Considering options and suggestions for international cooperation, participation and enforcement, and the tools and mechanisms for national legislative implementation.
- Analysing open issues relating to MPAs under the international oceans framework focused on whether and how they impact national and regional/cooperative actions and options.

It will be particularly important to specify the extent of the Guidance's interest in high-seas MPAs and MPAs in the Area. These issues have obscured other MPA issues in international discussions[187]

[186] This paper does not discuss legal/procedural issues related to the creation, adoption and promulgation of the Guidance.
[187] Note, for example, the number of primary research materials listed in the Specialised Bibliography which according to their titles focus on the High seas. The author attempted to find legal analysis of conservation issues under the ocean regime, and this sampling is more than representative – if anything it includes a lower percentage of high-seas papers than exists.

4.3 National legal and legislative issues and practices

The drafting of MPA laws and protections are, in some ways, very straightforward, once objectives and mandates from the national government are clarified, and the legislative framework's functions are designed. The design of the framework must be individualised, reflecting the national (or subnational) situation.

Given its situational requirements, national MPA legislation probably cannot be addressed through model laws or generic statements of what constitutes "good legislation." However, Guidance can provide a range of options and discuss particular factors that might suggest that one option is preferable over another, in a given country. While the outline of this guidance may be approached in several ways, the outline of Section 3.2 of this paper might provide a useful starting point:

- Institution(s): Selection and Authorisation
- Procedures and Civil Protections
- Specific Duties, Restrictions, Controls and Processes
- Additional Concerns in Deeper Water
- Penalties, Fees, Assessments and Other Requirements
- Financial, Logistical, Networking and Capacity Issues

The Guidance could also provide indicators of excellent legislation, including –

- Clear and direct legal authority/mandate;
- Status of current framework and potential of improvement or better utilisation of existing instruments as opposed to creating a new framework;
- Relationship between the mandate and the nature of the provisions selected (binding, non-binding, mandatory, voluntary, etc.);
- Direct connection between proposed legal approaches and priority/practical objectives;
- Strong commitment to scientific analysis and monitoring to validate that connection;
- Logistical ability to deliver the actions and outcomes necessary to make that connection (*i.e.* to enforce the law or support other kinds of mandates);
- Support and/or acceptance by relevant community and stakeholder groups; and
- Reasonable financial expectations with regard to those logistical matters.

One final essential element of legal guidance is a practical and legal examination of the value and utilisation of hard-law (legislation) vs. soft-law (including voluntary codes of conduct, non-mandatory provisions, incentive programmes, etc.). A wide range of such options are available, which may be used in any combination (making some elements of the overall regime voluntary and others mandatory). Given current limitations on the ability of states or regional/global bodies to enforce many MPA-related provisions, the practical value of voluntary approaches, particularly as initial measures, may be essentially equal to that of formally adopted mandatory measures.

Finally, it is important to remember that laws and legal systems are intended to facilitate human interactions with other humans and with their surroundings. As such, the law is an evolving construct, which has experienced dramatic, and constantly accelerating levels of change as population and technology have engendered exponential increases to the types of stresses which humans place on themselves (e.g. through the development and growth of urban areas and lifestyles) and on their environment.

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ANNEX 2: IUCN PROTECTED AREA MANAGEMENT CATEGORIES

Source: Guidelines for Protected Area Management Categories (1994)

CATEGORY la Strict Nature Reserve: protected area managed mainly for science

Definition

Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

Objectives of Management

- to preserve habitats, ecosystems and species in as undisturbed a state as possible
- to maintain genetic resources in a dynamic and evolutionary state
- to maintain established ecological processes
- to safeguard structural landscape features or rock exposures
- to secure examples of the natural environment for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded
- to minimise disturbance by careful planning and execution of research and other approved activities, and
- to limit public access.

Guidance for Selection

- The area should be large enough to ensure the integrity of its ecosystems and to accomplish the management objectives for which it is protected.
- The area should be significantly free of direct human intervention and capable of remaining so.
- The conservation of the area's biodiversity should be achievable through protection and not require substantial active management or habitat manipulation (c.f. Category IV).

Organizational Responsibility

Ownership and control should be by the national or other level of government, acting through a professionally qualified agency, or by a private foundation, university or institution which has an established research or conservation function, or by owners working in cooperation with any of the foregoing government or private institutions. Adequate safeguard and controls relating to long-term protection should be secured before designation. International agreements over areas subject to disputed national sovereignty can provide exceptions (e.g. Antarctica).

Equivalent Category in 1978 System

Scientific Reserve / Strict Nature Reserve

CATEGORY Ib Wilderness Area: protected area managed mainly for wilderness protection

Definition
Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

Objectives of Management
- to ensure that future generations have the opportunity to experience understanding and enjoyment of areas that have been largely undisturbed by human action over a long period of time;
- to maintain the essential natural attributes and qualities of the environment over the long term;
- to provide for public access at levels and of a type which will serve best the physical and spiritual well-being of visitors and maintain the wilderness qualities of the area for present and future generations; and
- to enable indigenous human communities living at low density and in balance with the available resources to maintain their life style.

Guidance for Selection
- The area should possess high natural quality, be governed primarily by the forces of nature, with human disturbance substantially absent and be likely to continue to display those attributes if managed as proposed.
- The area should contain significant ecological, geological, physiogeographic, or other features of scientific, educational, scenic or historic value.
- The area should offer outstanding opportunities for solitude, enjoyed once the area has been reached, by simple, quiet, non-polluting and non-intrusive means of travel (i.e. non-motorised).
- The area should be of sufficient size to make practical such preservation and use.

Organizational Responsibility
As for Sub-Category Ia.

Equivalent Category in 1978 System
This sub-category did not appear in the 1978 system, but has been introduced following the IUCN General Assembly Resolution (16/34) on Protection of Wilderness Resources and Values, adopted at the 1984 General Assembly in Madrid, Spain.

CATEGORY II National Park: protected area managed mainly for ecosystem protection and recreation

Definition
Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Objectives of Management
- to protect natural and scenic areas of national and international significance for spiritual, scientific, educational, recreational or tourist purposes;
- to perpetual, in as natural a state as possible, representative examples of physiographic regions, biotic communities, genetic resources, and species, to provide ecological stability and diversity;
- to manage visitor use for inspirational, educational, cultural and recreational purposes at a level which will maintain the area in a natural or near natural state;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation;
- to maintain respect for the ecological, geomorphologic, sacred or aesthetic attributes which warranted designation; and
- to take into account the needs of indigenous people, including subsistence resource use, in so far as these will not adversely affect the other objectives of management.

Guidance for Selection
- The area should contain a representative sample of major natural regions, features or scenery, where plant and animal species, habitats and geomorphological sites are of special spiritual, scientific, educational, recreational and tourist significance.
- The area should be large enough to contain one or more entire ecosystems not materially altered by current human occupation or exploitation.

Organizational Responsibility
Ownership and management should normally be by the highest competent authority of the nation having jurisdiction over it. However, they may also be vested in another level of government, council of indigenous people, foundation or other legally established body which has dedicated the area to long-term conservation.

Equivalent Category in 1978 System
National Park

CATEGORY Ill Natural Monument: protected area managed mainly for conservation of specific natural features

Definition
Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

Objectives of Management
- to protect or preserve in perpetuity specific outstanding natural features because of their natural significance, unique or representational quality, and/or spiritual connotations;
- to an extent consistent with the foregoing objective, to provide opportunities for research, education,
- interpretation and public appreciation;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purpose of designation; and
- to deliver to any resident population such benefits as are consistent with the other objectives of management.

Guidance for Selection
- The area should contain one or more features of outstanding significance (appropriate natural features include spectacular waterfalls, caves, craters, fossil beds, sand dunes and marine features, along with unique or representative fauna and flora; associated cultural features might include cave dwellings, cliff-top forts, archaeological sites, or natural sites which have heritage significance to indigenous peoples).
- The area should be large enough to protect the integrity of the feature and its immediately related surroundings.

Organizational Responsibility
Ownership and management should be by the national government or, with appropriate safeguards and controls, by another level of .government, council of indigenous people, non-profit trust, corporation or, exceptionally, by a private body, provided the long-term protection of the inherent character of the area is assured before designation.

Equivalent Category in 1978 System
Natural Monument / Natural Landmark

CATEGORY IV Habitat/Species Management Area: protected area managed mainly for conservation through management intervention

Definition
Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

Objectives of Management
- to secure and maintain the habitat conditions necessary to protect significant species, Levels of species, biotic communities or physical features of the environment where these require specific human manipulation for optimum management;
- to facilitate scientific research and environmental monitoring as primary activities associated with sustainable resource management;
- to develop limited areas for public education and appreciation of the characteristics of the habitats concerned and of the work of wildlife management;
- to eliminate and thereafter prevent exploitation or occupation inimical to the purposes of designation; and
- to deliver such benefits to people living within the designated area as are consistent with the other objectives of management.

Guidance for Selection
- The area should play an important role in the protection of nature and the survival of species, (incorporating, as appropriate, breeding areas, wetlands, coral reefs, estuaries, grasslands, forests or spawning areas, including marine feeding beds).
- The area should be one where the protection of the habitat is essential to the well-being of nationally or locally-important flora, or to resident or migratory fauna.
- Conservation of these habitats and species should depend upon active intervention by the management authority, if necessary through habitat manipulation (c.f. Category Ia).
- The size of the area should depend on the habitat requirements of the species to be protected and may range from relatively small to very extensive.

Organizational Responsibility
Ownership and management should be by the national government or, with appropriate safeguards and controls, by another level of government, non-profit trust, corporation, private Level or individual.

Equivalent Category in 1978 System
Nature Conservation Reserve / Managed Nature Reserve / Wildlife Sanctuary

CATEGORY V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation

Definition
Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

Objectives of Management
- to maintain the harmonious interaction of nature and culture through the protection of landscape and/or seascape and the continuation of traditional land uses, building practices and social and cultural manifestations;
- to support lifestyles and economic activities which are in harmony with nature and the preservation of the social and cultural fabric of the communities concerned;
- to maintain the diversity of landscape and habitat, and of associated species and ecosystems;
- to eliminate where necessary, and thereafter prevent, land uses and activities which are inappropriate in scale and/or character;
- to provide opportunities for public enjoyment through recreation and tourism appropriate in type and scale to the essential qualities of the areas;
- to encourage scientific and educational activities which will contribute to the long term well-being of resident populations and to the development of public support for the environmental protection of such areas; and
- to bring benefits to, and to contribute to the welfare of, the local community through the provision of natural products (such as forest and fisheries products) and services (such as clean water or income derived from sustainable forms of tourism).

Guidance for Selection
- The area should possess a landscape and/or coastal and island seascape of high scenic quality, with diverse associated habitats, flora and fauna along with manifestations of unique or traditional land-use patterns and social organisations as evidenced in human settlements and local customs, livelihoods, and beliefs.
- The area should provide opportunities for public enjoyment through recreation and tourism within its normal lifestyle and economic activities.

Organizational Responsibility
The area may be owned by a public authority, but is more likely to comprise a mosaic of private and public ownerships operating a variety of management regimes. These regimes should be subject to a degree of planning or other control and supported, where appropriate, by public funding and other incentives, to ensure that the quality of the landscape/seascape and the relevant local customs and beliefs arc maintained in the long term.

Equivalent Category in 1978 System
Protected Landscape

CATEGORY VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

Definition
Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Objectives of Management
- to protect and maintain the biological diversity and other natural values of the area in the long term;
- to promote sound management practices for sustainable production purposes;
- to protect the natural resource base from being alienated for other land-use purposes that would be detrimental to the area's biological diversity; and
- to contribute to regional and national development.

Guidance for Selection
- The area should be at least two-thirds in a natural condition, although it may also contain limited areas of modified ecosystems; large commercial plantations would *not* be appropriate for inclusion,
- The area should be large enough to absorb sustainable resource uses without detriment to its overall long-term natural values.

Organizational Responsibility
Management should be undertaken by public bodies with an unambiguous remit for conservation, and carried out in partnership with the local community; or management may be provided through local custom supported and advised by governmental or non-governmental agencies. Ownership may be by the national or other level of government, the community, private individuals, or a combination of these.

Equivalent Category in 1978 System
This category does not correspond directly with any of those in the 1978 system, although it is likely to include some areas previously classified as “Resource Reserves”, “Natural Biotic Areas/Anthropological Reserves” and “Multiple Use Management Areas / Managed

ANNEX 3: NATIONAL MPA LEGISLATION SURVEYED

NOTE: The following list is not complete. In preparation of this report, other legislation was sampled and surveyed, and legislators and administrators in several countries were contacted.

This list provides a general sampling of much of the legislation copied and specifically surveyed, including both countries with many detailed laws and those without (as well as many countries for which the consultant only reviewed a few recommended laws.) Its purpose is to give the reader an idea of the breadth of different instrument types, sectoral areas and substantive approaches relevant to the current report. Had the report sought to get an accurate picture of national marine protected areas and relevant laws for any one country, the list of statutes reviewed might well be as long as the following, for that country alone.

Where laws listed below are not available in English in ECOLEX or in the ELC Library in Bonn, an official summary or discussion with national lawyers was used instead. Not all laws cited in the text are listed below.

COUNTRY OR TERRITORY	Enactment Name	Date*
ALGERIA	Legislative Decree of 28 May 1994	1994
ANGOLA	Executive Decree No. 3/83 prescribing protection measures for the "Dentex Angolensi" and "Dentex Macrophtalmus" species.	1982
ANTIGUA AND BARBUDA	Beach Control Act (Cap. 45).	
	Marine Areas (Preservation and Enhancement) Regulations, 1973 (No. 25 of 1973).	6/28/1973
	Marine Areas (Preservation and Enhancement) Act 1972 (Act No. 5).	8/5/1972
ARGENTINA	Ley Nº 55 - Regula la preservación, conservación, defensa y mejoramiento del medio ambiente.	1992
	Adelaide Dolphin Sanctuary Act 2005.	6/4/2005
	Antarctic Marine Living Resources Conservation Act 1981.	1981
	Antarctic Marine Living Resources Conservation Regulations.	
	Antarctic Marine Living Resources Conservation Regulations.	
	Environment Protection and Biodiversity Conservation Act 1999.	1999
	Environment Protection and Biodiversity Conservation Regulations 2000.	2000
	Environmental Reform (Consequential Provisions) Act 1999 (Act No. 92 of 1999).	7/16/1999
	Fisheries Act 1982.	1982
	Fisheries Management (Aquatic Reserves) Regulation 1995.	1995
	Fisheries Management (Aquatic Reserves) Regulation 2000.	2000
	Great Barrier Reef Marine Park (Aquaculture) Regulations 2000.	2000
	Great Barrier Reef Marine Park Act 1975.	1975
	Great Barrier Reef Marine Park Regulations 1983.	1983
	Marine Parks Act 1982.	1982
	Marine Parks Act 1997.	1997
	Marine Parks Act 2004.	10/12/2004
	Marine Parks Amendment Regulation (No. 1) 2006.	3/17/2006
	Marine Parks Regulation 1990.	1990
	Marine Parks Regulation 1999.	1999
BARBADOS	Coastal Zone Management Act (No. 39 of 1998).	12/18/1998
	Marine Areas (Preservation and Enhancement) Act.	
	Marine Areas (Preservation and Enhancement) (Barbados Marine Reserve) Regulations, 1981 (No. 28 of 1981).	2/16/1981

COUNTRY OR TERRITORY	Enactment Name	Date*
BELGIUM	Accord de coopération entre le Service fédéral et la Région flamande concernant la recherche sur l'influence des activités d'exploration et d'exploitation sur le Plateau continental de la Belgique sur les dépôts de sédiments et sur l'environnement marin.	12/21/2005
	Arrêté royal créant des zones de protection spéciale et des zones de conservation spéciales dans les espaces marins sous juridiction de la Belgique.	10/14/2005
	Arrêté royal créant une réserve marine dirigée dans les espaces marins sous juridiction de la Belgique et modifiant l'arrêté royal du 14 octobre 2005 créant des zones de protection spéciales et des zones de conservation spéciales dans les espaces marins sous juridiction de la Belgique.	3/5/2006
	Loi visant la protection du milieu marin dans les espaces marins sous juridiction de la Belgique.	1/20/1999
	Loi visant la protection du milieu marin dans les espaces marins sous jurisdiction de la Belgique.	
	Royal Decree on the protection of navigation, sea fishing , the environment and other essential interests in the exploration and exploitation of mineral and other non-living resources in the seabed and subsoil of the territorial sea and the continental shelf.	
BELIZE	Fisheries Act (Chapter 210).	
	Fisheries (Bacalar Chico Marine Reserve) Regulations, 2001 (S.I. No. 68 of 2001).	4/26/2001
	Fisheries (Gladden Spit and Silk Cayes Marine Reserve) Regulations (S.I. No. 95 of 2003).	7/5/2003
	Fisheries (Glovers Reef Marine Reserve) Regulations 1996 (S.I. No. 70 of 1996).	5/18/1996
	Fisheries (Hol Chan Marine Reserve)(Amendment) Regulations, 1999 (S.I. No. 101 of 1999).	9/18/1999
	Fisheries (Port Honduras Marine Reserve) Regulations (S.I. No. 18 of 2000).	8/19/2000
	Hol Chan Marine Reserve Regulations.	
BERMUDA (UK)	Fisheries Act 1972.	1972
	Marine Board (Dolphin Habitat) (Prohibited Area) Notice 1997.	1997
	Protected Waters (Castle Harbour) Act 1951.	1951
BRAZIL	Decree No. 1.204 creating the Coastal Zone Protection Committee within the State of Rio de Janeiro - CODEL.	10/7/1987
	Decree No. 5382 approving the VI Plan for Maritime resources Â– VI PSRM.	3/3/2005
	Order No. N-6 prohibiting fishing activity in protected area of 'Taim' in the State of Rio Grande do Sul.	2/2/1983
CANADA	Act respecting the Ministère de l'Environnement et de la Faune (chapter M-15.2.1).	6/17/1994
	Fish and Wildlife Act (Chapter F-14.1).	
	Natural Resources Act.	
	Oceans Act.	
	National Parks Fishing Regulations (C.R.C., C. 1120).	8/31/1999
	National Parks Fishing Regulations.	4/30/2000
	Wildlife Area Regulations.	4/30/2000
CAYMAN ISLANDS (UK)	Marine Conservation Law, 1978.	1978
	Marine Conservation (Amendment) Regulations, 1988.	5/31/1988
	Marine Conservation (Marine Parks) (Amendment) Regulations, 1986.	4/29/1986
	Marine Conservation (Marine Parks) Regulations, 1986.	2/18/1986

COUNTRY OR TERRITORY	Enactment Name	Date*
CHILE	Ley Nº 19.800 - Modifica la Ley General de Pesca y Acuicultura.	4/22/2002
	Decreto Nº 117 - Modifica el Reglamento sobre parques marinos y reservas marinas de la Ley General de Pesca y Acuicultura.	4/10/2006
	Decreto Nº 123 - Medidas de conservación adoptadas por la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos en su XIX reunión de 2000.	2/1/2001
	Decreto Nº 19 - Medidas de conservación adoptadas por la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos en su XVII reunión de 1998.	1/12/1999
	Decreto Nº 2.186 - Medidas de conservación adoptadas por la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos en su XVIII reunión de 1999.	12/13/1999
	Decreto Nº 238 Â– Reglamento sobre parques marinos y reservas marinas de la Ley General de Pesca y Acuicultura.	9/16/2004
	Decreto Nº 287 - Medidas de conservación adoptadas por la Comisión para la Conservación de los Recursos Vivos Marinos Antárticos en su XVI reunión de 1997.	2/27/1998
COOK ISLANDS (New Zealand)	Environment Act 2003 (No. 23 of 2003).	11/19/2003
COSTA RICA	Ley Nº 7.317 - Conservación de la vida silvestre.	10/30/1992
CROATIA	Zone of Ecological Protection and Fisheries	12/3/2003
CUBA	Decreto Ley Nº 212 - Gestión de la zona costera.	8/8/2000
DENMARK	Environment Aims Act (Act No. 1150 of 2003).	12/17/2003
	Act on the Protection of the Marine Environment.	
	Environment Aims Act (Act No. 1150 of 2003).	12/17/2003
	Royal Decree of 21 December 1966 on delimitation of the territorial sea (No. 19).	
	Law No. 597 on the Fishing Territory of the Kingdom of Denmark.	12/17/1976
	Decree No. 129 amending decree regulating the inspection of fisheries in the waters around the Faeroe Islands.	3/18/1976
FAEROE ISLANDS (Denmark); DENMARK	Decree amending the Decree regulating the inspection of fisheries in the waters around the Faeroe Islands (No. 129 of 1976).	3/18/1976
	Decree governing delimitation of the territorial waters of the Faeroe Islands (Decree No. 128 of 1976).	3/18/1976
ECUADOR	Resolución Nº 33 - Protocolo de desinfección de barcos que ingresan a la provincia de Galápagos e Interislas.	11/1/2005
FRANCE	Loi nº 2003-346 relative à la création d'une zone de protection écologique au large des côtes du territoire de la République .	5/22/1985
	Loi nº 86-2 relative à l'aménagement, la protection et la mise en valeur du littoral.	1/3/1986
	Décret n° 2004-33 portant création d'une zone de protection écologique au large des côtes du territoire de la République en Méditerranée.	1/8/2004
	Décret n°86-1252 relatif au contenu et à l'élaboration des schémas de mise en valeur de la mer.	12/5/1986
FRANCE; FRENCH GUIANA (Fr.)	Loi nº 2006-436 relative aux parcs nationaux, aux parcs naturels marins et aux parcs naturels régionaux.	4/14/2006
FRANCE; GUADELOUPE; MARTINIQUE; RÉUNION; MAYOTTE; NEW CALEDONIA; FRENCH POLYNESIA; WALLIS-FUTUNA ISLANDS	Décret portant création du comité de l'initiative française pour les récifs coralliens.	7/7/2000
FRANCE; MARTINIQUE (France)	Arrêté relatif aux réserves de chasse maritime (extrait).	10/14/1976
GUADELOUPE (France); MARTINIQUE (France); RÉUNION (France); GUYANA	Loi nº 96-1241 relative à l'aménagement, la protection et la mise en valeur de la zone dite des cinquante pas géométriques dans les départements d'outre mer.	12/30/1996

COUNTRY OR TERRITORY	Enactment Name	Date*
GREECE	Ministerial Decision No. YPPO/ARX/A1/F43/21084/1003 establishing a marine area in the island of Trafos (Crete) as archaeological zone.	5/19/2000
	Ministerial Decision No. YPPO/ARX/A1/F43/21086/1004 establishing a marine area in the island of Crete as archaeological zone.	5/19/2000
	Ministerial Joint Decree No. 18670/777 establishing measures for the protection of the "Caretta-Caretta" turtle.	2/29/1988
	Presidential Order prohibiting fishing in the marine area of Fanari.	2/7/2000
HAITI	Décret du 4 avril 1944 déclarant "zone réservée" toute l'étendue nationale comprise dans les limites des Iles de la Gonâve et de la Tortue.	4/4/1944
INDONESIA	Ordinance on Territorial Waters and Maritime Zones, 1939.	8/18/1939
ITALY	Agreement between the National Government, the Regions and the Autonomous Provinces in matter of concessions relating to the maritime domaine and maritime areas falling within protected marine areas.	7/14/2005
JAMAICA	Beach Control Act.	
	Natural Resources (Marine Parks) Regulations, 1992 (S.R. No. 41B).	6/5/1992
	Wild life Protection Act.	
LEBANON	Resolution No. 129/1 creating a protected marine area within the territory of the Institute of Marine Sciences and Fishing in the region of Albatroun, and clarifying Resolution No. 242/1 of August 1975 regarding the cooperation between the Institute of Marine Sciences and Fishing and the General Department for Professional and Technical Education.	10/23/1991
LIBYAN ARAB JAMAHIRIYA	Declaration of a Libyan protected fishing area in the Mediterranean Sea.	2/24/2005
MALAYSIA	Fisheries Act 1985 (No. 317 of 1985).	1985
	Malaysian Maritime Enforcement Agency Act No. 633 of 2004.	6/25/2004
	Establishment of Marine Parks Malaysia (Amendment) Order 1998	1998
MAURITIUS	Maritime Zones Act 2005 (Act No. 2 of 2005).	2/28/2005
	Wildlife and National Parks Act 1993 (No. 13 of 1993).	3/1/1994
	Fisheries and Marine Resources (Marine Protected Areas) Regulations 2001.	2001
NEW ZEALAND	Antarctic Marine Living Resources Act 1981 (No. 53 of 1981).	1981
	Antarctica (Environmental Protection) Act 1994 (Act No. 119 of 1994).	12/6/1994
	Antarctica Act 1960.	1960
	Conservation Act.	
	Conservation Law Reform Act (No. 31 of 1990).	4/10/1990
	Foreshore and Seabed Endowment Revesting Act (No. 103 of 1991).	10/3/1991
	Harbour Boards Dry Land Endowment Revesting Act (No. 104 of 1991).	10/3/1991
	Hauraki Gulf Marine Park Act 2000.	2000
	Marine Mammals Protection Act 1978 (No. 80 of 1978).	1978
	Marine Reserves Act (No. 15 of 1971).	1971
NORWAY	Antarctic Environment Protection Decree (No. 408 of 1995).	5/5/1995
	Decree No. 299 of 1999 relative to protection of the coral reef.	1999
SVALBARD (Norway)	Act No. 79 of 2001 relative to environment protection on Svalbard.	6/15/2001
	Decree No. 3780 of 1973 relative to establishment of bird reserves and large nature conservation areas on Svalbard.	1973
PERU	Decreto Supremo Nº 023/01/PE - Reglamento de las concesiones para el desarrollo de la maricultura en la Reserva Nacional de Paracas.	6/1/2001
	Decreto Supremo Nº 028/01/PE - Prohíbe extracción de recursos mediante pesca de rodeo en el ecosistema del manglar.	7/3/2001
	Ley Nº 27.870 - Ley del Instituto Antártico Peruano (INANPE).	11/18/2002
	Resolución Nº 172/91/PE - Delimita una zona adyacente a la costa peruana de 0 a 5 millas marinas como zona de protección de la flora y fauna existentes.	5/14/1991

COUNTRY OR TERRITORY	Enactment Name	Date*
PHILIPPINES	Philippine Environment Code.	6/6/1988
SAINT LUCIA	Parks and Beaches Commission Act, 1983 (Act No. 4 of 1983).	3/16/1983
SAINT VINCENT GRENADINES	Marine Parks Act, 1997 (No. 9 of 1977).	11/19/1997
SAMOA	Lands, Surveys and Environment Act 1989.	1989
SENEGAL	Décret portant création d'aires marines protégées.	11/4/2004
	Arrêté nº 7164 portant règlement intérieur du parc national des Iles de la Madeleine.	1/16/1976
	Décret n° 76-033 portant création du parc national des Iles de la Madeleine.	1/16/1976
SEYCHELLES	Seychelles Maritime Zones Act, 1999 (Act No. 2 of 1999).	3/25/1999
	Environment Protection Act 1994 (Act No. 9 of 1994).	9/28/1994
	Seychelles Fishing Authority (Establishment) Act 1984 (No. 10 of 1984).	8/28/1984
	Conservation of Marine Shells Act, 1981	6/3/1905
	Marine Mammals Sanctuary Decree 1979	6/1/1905
	Licences Act 1986 (Act No. 3 of 1986).	8/27/1986
	Agricultural and Fisheries (Incentives) Act, 2005 (No. 3 of 2005).	
	National Parks and Nature Conservancy Ordinance	
	Fisheries (Spear-guns) Regulations, 1972	5/25/1905
	Green Turtles Protection Regulations, 1976 (S.I. No. 43 of 1967).	5/20/1905
	Green Turtles Protection (Amendment) Regulations, 1976 (S.I. No. 51 of 1977).	5/30/1905
	National Parks and Nature Conservancy (Procedure for Designation of Areas) Regulations (S.I. No. 110 of 1971).	5/24/1905
	St. Anne Marine National Park Regulations (S.I. No. 58 of 1973).	5/26/1905
	Port Launay Marine National Park Regulations 1981 (S.I. 9 of 1981).	1/27/1981
	St. Anne Marine National Park Regulations (S.I. No. 58 of 1973).	1973
SOUTH AFRICA	Environment Conservation Act (No. 73 of 1989).	1989
	Marine Living Resources Act.	1998
SPAIN	Royal Decree no. 1315/1997, modified by Royal Decree no. 431/2000	2000
SWAZILAND	National Trust Commission Act, 1972.	1972
TANZANIA, Un. Rep. of	Marine Parks and Reserves Act, 1994 (Act No. 29 of 1994).	1/17/1995
	Marine Parks and Reserves (Declaration) Regulations, 1999 (G.N. No. 85 of 1999).	3/2/1999
UNITED KINGDOM	Environment Act 1995 (Chapter 25).	7/19/1995
	Coast Protection Act, 1949 (Cap. 74).	11/24/1949
	Antarctic Regulations (S.I. No. 490 of 1995).	2/20/1995
	Designation of Nitrate Vulnerable Zones (Scotland) Regulations 2002 (S.S.I. No. 276 of 2002).	6/6/2002
	Habitat (Salt Marsh) (Amendment) Regulations 1996 (S.I. No. 1479 of 1996).	6/6/1996
	Shellfish (Specified Sea Area) (Prohibition of Fishing Methods) (Wales) Order 2003 (S.I. No. 607 (W. 81) of 2003).	3/6/2003
	Solent European Marine Site (Prohibition of Method of Dredging) Order 2004 (S.I. No. 2696 of 2004).	10/19/2004
ZAMBIA	International Game Park and Wildlife Act.	
	National Parks and Wildlife (Bird Sanctuaries) Regulations.	
	National Parks Regulations.	
ZIMBABWE	Parks and Wild Life Act [Chapter 20:14].	
	Parks and Wildlife (General) Regulations, 1981 (S.I. No. 900 of 1981).	1980

ANNEX 4: LIST AND CHART OF REGIONAL INSTRUMENTS RELATING TO MARINE AREAS

Source: Compiled in 2002 and revised and updated twice (including January 2006, for inclusion in this Review Report)[1]

Other Key Instruments	(Formal agreements (hard and soft) only -- action plans and other operational documents not listed)			
Instrument Title	**Reference Title / Acronym**	**Description**	**Scope/Mandate**	**Comment**
Global Instruments				
Agenda 21: Economic and Development Agenda	Agenda 21	A comprehensive action plan for the environment and development. Article 17 addresses marine issues, and is the only portion reproduced in the materials. It identifies a full range of issues that must be addressed in an integrated or interrelated way, in order to ensure the health, stability and sustainability of the ecosystems, species and the global environment.	Global	Soft law
Agreement Concerning Cooperation in Marine Fishing	Fishing Co-operation	The development of marine fishing, fishing techniques and fish processing technology and scientific research into the condition of live marine resources and cooperation in the development of fishing in the open sea, on practical matters relating to the organization of fishing, on the exchange the results of exploration for new fishing grounds and other research. [Preamble, Article 1]	Global	
Agreement relating to the Implementation of Part XI of UNCLOS	ISA Agreement	Includes basic structures for separate international governance of the ISA, under and in accordance with UNCLOS. Empowers rulemaking and other activities, through separate but consistent structural arrangements.	Global	
Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas	FAO Compliance Agreement	The Agreement establishes a broad obligation on flag states to adopt measures as may be necessary to ensure that their flag vessels do not engage in activities that undermines the effectiveness of international conservation and management measures	Global	

[1] Appendix 3 is intended to give some idea of the breadth of instruments (and thus of possibilities) at the regional and global levels. It has attempted to be comprehensive in its inclusion, however, it cannot include all of the other types of international instruments of relevance, such as the Vienna Conventions relating to the Law of Treaties and other principles of the application of international laws, the impact of conventions and processes for addressing commercial activities, and the broad range of instruments controlling or mandating various types of equipment and activities on, affecting or relating to oceans.

Convention on Biological Diversity	CBD	[See Legal Background Paper]	Global	
Convention on Fishing and Conservation of the Living Resources of the High Seas	HS Living Resources	Pre-UNCLOS instrument on HS biological resource conservation issues. Largely superceded but not repealed by UNCLOS.	Global	Still in force as to signatories who are not bound by UNCLOS
Convention on International Trade in Endangered Species of Fauna and Flora	CITES	[See Legal Background Paper]	Global	
Convention on Migratory Species	CMS	[See Legal Background Paper]	Global	
Convention on the Continental Shelf	Continental Shelf	Pre-UNCLOS instrument on rights in the continental shelf. Largely superceded but not repealed by UNCLOS.	Global	Still in force as to signatories who are not bound by UNCLOS
Convention on the Law of the Non-navigational Uses of International Watercourses	Watercourses	Regulating the uses of watercourses which cause impacts beyond national boundaries, including by particular attention to co-operation for the creation of regional watercourse agreements, using the principle of "equitable and reasonable utilisation. Most provisions limited to the watercourse itself, and to effects and concerns of "other watercourse states."	Global	Not in force
Convention on the Liability of Operators of Nuclear Ships	CLONS	IMO Convention, Would set uniform liability provisions for nuclear damage caused by ships operating on nuclear power.	Global	Not in force
Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, (and 1996 Protocol.)	London Convention	A system to regulate ocean dumping, originally identifying three categories of waste (prohibited, special permit, and general permit). The 1996 Protocol will, when in force, prohibit all at-sea incineration of wastes, waste storage in the seabed, and all other waste dumping, except for a "reverse list" of substances that may be dumped at sea.	Global	1996 Protocol not in force
Convention on the Territorial Sea and the Contiguous Zone	Territorial Sea	Pre-UNCLOS instrument on national rights and duties with regard to Territorial Seas. Largely superceded but not repealed by UNCLOS.	Global	Still in force as to signatories who are not bound by UNCLOS

Declaration of Principles Governing the Sea Bed and the Ocean Floor and the Subsoil Thereof, Beyond the Limits of National Jurisdiction	Sea Bed Principles	UNGA Resolution on Sea Bed issues	Global	Soft law
Declaration of the United Nations Conference on the Human Environment	Stockholm Declaration	Enunciates basic principles relating to conservation and its relation to the quality of human life.	Global	Soft law
Declaration of the World Summit for Sustainable Development	WSSD Declaration	[See Legal Background Paper]	Global	Soft law
FAO Code of Conduct for Responsible Fisheries (FAO-CRF)	FAO-CCRF	Designed to *inter alia,* "establish principles, in accordance with relevant rules of international law, for responsible fishing and fisheries activities, taking into account all relevant biological, technological, economic, social, environmental and commercial aspects," as well as to serve as an instrument of reference "to help States establish or improve the legal and institutional framework required for the exercise of responsible fisheries and the formulation of appropriate measures" and to provide guidance in "the formulation... of international l agreements and other instruments both binding and voluntary."	Global	Soft law
Guidelines: Designation of Special Areas Under MARPOL 73/78 and Identification and Designation of Particularly Sensitive Sea Areas	PSSA Guidelines	These Guidelines implement MARPOL provisions for designation of areas of special care and/or limited passage in shipping/navigation, based on a variety of factors including *inter alia* consideration of ecological (species, habitat and ecosystem) and oceanographic factors, but giving due consideration of "vessel traffic characteristics."	Global	IMO Guidelines
International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto	(MARPOL 73/78)	Direct international agreement on pollution from ships, with a primary focus on "operational" pollution (as opposed to accidental. Supported by numerous agreements and protocols.	Global	
International Convention for the Regulation of Whaling	IWC	Designed as a "fisheries management"-type convention, to oversee whaling activities worldwide. Has been under a moratorium on all whaling (apart from aboriginal subsistence whaling, that conducted for scientific purposes, and that undertaken within national jurisdiction) since 1982 when, because of uncertainties in the scientific analyses and inability to determine the precise status of the various whale stocks, the IWC decided that there should be a pause in commercial whaling on all whale stocks beginning in 1985/86. That moratorium still continues.	Global	

International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances By Sea	HNS Convention	IMO convention addressing compensation standards for incidents involving the discharge of hazardous or noxious substances.	Global	Not in force
International Convention on Oil Pollution Preparedness, Response and Co-operation	Oil Preparedness	An agreement, negotiated in response to the Exxon Valdez incident, regarding the kind of advance measures that should be required of ships, in order to be prepared for prompt response in the event of oil pollution incidents, as well as for prompt reporting of such incidents.	Global	
International Convention on Salvage	Salvage	IMO convention addressing the application of maritime and international law of salvage.	Global	
Kyoto Protocol to UNFCCC	Kyoto	Implements a key component of the a carbon accounting system by which the UNFCCC seeks to foster limiting/curtailing damage to the ozone layer, by a combination of (1) limiting the amount of chlorofluorocarbons and other ozone-damaging pollutants, and (2) preserve and maintain "carbon sinks" -- natural features that fix ozone damaging pollutants in soil or natural substances (coral reefs, forests, etc.)	Global	
Rio Declaration on the Environment and Development	Rio Declaration	General international non-binding statement enunciating the principles of sustainable development with regard to conservation and environmental issues.	Global	Soft law
UN Agreement for the… Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks	FSA	[See Legal Background Paper]	Global	
UNGA Assembly Resolution n° A/57/L.48		[See Legal Background Paper]	Global	
United Nations Convention on the Law of the Sea	UNCLOS	[See Legal Background Paper]	Global	
United Nations Framework Convention on Climate Change	UNFCCC	Creates a system for limiting/curtailing damage to the ozone layer, through national commitments to limit emission of ozone-damaging chemicals and remedy those already in the atmosphere, creating a system of accounting on a national basis for reductions of emissions of ozone damaging pollutants and other activities that reduce the amount of such pollutants in the atmosphere.	Global	

World Charter for Nature	World Charter	A declaration regarding the need for appropriate measures to protect and conserve nature, and to promote international co-operation in this field. States General Principles, identifies environmental functions and promotes a balanced programme for their sustainable use, identifies "implementation principles" for application of the general principles and functions. Adopted and proclaimed by the United Nations General Assembly on 28 October, 1982.	Global	Soft law
World Heritage Convention	WHC	[See Legal Background Paper]	Global	
Operational Guidelines for the Implementation of the World Heritage Convention (provisional revision WHC.02/2 July 2002; and last finally approved version, Mar. 1999)	WH Guidelines	Set out criteria and procedures for determining that properties have outstanding universal value (primary criteria for listing), determining size, ensuring legal protection status, adding them to the World Heritage list, and maintaining them according to the standards of the WHC	Global	Operationalizing the convention
Convention on Biological Diversity: Jakarta Ministerial Statement on the Implementation of the Convention on Biological Diversity (attaching CBD/COP Decision II/10)	Jakarta Mandate	Declaration of the High-level (Ministerial) segment of CBD COP-2, as supported by subsequent COP Decision II/10, forming the basis of an international programme for addressing biodiversity concerns as regards oceans and coastal areas.	Mandate is global, but all provisions are recommendatory, or are clarifications of CBD objectives.	
Convention on Biological Diversity: Programme of Work on Marine and Coastal Biological Diversity (CBD COP Decision IV/5, as further elaborated in Decisions V/3 and VI/3, and in the Report of the Ad-hoc Technical Expert Group on Marine and Coastal Biodiversity	CBD Marine Programme	A broad-based programme of work, focusing on 5 key programme elements (i) integration of marine and coastal areas management, (ii) marine and coastal living resources, (iii) marine and coastal protected areas (iv) mariculture and (v) alien species and genotypes. Particular activities focus on MPAs, and a sub-group has created a specific report on MPA issues.	Mandate is global, but all provisions are recommendatory, or are clarifications of CBD objectives.	
IUCN WCC Resolution 2.20, Conservation of Marine Biodiversity	IUCN Marine Res.	Supports the conservation of marine biodiversity in several respects, including most relevantly a the Union's support to the goal of "a representative network of Marine Protected areas at regional and global scales" and the related mandate to the Union to investigate the possible value of HSMPAs and other natural resource management tools in the high-seas	Mandate is global, but all provisions are recommendatory.	

Regional Instruments				
Antarctica				
Antarctic Treaty	Antarctic Treaty	[see legal background paper]	Antarctic	
Annex V to the Protocol on Environmental Protection to the Antarctic Treaty. Area Protection and Management	Madrid Protocol Annex V	(Antarctic Treaty) Annex V to the Madrid Protocol establishes a revised system of protected areas that distinguishes between protected areas (Antarctic Specially Protected Areas "ASPAs") and managed areas (Antarctic Specially Managed Areas "ASMAs")	Antarctic	
Convention for the Conservation of Antarctic Seals	CCAS	Specific focus on seal conservation and sustainable use issues	Antarctic	
Convention on the Conservation of Antarctic Marine Living Resources (1980)	CCAMLR	Conservation of Antarctic marine living resources operating through a Commission with advice from a Scientific Committee	Antarctic	
Convention on the Regulation of Antarctic Mineral Resource Activities	CRAMRA	Regulates activities involving Antarctic mineral resources activities to minimise significant effects on the Antarctic environment	Antarctic	Not in force
Protocol on Environmental Protection to the Antarctic Treaty	Madrid Protocol	Comprehensive protection of the environment and dependent and associated ecosystems, designates Antarctica as a natural reserve, devoted to peace and science (Article 2).	Antarctic	
Agreed Measures for the Conservation of Antarctic Fauna and Flora (1964)	1964 Agreed Measures	Specific measures for Antarctic conservation.	Antarctica	

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Basel	An agreement regarding the transportation of wastes between countries, and their disposal in a country other than the country in which they were generated. Ocean disposal generally is not addressed, as it is deal with in other international agreements, however, this Agreement does contain provisions related to Antarctica.	Global, but with special relevance to Antarctica	Convention is global, but relevant provision relates to Antarctica
Arctic				
Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas	ASCOBANS	The basic purpose of ASCOBANS is to promote close cooperation "in order to achieve and maintain a favourable conservation status for small cetaceans" in the Baltic and North Seas [Article 2(1)]. The principal measures by which this objective is to be achieved are outlined in the Conservation and management plan, which appears an Annex to the Agreement, and which requires parties, inter alia, to endeavour to establish the prohibition under international law of the intentional taking and killing of small cetaceans and the obligation to release immediately any animals caught alive and in good health; to reduce pollution harmful to small cetaceans; to modify fishing gear and practices in order to reduce bycatch and prevent gear from being abandoned or discarded at sea; to regulate activities which seriously affect the food sources of small cetaceans; to prevent significant disturbance (e.g. seismic testing, whale-watching) to small cetaceans; to carry out population surveys and research into the causes of their decline.	Baltic (Arctic, Northeast Atlantic)	
Agreement Concerning Measures for the Protection of the Stocks of Deep-Sea Prawns (*Pandalus borealis*), European Lobsters (*Homarus Vulgaris*, Norway Lobsters (*Nephrops norvegicus*) and Crabs (*Cancer pagurus*) (1952)	Shellfish Agreement	To protect the stocks of the four species of crustaceans in the seas lying between Denmark, Sweden and Norway by regulating size of mesh of nets and minimum size of crustaceans to be caught are regulated.	Northeast Atlantic, Arctic	
Convention on the Conservation and Management of Pollock Resources Central Bering Sea (1994)	Pollock	The Convention establishes an international regime (Annual Conference of the Parties, Scientific Committee) for conservation, management and optimum utilisation of Pollock resources	Pacific/Arctic	

Arabian Seas				
Kuwait Regional Convention for Co-operation on the Protection of the Marine Environment from Pollution	Kuwait Convention	To prevent, abate and combat pollution of the marine environment.	Arabian	
Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1982)	Gulf Conservation	A regional seas convention, whose goal is 'to ensure rational human use of living and non-living marine and coastal resources in a manner ensuring optimum benefit for the present generation, at the same time maintaining the potential of that environment to satisfy the needs and aspirations of future generations.' A draft Protocol Concerning the Conservation of Biological Diversity and the Establishment of Protected Areas and a draft Protocol on the Protection of the Marine Environment from Land-based Sources of Pollution in the Red Sea and Gulf of Aden have been sent to member states for review.	Arabian	
Indo-pacific Fisheries Commission Agreement (1996)	Indo-pacific Fisheries	The Agreement establishes an Asia-Pacific Fishery Commission to promote proper utilisation of the living aquatic resources of the region.	East Asian Seas, Central Indian Ocean, East Africa, Arabian Sea	
Australia/New Zealand				
Memorandum of Understanding on Port State Control in the Asia-Pacific Region. Maritime Authorities of Australia, New Zealand, Russian Federation, Thailand, Canada, Hong Kong, China, Republic of Korea (1993)	Port State Control	The Parties establish a Committee with the main task to coordinate inspection activity of foreign merchant ships in the region.	East Asian Seas, Australia/New Zealand, Northwest Pacific	Soft law
Convention for the Conservation of Southern Bluefin Tuna (1993)	Bluefin Tuna	RFMO created "to ensure the conservation and optimum utilisation of southern bluefin tuna, by establishing Commission responsible for gathering all relevant information and coordinating legal and policy measures of the Parties in order to preserve the bluefin tuna population in the area."	Australia/New Zealand	

Baltic				
Convention on Fishing and Conservation of the Living Resources in the Baltic Sea and Belts (1973)	IBSFC	RFMO created "to preserve and increase the living resources of the Baltic Sea and the Belts and to obtain the optimum yield, in particular, to expand and coordinate studies towards these ends and to put into effect organizational and technical projects on conservation and growth of the living resources on a just and equitable basis as well as take other steps towards rational and exploitation of the living resources."	Baltic	
Convention on the Protection of the Marine Environment of the Baltic Sea Area (1974)	Helsinki Convention (or HelCom)	Generally focused on pollution issues, this Instrument has become a 'partner convention' under the regional seas programme. Contracting parties are under a general duty to take all appropriate measures, either individually or jointly, to conserve natural habitats and biological diversity and to protect ecological processes and such measures shall also be taken in order to ensure the sustainable use of natural resources within the Baltic Sea Area. Since 1992, has focused on the creation and active implementation of a Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) which gives primary attention to cleaning up pollution 'hot spots' within the Baltic region, and beginning to develop shipping routes and other geographic-based controls. Recent decisions have emphasised the need to utilise an 'ecosystem approach' including recognising important or sensitive environmental areas and habitats.	Baltic	
Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992)		Updating and generally included in HELCOM	Baltic	
Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas	ASCOBANS	The basic purpose of ASCOBANS is to promote close cooperation "in order to achieve and maintain a favourable conservation status for small cetaceans" in the Baltic and North Seas [Article 2(1)]. The principal measures by which this objective is to be achieved are outlined in the Conservation and management plan, which appears an Annex to the Agreement, and which requires parties, inter alia, to endeavour to establish the prohibition under international law of the intentional taking and killing of small cetaceans and the obligation to release immediately any animals caught alive and in good health; to reduce pollution harmful to small cetaceans; to modify fishing gear and practices in order to reduce bycatch and prevent gear from being abandoned or discarded at sea; to regulate activities which seriously affect the food sources of small cetaceans; to prevent significant disturbance (e.g. seismic testing, whale-watching) to small cetaceans; to carry out population surveys and research into the causes of their decline.	Baltic (Arctic, Northeast Atlantic)	

Caspian Sea				
Framework Convention for the Protection of the Marine Environment of the Caspian Sea (2003)	Caspian Convention	Although apparently not adopted under the RSA, this is in content very similar to a regional seas agreement, focusing on both pollution and marine conservation. The Caspian as a fully enclosed sea (or perhaps 'lake') includes some aspects not found in other regional seas. Although not discussing protected areas per-se, the agreement calls on parties to take "all appropriate measures to protect, preserve and restore the environment of the Caspian Sea"	Caspian	Not yet in force
East Asian Seas				
Indo-pacific Fisheries Commission Agreement (1996)	Indo-pacific Fisheries	The Agreement establishes an Asia-Pacific Fishery Commission to promote proper utilisation of the living aquatic resources of the region.	East Asian Seas, Central Indian Ocean, East Africa, Arabian Sea	
Memorandum of Understanding on Port State Control in the Asia-Pacific Region. Maritime Authorities of Australia, New Zealand, Russian Federation, Thailand, Canada, Hong Kong, China, Republic of Korea (1993)	Port State Control	The Parties establish a Committee with the main task to coordinate inspection activity of foreign merchant ships in the region.	East Asian Seas, Australia/New Zealand, Northwest Pacific	Soft law
Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South East Asia	IOSTA	This MoU closely the concepts of other CMS agreements, focusing on "achieving favourable conservation status," and on development of a mutually agreed Conservation and Management Plan. Because of its ocean-oriented focus, it attempts to extend its coverage to the "high seas," by asking its parties to apply its principles to "vessels operating under [the party's] flag," and suggesting that the Conservation and Management Plan should address "fisheries by-catch" issues.	South Asia, North Africa, West Africa, Southern Africa, and the island states of the Indian Ocean.	Soft law
East Africa				
Indo-pacific Fisheries Commission Agreement (1996)	Indo-pacific Fisheries	The Agreement establishes an Asia-Pacific Fishery Commission to promote proper utilisation of the living aquatic resources of the region.	East Asian seas, Central Indian Ocean, East Africa, Arabian Sea	

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South East Asia	IOSTA	This MoU closely the concepts of other CMS agreements, focusing on "achieving favourable conservation status," and on development of a mutually agreed Conservation and Management Plan. Because of its ocean-oriented focus, it attempts to extend its coverage to the "high seas," by asking its parties to apply its principles to "vessels operating under [the party's] flag," and suggesting that the Conservation and Management Plan should address "fisheries by-catch" issues.	South Asia, North Africa, West Africa, Southern Africa, and the island states of the Indian Ocean.	Soft law
Western Indian Ocean Tuna Organisation Convention	Western IO Tuna	The Organization's objectives are: (a) harmonization of policies with respect to fisheries; (b) relations with distant water fishing nations; (c) fisheries surveillance and enforcement; (d) fisheries development; and (e) reciprocal access to EEZs of other members. The Organization does not have regulatory powers.	Western Indian Ocean	
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (1985)	Nairobi Convention	A regional seas convention focused on conservation and natural/living resource management. "Specially protected areas" are formally mandated in Article 10. Protocols include a Protocol on Protected Areas and Wild Fauna and Flora in the Eastern African Region, adopted in 1985, entered into force 1996	Eastern Africa (and western Indian Ocean)	
Eastern Pacific				
Convention for the Establishment of an Inter-American Tropical Tuna Commission (1949, rev. 2003)	Inter-Amer. Tuna	RFMO whose main objectives are to maintain the populations of yellowfin and skipjack tuna and other kind of fish taken by tuna vessels in the Eastern Pacific Ocean and to cooperate in the gathering and interpretation of factual information to facilitate maintaining the populations of these fish at a level which permits maximum sustainable catches year after year. [Preamble, Article II]	East Pacific	
Indian Ocean				
Agreement for the Establishment of the Indian Ocean Tuna Commission (1993)	IOTC	The Convention established the Indian Ocean Tuna Commission to promote cooperation in the conservation of tuna and tuna like species and to promote their optimum utilization, and the sustainable development of the fisheries. [Articles I and V]	Indian Ocean	
Indo-pacific Fisheries Commission Agreement (1996)	Indo-pacific Fisheries	The Agreement establishes an Asia-Pacific Fishery Commission to promote proper utilisation of the living aquatic resources of the region.	East Asian Seas, Central Indian Ocean, East Africa, Arabian Sea	

Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South East Asia	IOSTA	This MoU closely the concepts of other CMS agreements, focusing on "achieving favourable conservation status," and on development of a mutually agreed Conservation and Management Plan. Because of its ocean-oriented focus, it attempts to extend its coverage to the "high seas," by asking its parties to apply its principles to "vessels operating under [the party's] flag," and suggesting that the Conservation and Management Plan should address "fisheries by-catch" issues.	South Asia, North Africa, West Africa, Southern Africa, and the island states of the Indian Ocean.	Soft law
Mediterranean and Black Seas				
Convention for the protection of the Mediterranean Sea against Pollution (1976)	Barcelona Convention	Provides for international cooperation for a coordinated and comprehensive approach to the protection and enhancement of the marine environment in the Mediterranean area through, amongst others, pollution management, monitoring and liability provisions.	Mediterranean and Black Seas	
Protocol concerning Mediterranean Specially Protected Areas (1982)	SPA Protocol	The Protocol calls for the establishment and management of a list of Specially Protected Areas to protect and improve the state of the natural resources and natural sites of the Mediterranean Sea.	Mediterranean and Black Seas	
Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean	SPAMI Protocol	The Protocol calls for the establishment of a list of Specially Protected Areas of Mediterranean Importance (SPAMI) in order to conserve biodiversity and to contain specific Mediterranean ecosystems. Related measures include, protection and conservation of species, regulation of the introduction of non-indigenous or genetically modified species, and the improvement of the scientific, technical, and management research relevant to Specially Protected Areas.	Mediterranean and Black Seas	
Protocol for the prevention of pollution of the Mediterranean Sea by dumping from ships and aircraft.	PPPMD	Creates a system of permits for the dumping of wastes (with a specific list) into the Mediterranean and sets out procedure for dealing with emergencies.	Mediterranean and Black Seas	
Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	ACCOBAMS	Agreement among range-states, entered into pursuant to CMS, creating and committing to an action plan for the conservation of whales, dolphins and other cetaceans in and near the Mediterranean Sea. This agreement was one tool used in the creation of the Ligurian Sea Sanctuary (see legal background paper.)	Mediterranean and Black Seas	

Convention Concerning Fishing in the Black Sea	Black Sea Fishing	To promote the rational utilization of the fishery resources of the Black Sea and the development of marine fishing and to promote mutual assistance in improving fishing technique and in carrying out research in the field of ichthyology and hydrobiology for the purpose of maintaining and augmenting the stocks of fish in the Black Sea with a view to increasing the yield. [Preamble, Article 1]	Black Sea	
Agreement for the Establishment of a General Fisheries Commission for the Mediterranean (1997)	AEGFCM	Establishes a General Fisheries Commission and updates the previous agreement to reflect provisions in the U.N. Convention on the Law of the Sea relating to the conservation and management of the living marine resources. Purpose being to promote the development, conservation, rational management and best utilization of living marine resources, as well as the sustainable development of aquaculture in the Region.	Mediterranean and Black Seas	Not in force
Convention on the Protection of the Black Sea against Pollution	Black Sea	A Regional Seas convention, focused on pollution issues, but specifically including the planning of the area to protect important biological features. A protocol on Black Sea Biodiversity and Landscape Conservation was signed in 2003.	Black Sea	
Commission under the Agreement for the Establishment of the General Fishery Commission for the Mediterranean (1949, rev. 1997)	GFCM	RFMO for the Mediterranean region	Mediterranean and Black Seas	
North Africa				
Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution	Kuwait Convention	Regional Seas convention, with four protocols focused on direct threats and discharges. A draft Protocol Concerning the Conservation of Biological Diversity and the Establishment of Protected Areas was prepared in 2002, but has not been adopted.	North Africa	

Northeast Atlantic				
Agreement between the Government of Iceland, the Government of Norway and the Government of the Russia Federation Concerning certain aspects of Cooperation in the Area of Fisheries	St Petersburg Agreement	The basic purpose of the Agreement is a mutual exchange of quotas between the three Parties, combined with ceilings placed on the total catch that may be taken of particular species and a number of other undertakings, such as a duty to attempt to prevent the reflagging of vessels in order to avoid the measures contained in the Agreement. An important feature of the Agreement, however, is that Iceland will cease fishing in the high seas area of the Barents Sea (known as the "Loop Hole"), although the Agreement does not expressly state this.	Northeast Atlantic	
Convention for the Protection of the Marine Environment of the North-East Atlantic	OSPAR	OSPAR unites Northeast Atlantic states in an effort prevent and eliminate pollution in the area and to conserve marine ecosystems, specifically including areas in the high seas. Categories of sources of pollution covered include: land-based sources, dumping or incineration, offshore sources. Includes a detailed monitoring program involving cooperation between the parties and generally applying the precautionary principle. Aims for the application of an integrated ecosystem approach in the protection of ecosystems in the maritime area and provides for protective measures relating to specific areas.	Northeast Atlantic	
Convention on Future Multilateral Cooperation in Northeast Atlantic Fisheries (1980)	NEAFC	The Convention established the North-East Atlantic Fisheries Commission, which is charged with performing its functions "in the interests of the conservation and optimum utilization of the fishery resources of the Convention area." [Articles 3 and 4]	Northeast Atlantic	
Agreed Record of Conclusions of Fisheries Consultations on the Management of the Norwegian Spring Spawning Herring (Atlanto-Scandian Herring) Stock in the Northeast Atlantic for 1997.	NOR. HERRING	To promote conservation, rational utilization and management of Norwegian spring spawning herring and to provide for long-term sustainable exploitation of the stock. To this end, the parties agreed to establish, taking into account the best scientific advice available, such measures as will ensure that the spawning stock will be maintained above safe biological limits, where sufficient recruitment is ensured to allow for long-term sustainable exploitation.	Northeast Atlantic (Norwegian Sea)	

Agreement Concerning Measures for the Protection of the Stocks of Deep-Sea Prawns (*Pandalus borealis*), European Lobsters (*Homarus Vulgaris*), Norway Lobsters (*Nephrops norvegicus*) and Crabs (*Cancer pagurus*) (1952)	Shellfish Agreement	To protect the stocks of the four species of crustaceans in the seas lying between Denmark, Sweden and Norway by regulating size of mesh of nets and minimum size of crustaceans to be caught are regulated.	Northeast Atlantic, Arctic	
Convention for the Conservation of Salmon in the North Atlantic Ocean (1982)	NASCO	RFMO Creation whose main purposes are: (a) to promote the acquisition, analysis, and dissemination of scientific information pertaining to salmon stocks in the North Atlantic Ocean; and (b) to promote the conservation, restoration, enhancement, and rational management of salmon stocks in the North Atlantic Ocean through international cooperation.	Northeast Atlantic, Northwest Atlantic	
International Convention for the Conservation of Atlantic Tunas (1996)	ICCAT	RFMO whose objective is "to co-operate in maintaining the population of tunas and tuna-like species found in the Atlantic Ocean and the adjacent seas at levels that will permit the maximum sustainable catch for food and other purposes."	Northeast Atlantic, Northwest Atlantic, South Atlantic	
North-East Pacific				
Convention for Cooperation in the Protection and Sustainable Development of the Marine and Coastal Environment of the North-East Pacific (2002)	The Antigua Convention	A Regional Seas convention, broadly focused on a range of ocean environmental problems (pollution, sustainable development, and conservation.) Although not yet in force the parties have adopted an Action Plan under this document	Central American coastline of the North-east Pacific	Not yet in force
Treaty Between the Government of Canada and the Government of the United States of America concerning Pacific Salmon (1999)	Pacific Salmon	Promotes enhancement, conservation and rational management of Pacific salmon stocks between Canada and the US.	North-east Pacific	
Convention on the Conservation and Management of Pollock Resources Central Bering Sea.(1994)	Pollock	The Convention establishes an international regime (Annual Conference of the Parties, Scientific Committee) for conservation, management and optimum utilisation of Pollock resources	Bering Sea	

Agreement for the International Dolphin Conservation Programme (1998)	IDCPA	Controls on fisheries utilising equipment that harms dolphin populations (in support of governmental and other tuna labelling schemes.	Eastern Pacific	In force since 1999, but with limited membership (United States, Ecuador, Mexico and Panama)
North Pacific Anadromous Fish Commission under the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (1992)	NPAFC	RFM Agreement whose purposes is that all abutting states agree to fish for anadromous stocks only within EEZ areas. Somewhat unusual, in that the geographic area covered by the instrument is entirely/solely areas outside of national jurisdiction (*i.e.,* beyond 200 miles from national baselines in the region.)	North West Pacific; North-east Pacific (and any other North Pacific area)	
North-west Atlantic				
Convention for the Conservation of Salmon in the North Atlantic Ocean	North Atlantic Salmon	The main purposes of the Convention are: (a) to promote the acquisition, analysis, and dissemination of scientific information pertaining to salmon stocks in the North Atlantic Ocean; and (b) to promote the conservation, restoration, enhancement, and rational management of salmon stocks in the North Atlantic Ocean through international cooperation.	Northeast Atlantic, Northwest Atlantic	
International Convention for the Conservation of Atlantic Tunas (1996)	ICCAT	RFMO whose objective is "to co-operate in maintaining the population of tunas and tuna-like species found in the Atlantic Ocean and the adjacent seas at levels that will permit the maximum sustainable catch for food and other purposes."	Northeast Atlantic, Northwest Atlantic, South Atlantic	
Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries (Ottawa, 1978)	NAFO	The establishment and maintenance of an international organization whose object is to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area. [Article 2(1)]	Northwest Atlantic	
Convention for the Protection of the Marine Environment of the North-East Atlantic (1992)	OSPAR Convention	Integrating and updating the Oslo Convention (1972) and Paris Convention (1974) this instrument focuses on pollution, but increasingly addresses conservation issues. Its Annex on the Protection and Conservation of Ecosystems and Biological Diversity of the Maritime Area (1998) specifically entitles the OSPAR Commission to protect the marine environment of the North East Atlantic from all kinds of human activities, including through the designation of protected areas.	Northeast Atlantic	

North-west Pacific				
Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment	Birds, Japan Australia.	The Parties agree to protect the migratory birds and birds in danger of extinction and their environment, mainly by limiting their hunting and prohibiting their sale, purchase or exchange.	North-west Pacific /South Pacific	National juris. of signatories
Memorandum of Understanding on Port State Control in the Asia-Pacific Region. Maritime Authorities of Australia, New Zealand, Russian Federation, Thailand, Canada, Hong Kong, China, Republic of Korea (1993)	Port State Control	The Parties establish a Committee with the main task to coordinate inspection activity of foreign merchant ships in the region.	East Asian Seas, Australia/New Zealand, Northwest Pacific	Soft law
Convention on the Conservation and Management of Pollock Resources Central Bering Sea.(1994)	Pollock	The Convention establishes an international regime (Annual Conference of the Parties, Scientific Committee) for conservation, management and optimum utilisation of Pollock resources	Bering Sea	
Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment	Birds, Japan Australia.	The Parties agree to protect the migratory birds and birds in danger of extinction and their environment, mainly by limiting their hunting and prohibiting their sale, purchase or exchange.	North-west Pacific /South Pacific	National juris. of signatories
Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean (1992)	NPAFC	RFM Agreement whose purposes is that all abutting states agree to fish for anadromous stocks only within EEZ areas. Somewhat unusual, in that the geographic area covered by the instrument is entirely/solely areas outside of national jurisdiction (*i.e.,* beyond 200 miles from national baselines in the region.)	North West Pacific; North-east Pacific (and any other North Pacific area)	
South Asia				
Colombo Declaration on the South Asia Co-operative Environment Programme (1981)	SACEP	Regional sea arrangement based on, essentially an MOU to address operational responsibility, but operating otherwise through action plans and similar documents	South Asia	

South Atlantic				
Agreement instituting the Latin American Organization for Fisheries Development	OLDEPESCA	The main objective of the Agreement is to provide adequately for the food needs of Latin America and the Caribbean, using the potential of fishery resources for the benefit of the people in the region. The Organization is actively involved in areas of research in fisheries resources, exploitation of fisheries resources, aquaculture, fisheries technology, etc.	Wider Caribbean, South Atlantic, South Pacific, Southeast Pacific	
International Convention for the Conservation of Atlantic Tunas (1996)	ICCAT	RFMO whose objective is "to co-operate in maintaining the population of tunas and tuna-like species found in the Atlantic Ocean and the adjacent seas at levels that will permit the maximum sustainable catch for food and other purposes."	Northeast Atlantic, Northwest Atlantic, South Atlantic	
South-east Atlantic				
Convention on the Conservation and Management of Fishery Resources in the South East Atlantic Ocean (2001)	SEAFO	RFMO Creation agreement, including general principles agreed by all parties with regard to conservation of biodiversity and the marine environment. (Although in force, its current membership is limited (Namibia, the EU and Norway)	Southeast Atlantic	
South-east Pacific				
Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific (1981)	Lima Convention	A regional seas convention focused broadly on a range of environmental issues. A protocol on Conservation and Management of Protected Marine and Coastal Areas of the South East Pacific (1989) entered into force 1984	South-East Pacific	
Framework Agreement for the Conservation of Living Marine Resources on the High Seas of the South Pacific (Santiago, 2000)	Galapagos Agreement	The objective of the Galapagos Agreement is the conservation of the marine living resources in the high seas of the Southeast Pacific, particularly the straddling and higly migratory fish populations.	South-east Pacific	Not yet in force
Agreement instituting the Latin American Organization for Fisheries Development	OLDEPESCA	The main objective of the Agreement is to provide adequately for the food needs of Latin America and the Caribbean, using the potential of fishery resources for the benefit of the people in the region. The Organization is actively involved in areas of research in fisheries resources, exploitation of fisheries resources, aquaculture, fisheries technology, etc.	Wider Caribbean, South Atlantic, South Pacific, Southeast Pacific	

Agreement for the International Dolphin Conservation Programme (1998)	IDCPA	Controls on fisheries utilising equipment that harms dolphin populations (in support of governmental and other tuna labelling schemes.	Eastern Pacific	In force since 1999, but with limited membership (United States, Ecuador, Mexico and Panama)
South Pacific				
Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment	Birds, Japan Australia.	The Parties agree to protect the migratory birds and birds in danger of extinction and their environment, mainly by limiting their hunting and prohibiting their sale, purchase or exchange.	North-west Pacific /South Pacific	National juris. of signatories
Convention for the Prohibition of Fishing with Long Drift Nets in the South Pacific	Long Drift Nets Treaty	The convention restricts and prohibits the use of drift nets in the South Pacific region in order to conserve marine living resources.	South Pacific	
Convention to ban the Importation Into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region	Waigani Convention		South Pacific	
South Pacific Forum Fisheries Agency Convention (1979)	SPFFA	The convention establishes a Forum Fisheries Agency in order to facilitate the co-operation and provide assistance to in the development of fisheries, policies and negotiations and to collect and disseminate to Parties relevant information concerning legislation and management procedure within and beyond the region.	South Pacific	
Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the United States of America (1987)	Pacific-USA Fisheries	Regulates fishing by US vessels in Pacific Island waters.	South Pacific	
Niue Treaty on Co-operation in Fisheries Surveillance and Law Enforcement in the South Pacific Region (1992)	Niue Treaty	This Treaty provides for a co-operation of the Parties in fisheries surveillance and law enforcement, mainly by harmonising the relevant legislation of the Parties, allowing for them to extend their inspecting activities in the territories of other Parties, and exchange of relevant information	South Pacific	

Agreement instituting the Latin American Organization for Fisheries Development	OLDEPESCA	The main objective of the Agreement is to provide adequately for the food needs of Latin America and the Caribbean, using the potential of fishery resources for the benefit of the people in the region. The Organization is actively involved in areas of research in fisheries resources, exploitation of fisheries resources, aquaculture, fisheries technology, etc.	Wider Caribbean, South Atlantic, South Pacific, Southeast Pacific	
Agreement establishing the South Pacific Regional Environment Programme (1993)	SPREP (or "Noumea Convention)	Originally a South Pacific Regional Seas instrument, SPREP has blossomed into a tool for marine management and cooperation for the entire pacific non-rim area. This instrument (its primary binding document) focuses on administration enabling SPREP to extend to broader areas of cooperation. The SPREP Secretariat is the Secretariat for the Apia convention, the Waigani Convention and other instruments. There are presently two Protocols under this Convention, both dealing with pollution and discharge/disposal issues.	South Pacific (and other Pacific Islands)	
Convention on Conservation of Nature in the South Pacific (1976)	Apia Convention	Formally requires the development of protected areas and their maintenance. Does not distinguish or mention marine areas.	South Pacific	
Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean	Western & Central Pacific FSA	Delineation and implementation of the FSA in the Pacific Islands and Western Pacific	South Pacific (and other Pacific Islands); Western Pacific	
Western Pacific				
Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (2000)	WCPFC	Delineation and implementation of the FSA in the Pacific Islands and Western Pacific	South Pacific (and other Pacific Islands); Western Pacific	
West Africa				
Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats in the Indian Ocean and South East Asia	IOSEA MoU	This MoU closely the concepts of other CMS agreements, focusing on "achieving favourable conservation status," and on development of a mutually agreed Conservation and Management Plan. Because of its ocean-oriented focus, it attempts to extend its coverage to the "high seas," by asking its parties to apply its principles to "vessels operating under [the party's] flag," and suggesting that the Conservation and Management Plan should address "fisheries by-catch" issues.	South Asia, North Africa, West Africa, Southern Africa, and the island states of the Indian Ocean.	Soft law

Understanding Concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa,	Atlantic Africa Turtles MoU	A relatively straightforward framework for mutual cooperation in the conservation of turtles and their habitats. Its parties agreed to make all reasonable efforts to protect turtles at all stages of their life cycle, both legislatively and through conservation management, achieved in mutual cooperation. Integral to the MoU is the Conservation and Management Plan, which is specifically included by reference in the MoU, and will be the subject of regular meetings of the parties.	South-east Atlantic	Not in force
Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean	The SEAFO Convention	The purpose is to ensure long term conservation and sustainable use of all living marine resources in the South-East Atlantic Ocean, including the high seas, and to safeguarding the environment and marine ecosystems in which the resources occur. Parties shall in particular: (a) adopt appropriate measures to ensure the long-term conservation as well as the sustainable use of fishery resources; (b) take into due account the impact of fishing activities on ecologically related species (such as seabirds, cetaceans, seals and marine turtles); (c) adopt, if necessary, conservation and management measures for species which belong to the same ecosystem as the harvested fishery resources; (d) protect biodiversity in the marine environment.	South-east Atlantic	
International Convention for the Conservation of Atlantic Tunas	ICCAT	To co-operate in maintaining the population of tunas and tuna-like species found in the Atlantic Ocean and the adjacent seas at levels that will permit the maximum sustainable catch for food and other purposes.	Northeast Atlantic, Northwest Atlantic, South Atlantic	
Convention on Fisheries Cooperation among African States Bordering the Atlantic Ocean	Dakar Convention	Promote cooperation in fisheries conservation, management and development in the region, including the monitoring, surveillance and control of fishing vessels; to "take up the challenge" of food self-sufficiency through the rational utilization of fishery resources; to stimulate the national economic sectors through the direct and secondary effects resulting from fishery resources exploitation, bearing in mind the importance of the fisheries sector in the economic, social and nutritional development process of the people of the region; to enhance, coordinate and harmonize efforts and capabilities for the purpose of conserving, exploiting, upgrading and marketing fishery resources; and to reinforce solidarity with African land-locked States and geographically disadvantaged States of the region.	West Africa	

International Convention for the Conservation of Atlantic Tunas	ICCAT	To co-operate in maintaining the population of tunas and tuna-like species found in the Atlantic Ocean and the adjacent seas at levels that will permit the maximum sustainable catch for food and other purposes.	Northeast Atlantic, Northwest Atlantic, South Atlantic	
Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region	Abidjan Convention	A regional seas convention focused on protecting the marine environment, coastal zones and related internal waters falling within the jurisdiction of the States of the West and Central African region. Many activities are undertaken in coordination with the Nairobi Convention.	West Africa, South Atlantic	
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	CARTHAGENA	Generally promotes pollution prevention from a variety of pollution sources. Allows for the creation of Protected Areas within the Convention Area.	Wider Caribbean	
Wider Caribbean				
Agreement instituting the Latin American Organization for Fisheries Development	OLDEPESCA	The main objective of the Agreement is to provide adequately for the food needs of Latin America and the Caribbean, using the potential of fishery resources for the benefit of the people in the region. The Organization is actively involved in areas of research in fisheries resources, exploitation of fisheries resources, aquaculture, fisheries technology, etc.	Wider Caribbean, South Atlantic, South Pacific, Southeast Pacific	
Protocol Concerning Specially Protected Areas and Wildlife	SPAW Protocol	The objectives of the SPAW Protocol are to protect and preserve and manage in a sustainable way: areas and ecosystems that require protection to safeguard their special value; threatened or endangered species of flora and fauna and their habitats; and species with the objective of preventing them from becoming endangered or threatened.	Wider Caribbean	

APPENDIX 5: STATUS CHART FOR SELECTED TREATIES

This appendix has been omitted due to its unusually large size. If interested in this appendix, Please contact the author of the paper (tomme.young@googlemail.com)

BACKGROUND PAPER 6

ISSUES ARISING ON THE INTERFACE OF MPAs AND FISHERIES MANAGEMENT[1]

by

Anthony Charles and Jessica Sanders[2]

Summary

This paper focuses on three key themes. First, it highlights the commonalities between discussions of marine protected areas and of fisheries management, with emphasis on their mutual use of spatial measures and ecosystem approaches. Second, the paper draws on the other Background Papers prepared for the Workshop, as well as a range of additional literature, to produce a substantial compilation of issues and considerations relating to the development and implementation of MPAs, within a fisheries management context. This compilation is organized according to three sequential stages in the process of consideration and development of MPAs: (1) Preliminary Steps; (2) Design; (3) Implementation and Review. This structuring seeks to make clear the variety of issues to be addressed within the different stages of the process, integrated across disciplines and across types of fisheries. The third key theme of the paper is a focus on the first of the above-noted stages – the 'preliminary steps' of decision-making, in which scoping of needs, gaps and feasibility takes place from the dual perspectives of MPAs and fisheries management. A relative paucity of information and analysis on this topic is noted, along with a consequent need for additional work on the subject. An initial effort is undertaken to explore the key decision-making elements in this 'preliminary stage'.

1. INTRODUCTION

Marine Protected Areas (MPAs) are being implemented at increasing rates around the world, particularly since the call for their development and implementation in the 2002 World Summit on Sustainable Development (Johannesburg Plan of Implementation, WSSD). MPAs are taking a wide range of shapes and forms, to meet an equally wide range of objectives. Despite this diversity, a common feature of many if not most MPAs is their impact on, and interaction with, fishery systems. Such impacts and interactions have received considerable attention in the literature on MPAs and in practical implementation. A common theme, for example, is whether the implementation of an MPA will lead to long-term increases in fish stock biomasses, and thus in fishery catch levels.

On the other hand, much less attention has been paid to the potential for synergy between MPAs and the management of fisheries. Accordingly, this paper focuses specifically on the role of MPAs as a tool of fisheries management and a means of meeting fisheries management goals. The paper seeks thereby to contribute to FAO's initiative to achieve a better understanding of the linkages between MPAs and fisheries management, within the framework of the Code of Conduct for Responsible Fisheries. Indeed, the 26th session of the FAO Committee on Fisheries (COFI) noted that "MPAs have potential benefits as a fisheries management tool..." (FAO 2005) and that there is a need for an appropriate legal framework for MPAs, a scientific basis, and effective monitoring and enforcement.

The paper has been organized into seven sections. Following this first introductory section, the second section explores the range of MPA definitions and objectives being pursued through MPAs. Section three describes how MPAs and fisheries management are linked in three ways – through the common avenue of spatial management, through the Ecosystem Approach to Fisheries, and through the policy

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[1] This paper was produced for the FAO Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations (12–14 June, 2006).

[2] The views expressed in this paper are solely those of the authors, Anthony Charles (Saint Mary's University, Halifax N.S. Canada: tony.charles@smu.ca), and Jessica Sanders (FAO Consultant, jessica.sanders@fao.org).

context. The fourth section describes the variety of forms (models) and scales of MPAs. The fifth section first presents a structure within which to explore the linkages between MPAs and fisheries management, based on three major stages: (1) a preliminary stage of initial aspects and policy/legal frameworks, (2) the design stage, and (3) implementation, management, monitoring and assessment. This is followed by an extensive listing of the various issues and considerations arising on the topic, and a synthesis of those issues. Section six goes into detail on the 'preliminary stage' of MPA decision making, noted above, within which the objectives and approaches of both MPAs and fisheries management must be examined. Finally, section seven provides a closing discussion. Throughout the paper, the recommendations of the five background documents associated with the Workshop, as well as other relevant research, are incorporated to the extent possible.

2. DEFINITIONS AND OBJECTIVES OF MPAs

2.1 Definitions

Among scholarly studies on marine protected areas, and among the range of international, national and nongovernmental initiatives to implement MPAs, there is a considerable diversity of views of what exactly should be considered an MPA. This diversity has arisen because MPAs are used for a wide range of purposes, and take a wide range of forms (depending on how wide the net is cast of what is included as an MPA). What is common to all the definitions is an understanding that an MPA is in the 'marine' environment, it is an 'area' of ocean space, and it is 'protected' in a manner beyond that of neighbouring areas.

These fundamental features are reflected in what is perhaps the most widely accepted definition of an MPA, that produced by the IUCN:

> *"Any area of intertidal or subtidal terrain, together with its overlaying waters, and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."(IUCN 1994)*

An extension of this definition has been put forward (although not yet formally agreed upon) by the Convention on Biological Diversity, a major forum for discussion of MPAs:

> *"'Marine and Coastal Protected Area' means any confined area within or adjacent to the marine environment, together with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that it's marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings." (CBD 2002)*

While these definitions are often quoted, there remain elements of debate, and indeed variations on what is considered to *be* an MPA, and what types of spatial measures are considered as MPAs. This has been blamed for problems involving misuse and abuse of the term[3]. Certainly, confusion can result: in referring to MPAs, some exclude anything other than 'no-take' areas in which no resource use is allowed, others exclude single-sector fishery closed areas, others exclude large-scale zoned areas, while many others take a broad and inclusive view of the term MPA. While a common understanding would make discussion easier, there is also debate over the utility of pursuing a single internationally accepted definition – since a multitude of individual jurisdictions have already adopted their own definitions.

There remains a further challenge with respect to fisheries specifically, in that most definitions have not explicitly included fisheries management considerations. This has led to additional confusion in that some refer to the idea of separate "fishery MPAs" (whether or not this simply means a fishery

[3] Such as at the Conference on Marine Biodiversity, Fisheries Management and Marine Protected Areas (Brussels, 10 November 2005)

closed area). There is no consensus over the usefulness of such a term, but rather a widespread sense that in terms of the role of MPAs in fisheries management, it would be more helpful to work with existing definitions, to focus these on the key MPA-fishery interactions.

2.2 Objectives

Each MPA is implemented to achieve some sub-set of what is in reality a wide variety of potential objectives. Indeed, there have been many listings made of the possible benefits provided by MPAs. An illustration of such a list is that of the Independent World Commission on the Oceans (1998: p.200):

- "protection of marine species at certain stages of their life cycle;
- protection of fixed, critical, habitats (e.g., coral reefs, estuaries);
- protection of cultural and archaeological sites;
- protection of local and traditional sustainable marine-based lifestyles and communities;
- provision of space to allow shifts in species distributions in response to climate and other environmental changes;
- provision of a refuge for recruits to commercial fisheries;
- provides a framework for resolving multiple stakeholder conflicts;
- provides models for integrated coastal zone management;
- provision of revenue and employment;
- provision of areas for scientific research, education, and recreation."

In addition to these, other indirect objectives could be envisioned, such as the following:

- Generating 'spin-off' benefits to the coastal economy, thereby helping to diversify the economy (e.g. through tourism and conservation work), which in turn can reduce stress on fish stocks.
- Providing a hedge against uncertainty, a form of conservation 'insurance policy' (Dugan and Davis 1993; Holland and Brazee 1996; Rowley 1994).
- Generating non-market values such as (a) non-use value (e.g. increased oxygen production from the sea), 'existence value' (the societal value derived from the existence of the MPA), and 'option value' (the value of maintaining a marine ecosystem for future use).

Among the many objectives MPAs may be designed to meet, some are directly fishery-related – for example, an MPA in the form of a closed spawning area may be put in place explicitly to improve fishery yields and sustainability by protecting spawning fish, and an MPA on a tropical coral reef may be designed to both improve reef quality and increase fish biomasses, thereby supporting the fishery. Even MPAs implemented with an emphasis on other economic sectors (e.g. tourism, recreation), on marine conservation and biodiversity goals, or on other values in the marine environment, will likely indirectly affect fisheries, even if no fishery-specific objectives are in place.

In such cases, attention may well be paid to the possible *impacts* the MPA has on fisheries, whether positive (e.g. long-term increased biomass) or negative (e.g. decreased short-term yields). While there may also be some attention paid to fisheries management needs, it has been less common for MPAs to be designed to serve fisheries management goals *per se*. This paper focuses on the idea that, whether new marine protected areas are being contemplated or existing ones adjusted, it can be useful to focus more on opportunities to consider the role of MPAs in meeting fisheries management objectives.

Whatever the mix of objectives being pursued, it will be important to assess the extent to which the potential benefits of the MPA (as listed above) are being realized, relative to the costs that will likely arise in the establishment of the MPA – including direct management costs (additional costs incurred to manage the MPA), as well as opportunity costs (e.g. foregone catches, due to restrictions in the MPA). With respect to fisheries management, it will be important to understand the balance of costs and benefits involved with the use of MPAs, in comparison with other management tools, in order to undertake evaluations of the MPAs in meeting objectives, both fishery-related and otherwise. Equally, it is important to examine distributional considerations, since each of the benefits and costs of MPAs may impact in differing ways those affected. This involves assessing (1) who is receiving the benefits and who is incurring the costs, as well as (2) how benefits and costs are distributed spatially (including at local, regional and national levels) and over time.

3. LINKING MPAs AND FISHERIES MANAGEMENT

3.1 Spatial management

All Marine Protected Areas – and indeed all protected areas, whether marine or terrestrial – have in common the fact that, by definition, they are forms of *spatial management*. A management measure is spatial in nature if it is geographically-defined, and implemented within certain delimited sub-areas of a given jurisdiction or management area. It is important to highlight the idea of a sub-area, in the sense of drawing a clear distinction between an MPA on the one hand, and on the other hand, management measures that apply throughout the jurisdiction or management area in question (whether that be the EEZ of a nation, or an entire statistical area designated by a regional fishery organization, or the entire area of a municipal fishery in the Philippines).

Spatial management, in turn, is a well established component of fisheries management, notably in terms of fishery 'closed areas' that typically protect spawning or juvenile fish (discussed below). It is crucial to assess and understand how MPAs and other spatial management measures fit within the 'toolkit' of fisheries management – along with effort/input controls, quota/output controls, and technical measures. Conversely, it is important to see how fishery-oriented closed areas – as spatial management measures developed for fisheries management – mesh with moves toward establishing protected areas having broader objectives.

3.2 Ecosystem approach to fisheries

Since MPAs provide protection on a spatial basis to components of marine areas, it is useful to view the connection of MPAs to fisheries management in the context of the Ecosystem Approach to Fisheries (EAF). The EAF broadens the approach to fisheries management, and to utilization of fisheries, by placing the fishery within the context of the surrounding ecosystem, as well as by incorporating relevant human interactions [e.g. FAO 2003, Garcia *et al.* 2003]. As noted in the FAO Technical Guidelines for Responsible Fisheries (FAO 2003):

> "an ecosystem approach to fisheries (EAF) strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries"

From the perspective of EAF, it is important for fisheries management to take into account the impacts of fishing on the ecosystem, and conversely, the impacts of the ecosystem and of other human uses of that ecosystem, on fisheries. Martin *et al.* (2007) have noted that MPAs can play a role in this:

> "MPAs may be viewed as a complement to other fisheries management tools and integrated with sustainable management practices over the wider marine environment."

Indeed, it has been argued in many contexts that MPAs, and fisheries management for that matter, often fit within a larger context of integrated ocean and coastal management. For example:

> "To be effective on a wide scale, MPAs should be embedded within large planning frameworks such as integrated coastal management (ICM)… These frameworks are designed to balance resource management and economic development, consider ecologically-significant processes, and encourage cross-sectoral planning." (Christie and White 2007)

3.3 The policy context of MPAs and fisheries management

Although spatial management – notably in the form of closed areas – is not new as a tool of fisheries management, the particular integration of MPAs into fishery policy frameworks is evolving. The varying roles, definitions, and uses of MPAs on domestic, regional and international scales are still subject to debate. However, there do seem to be certain recurring aspects of a policy and institutional nature that need to be understood to provide a larger understanding of how MPAs connect within marine conservation and fisheries management regimes. Some of these key aspects are noted in the template of Table 1, which includes:

- the departments/agencies involved or responsible for MPAs
- whether an MPA policy is in place within the jurisdiction
- the integration of MPAs into a larger policy frameworks of ICM or IOM
- the extent of application and incorporation of EAF within fisheries policy
- the definition of an MPA in the particular jurisdiction/organization
- the spatial dimensions of the jurisdiction's principal fisheries
- whether the definition or use of MPAs includes the following fisheries management tools: (1) Closed fishery area, (2) Fishery zoning, (3) Habitat conservation for fisheries management
- whether the country/region has other spatially managed areas that might provide protection or sustainable management of fisheries, apart from those identified as MPAs.

The headings in Table 1 constitute a set of key elements relating to the interaction of MPAs and fisheries management, and accordingly, if the Table were to be completed for relevant countries, regions, sub-national jurisdictions and/or organizations, this could provide a vehicle for comparing how MPAs and fisheries management interact, across jurisdictions and/or organizations. In turn, such an assessment of the international diversity with which spatial protection is applied within varying policy situations could lead to insights into 'best practices' in the application of MPAs to fisheries management, and into 'gaps' and areas for further research. To maximize the utility of Table 1, the set of information compiled could be combined with that produced in current projects that are helping to inform MPA implementation (e.g. with respect to management effectiveness), and efforts to catalogue MPAs globally.

TABLE 1: Template for Policy Analysis of MPAs and Fisheries Management

Country/ Organization	Departments involved or responsible	MPA Policy in place?	Application and incorporation of EAF in Fisheries Policy	What wider ocean/coastal management regimes are in place (IOM ,ICM, etc)?	Definition of an MPA	What are the spatial dimensions of the jurisdiction's principal fisheries?	Does the country/region have other spatially managed areas that might provide protection or sustainable management of fisheries which are not identified as MPAs?	Are the following fisheries management tools included in the country's/organization's definition or use of MPAs?	
NON-GOVERNMENTAL AND INTERGOVERNMENTAL ORGANIZATIONS									
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
COUNTRIES									
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
REGIONAL BODIES									
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	
								Closed fishery area	
								Fishery zoning	
								Habitat conservation for fisheries mgmt	

4. TYPES AND SCALES OF MPAs IN THE CONTEXT OF FISHERIES MANAGEMENT

4.1 Diverse models of MPAs

A key challenge in assessing the role of MPAs in the context of fisheries management lies in the multiplicity of forms they can take. As Martin *et al.* (2007) note:

> "MPAs are a flexible tool encompassing a range of management options, from smaller, strictly protected no-take reserves to larger, zoned multiple use areas where different activities are carefully managed."

Of the various forms MPAs can take, some key examples include:

- spatial limits on fishing areas (as well as simple fishery closures)
- 'no take' areas in which there is a complete prohibition on entry or resource extraction
- areas with ocean zoning schemes or other comprehensive controls on usage
- areas with regulation of specific designated activities, e.g. modes of fishery production
- territorial rights systems and allocation-oriented area regulation

Each of these forms of MPAs is discussed briefly below.

4.1.1 Fishery closed areas

Every fishery textbook covers the use of 'closed areas', specific parts of a fishery management jurisdiction within which fishing (whether all fishing or that for certain species or using a certain method) is prohibited, most often to protect the spawning or juvenile fish on spawning and/or nursery grounds therein. A closed area is a form of spatial management, as discussed above, contrasting with non-spatial management tools, such as limiting the size of mesh in fishing nets, that typically apply *throughout* the range of the competent authority, as opposed to a sub-area within it.

In closed areas, the closure may be temporary (seasonal) within a given year, perhaps during a spawning period, or it may be permanent. In either case, however, the restriction is most often focused on a specific activity, such as fishing for a certain species. For example, fishing for groundfish may be prohibited in a closed area known to be a cod spawning ground, but fishing within that area may be permitted for shellfish. One of many examples of a permanent but limited closure is the 'haddock box', a designated area of ocean space on the Scotian Shelf off Nova Scotia, Canada. This area was identified by fishers as being important for spawning and as a juvenile area for haddock. Fishers themselves therefore pushed for, and consistently support, a prohibition on targeting the haddock stock within the 'box'. The fishers are convinced that protecting the area is both in their own self-interest and the 'right thing to do' in conserving the haddock stock.

Fishery closed areas are typically narrowly-targeted and fishery-focused, having the advantage that their purpose is very apparent and clear-cut. Fishers, for example, can see that the goal of a fishery closure is to protect and conserve a specific stock. On the other hand, their narrow focus means that while such closed areas may provide indirect ecosystem benefits, they cannot be expected to provide comprehensive protection or management of the designated spatial area (nor of the full ecosystem, however defined). In other words, closed fishery areas are certainly spatial management measures, and may fit within many definitions of what is considered an MPA, but they are but one specific class of spatial measures.

4.1.2 No-take reserves

While a fishery closed area is specifically and usually solely designed as a fisheries management measure, 'no-take reserves' typically have broader, more ecosystem-level, goals. These types of spatial measures are generally MPAs in which no extractive activities are permitted – they may well permit tourism and recreational activities, such as diving and boating, but are essentially meant to be parts of the ecosystem relatively unaffected by human use. The establishment of such an MPA may reflect a specific objective, such as protection of a fragile or unique habitat, while a system of several no-take areas could serve the broader pursuits of biodiversity conservation and ecosystem well-being. It has been suggested that no-take reserves can also serve as tools for public education and as a means to reflect "heritage and moral values" (Ballantine 1994: 210). To gain acceptance, no-take reserves have tended to be relatively small in size, albeit possibly within the context of a network of such areas, or within a zoned approach (see below). However, the idea of closing most of a fishery management jurisdiction through 'large space-time refuges' has been suggested as well (Walters 1998). Early examples of no-take reserves are New Zealand's Leigh Marine Reserve established in 1977 (from Cape Rodney to Okahari Point) (Ballantine 1996); France's Scandola Nature Reserve established by decree in 1975 (Mabile and Piante 2005); and the Philippine's Sumilon Reserve gazetted in 1974 (Russ and Alcala 1999).

4.1.3 Ocean zoning

Ocean zoning refers to the practice of specifying the kinds of activities allowable within each of a set of sub-areas ("zones") within an overall geographically-defined area. This produces what can be seen as a larger-scale multiple-use MPAs, usually designed from a multi-objective perspective. In a zoned marine region, there could be (for example) an interior no-take area at the 'core' of the MPA, together with selective use limitations (e.g. on fish harvesting) throughout the MPA, often with a declining level of stringency further from the core. From a fishery perspective, one could envision conservation and stock rebuilding efforts in outer zones of the MPA, being aided by larval migration from no-take areas, and potentially efforts to reduce the pressure on the fish stocks through economic diversification in neighbouring coastal communities. King (1995: 282) notes that a multi-use MPA might include zones ranging from preservation zones (no access allowed) to recreational zones (with only regulated recreational fishing allowed) to traditional fishing zones (with exclusive fishing rights held by local fishers) to scientific and experimental zones. Perhaps the best known zoned MPA is the Great Barrier Reef Marine Park (GBRMP) in Australia – roughly 350 000 square kilometres, approximately 2 500 individual reefs, and varying levels of protection relating to a range of uses (Independent World Commission on the Oceans, 1998: 199).

4.1.4 Spatial restrictions on mode of production

Increasingly, spatial management is being used in fisheries in ways more elaborate than the classic 'closed area' described above. In many jurisdictions, patchworks of area-specific restrictions have developed, in which a range of spatial restrictions are imposed on specific fishery sectors (e.g. recreational), or specific modes of production (e.g. large-scale or industrial fleets) and gear types (e.g. bottom trawling). Not only do these situations often involve a wide variety of spatial restrictions, the measures are put in place for varying purposes – notably (a) for conservation, habitat protection, etc., or (b) for allocation and/or conflict resolution.

4.1.5 Access rights in small-scale fisheries

Spatial management tools such as those that deal with access rights can play a large role in general fisheries management, but have become increasing important in the management of small-scale fisheries. Territorial use rights in fishing (TURFS) and customary marine tenure (CMT) are rights-based approaches in which rights are assigned to individuals or groups. Such systems can be representative of traditional use patterns and exist in many areas of the world (Christy 1982; Charles 2001). Examples of the widespread successful use of these systems is apparent in Chile where TURFs have been allocated in the form of Management and Exploitation Areas for Benthic Fisheries (MEABR), and are supported through legislation. Such arrangements can be a feasible option for small-scale artisanal fisheries and have enjoyed success in Chile, producing long-term benefits in terms of the economic welfare of fishers, the strengthening of monitoring and management, and reduced costs (Defeo and Castilla 2006). TURFs can be beneficial, particularly, in areas where the central governance system is weak or distant. The assignment of rights to local fishers can provide a powerful incentive for sustainable management of fisheries. These systems represent yet another form of spatial management, which is defined by some as a type of marine protected area.

4.2 Varying scales of marine protected areas

The discussion of MPAs and their role in fisheries management must also take into account the wide range of scales of MPAs – from the local, community and sub-national levels, through to those that cross national boundaries, and indeed those that may be implemented on the high seas beyond national jurisdiction.

4.2.1 Local, community and sub-national MPAs

Most MPAs are of a scale that fits easily within the borders of a given nation. Indeed, many are of a local and/or community level – as is common in the Philippines and in well-known cases such as that of Soufriere in St. Lucia (eastern Caribbean). On the other hand, the Great Barrier Reef in Australia, and the recently declared MPAs of the Northwestern Hawaiian Islands Marine National Monument composed of 362 062 km^2 in the United States (June 2006) and the 184 700 km^2 Phoenix Island Protected Areas in Kiribati (April 2006) are examples of large MPAs that nevertheless fit within a nation's borders (White House 2006; MPA News 2006a). While the complexities of all these MPAs can be considerable, they obviously avoid the challenges of international considerations, found in the two cases discussed below.

4.2.2 Regional and transboundary MPAs

Transboundary spatial management is becoming more feasible as instruments to facilitate the development of marine protected areas across borders are developed. An instrument that currently supports planning to create MPAs across national boundaries of members is the Barcelona Convention and its Protocol concerning Specially Protected Areas and Biological Diversity (Young 2007). Regional Fisheries Management Organizations (RFMOs) are also beginning to address issues of resource sustainability through spatial measures, including the use of MPAs. RFMOs, in fact, need to apply principles of sustainability under the UN Convention on the Law of the Sea (UNCLOS) which implies that they are expected to "to establish conservation and management measures to facilitate joint assessment of stocks and ecosystems, and ensure that the biodiversity of aquatic habitats and ecosystems is conserved and endangered species are protected" (Young 2007). However, only a few RFMOS have incorporated this aspect of management informally into their 'toolbox', and many have yet to address this issue, representing a serious weakness in global and regional governance regimes (Molenaar 2005)

4.2.3 Areas beyond national jurisdiction ("the high seas")

Spatial management is now being considered in areas governed by international or regional agreements, or in areas only governed by the regime of the high seas. As interest grows in the resources of such areas, including both demersal and highly migratory and straddling stocks, as well as in corresponding resource management and research approaches, various management regimes are being considered and debated internationally. Many of the issues associated with coastal or offshore (within-EEZ) MPAs carry over directly to questions relating to the high seas. Despite the differing history of fishery management and diversity of management regimes, many of the conversations on the benefits and costs of MPAs within national jurisdiction are also applicable to the seabed, water column and ocean surface of the high seas. Though few in number and rarely designed for fishery management purposes, examples of such spatial protection measures do exist in the high seas. For example, the North East Atlantic Fisheries Commission (NEAFC) established a temporary ban on trawling and use of static gear over seamounts in its jurisdiction to protect "vulnerable deep-water habitats."(NEAFC 2004) Efforts to identify international regimes through which to establish MPAs are ongoing, although discussions relating to spatial protection for fisheries management in this are still nascent. Indeed, there is still much debate internationally as to whether such measures are feasible and necessary in the high seas.

5. ISSUES ARISING AT THE INTERFACE OF MPAs AND FISHERIES MANAGEMENT

This section first presents a 3-stage process for assessing the links of MPAs and fisheries management, then provides a preliminary listing of issues, questions and considerations that may arise in addressing the potential for and implementation of MPAs (including high seas MPAs), with emphasis on the fisheries management context.

5.1 MPAs and fisheries management: decision-making stages

There is an abundant literature on the process of fisheries management, and a rapidly growing literature on MPA design and implementation. However, when one examines the linkage between these two – MPAs and fisheries management – there arises a need to adjust the analysis somewhat to effectively combine two related but different processes. On the one hand, in MPA implementation, one might typically begin by determining the goals of the MPA, where it should be located, suitable dimensions and internal regulations, among other details required to best meet the goals. On the other hand, in considering fisheries management, one might begin by examining the fishery goals being pursued, along with the current management realities and needs, before choosing suitable tools from the 'toolkit' of fishery management. However, when we are looking at both MPAs and fisheries management together, it is not enough to carry out these processes separately.

Instead, we must initially integrate, simultaneously within a 'preliminary stage', an understanding of fisheries management needs and MPA needs, as well as the current state of the world, in terms of the fisheries management tools already in place, and whether MPAs are already in place. Questions that arise in this preliminary stage may include: What are the fisheries management needs? Can an MPA help meet those needs? What non-fishery needs motivate MPA implementation? Is an MPA a feasible tool to meet the various fishery and non-fishery needs?

The nature of this combined examination of MPAs and fisheries management leads to a modified process, based on three sequential stages in the process of consideration and development of MPAs: (1) Preliminary; (2) Design; (3) Implementation and review.

5.1.1 Preliminary issues

This preliminary stage is intended to address the issues that might be faced before the actual decision of implementing an MPA is taken. Many questions are posed that might determine whether an MPA is indeed feasible or desirable for a specific area, and in particular, whether an MPA fits with the needs and current reality of fisheries management (or alternatively, whether it is motivated by other goals). This is an initial 'scoping' stage in which information on the nature of the marine system, and the fishery, is gathered to determine the most effective method or tool necessary to address the problems at hand. The preliminary stage may also provide an appropriate avenue for making decisions on the best possible method for addressing international obligations, implementing the precautionary approach, and adopting different avenues for management proactively to avoid future fisheries problems.

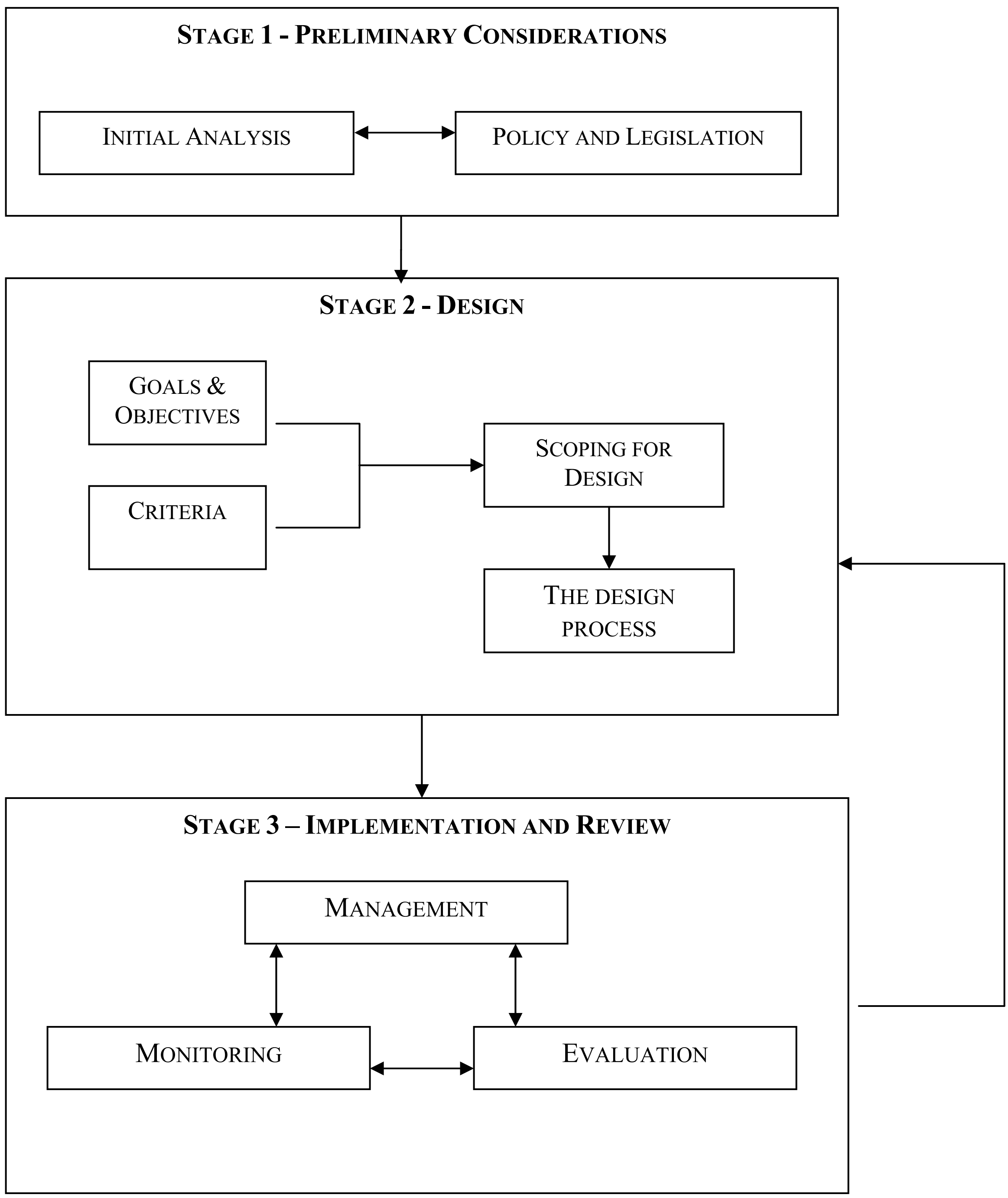
5.1.2 Design

In the Design stage, the decision to implement an MPA has already been made, and the focus turns to an initial concentration on goals and objectives to be met, as well as criteria (i.e. criteria established for particular MPA regimes within a nation, region or internationally). This is followed by the scoping phase for design of the MPA, which includes suitable assessments (biological, socioeconomic, etc.) to determine feasibility in a specific area as well as appropriateness of the selected fisheries management measures to meet the issues faced by the fishery and community. Once these questions are addressed this stage flows into the actual design process, which has been the subject of abundant MPA literature.

5.1.3 Implementation and review

The last stage in the process incorporates management, monitoring and evaluation components. All of these are key to an effective MPA, whether or not it is related to fisheries management. Furthermore, these can be seen as providing feedback into the design stage, as an essential ingredient of adaptive management.

The structure of the 3-stage process is reflected in the diagram presented below.



5.2 Issues and considerations at the interface of MPAs and fisheries management

This section of the paper presents an extensive listing of issues and considerations that arise in terms of the interactions between MPAs and fisheries management, and particularly the role of the former (MPAs) in carrying out the latter. The list is organized to follow the 3-stage structure described above, with sub-headings within each stage. Within the first stage of the process, the issues in each component are presented in two groupings: issues relating to the MPA-Fishery Interactions, and general issues. In the second and third stage (Stage II — Design, and Stage III — Implementation and Review), the issues presented within each component are organized under three groupings: (a) Stakeholders and Participation; (b) Management System; and (c) Structure, Information, Uncertainty.

It should be noted that a listing of issues, such as this, may facilitate the step-by-step assessment of MPAs in the context of fisheries management, but it cannot represent *guidelines* for the actual implementation of an MPA. The question of how to actually carry out the steps necessary to create an MPA is a separate one, which has been addressed by many others (e.g. Sobel 2004) and will not be dealt with here.

Issues and Considerations at the Interface of MPAs and Fisheries Management

[citations for the papers commissioned for the Workshop use only the last name of the author[s]]

STAGE I - PRELIMINARY CONSIDERATIONS

STAGE I, SECTION A: INITIAL ANALYSIS

I - A.1 Issues Relating to MPA-Fishery Interactions

1. What issues are being faced in fisheries management?
2. What societal objectives are being pursued with respect to (1) fisheries, and (2) marine management?
3. What international goals or commitments drive and/or constrain how the issues are addressed?
4. With respect to both the issues faced and the objectives pursued, are spatial management measures potentially feasible (e.g. from a biological/species and a governance perspective) and beneficial? Has a preliminary analysis been done of the possibilities of spatial management?
5. Within the realm of spatial management, is a marine protected area the appropriate spatial tool? (Or does the concept of "MPA" encompass all spatial management measures for the jurisdiction involved?) In the specific circumstances being addressed, is there a priority to meet biodiversity conservation goals or fisheries management goals (or alternatively, a combination of goals)? Are there variations in addressing these questions across local, national, regional, international levels?
6. If an MPA (or MPA network) is being considered as one of the fishery management tools for a specific area or species, how effective is it expected to be as a tool (either solely or in conjunction with other measures) for management of the specific species, ecosystem and/or administrative area?

7. What level of cooperation is needed to develop MPAs and MPA networks, whether internationally (e.g. within the UN system) or domestically? What is the role of UN agencies, regimes and agreements? What should be the role of domestic or regional departments or agencies?
8. If MPA networks with mixed objectives are desirable, how can MPAs with a fisheries focus be integrated? Is this desirable? How does this vary across national, regional and/or global scales?
9. What mechanisms can assist in identifying short-term and long-term legal/institutional goals for MPAs? Is there integration with long-term and short-term fisheries management goals? If not, would this integration be beneficial?

I - A.2 <u>Generic MPA Issues</u>

1. What is the appropriate scale for an MPA in the given circumstances? What is the knowledge base with respect to MPAs of this scale? Can available research on small-scale MPAs be 'scaled up' to larger scale situations, or vice versa? What would be the appropriate institution, group and/or mechanism to do this? What research is need on this?
2. In light of studies indicating current relatively high rates of unsuccessful implementation and/or management of MPAs, what lessons can be learnt, or what analysis should be undertaken, to proactively avoid the risk of this occurring?
3. What is the role of large-scale spatial management – notably Large Marine Ecosystems (LME) and large MPA networks - and under what circumstances is such management feasible? What analyses are needed of corresponding institutional structures? With respect to establishing large MPA networks, what approaches can lead to broad international acceptance of these, or should these be pursued only in contexts for which the institutional and financial means are available in all the nations involved?
4. *On the high seas:* Can MPAs offer an opportunity to address illegal fishing (IUU) through establishing a strong enforcement and compliance scheme? (Martin *et al*.) How can current illegal fishing on the high seas be dealt with and how can IUU fishing be reduced in order to make potential high seas MPAs effective?

STAGE I, SECTION B: POLICY AND LEGISLATION

I - B.1 <u>Issues Relating to MPA-Fishery Interactions</u>

1. In within-nation situations, which ministry is responsible for marine protected areas, or is this divided among ministries, or are there sub-national (provincial, state) jurisdictions responsible? Which ministry is responsible for fisheries management? Is there coordination between the different ministries?
2. *On the high seas:* What agency/department/organization/etc. would be responsible for high seas MPAs? And what would be the roles of the many potentially-involved agencies or organizations, including fisheries related organizations?
3. At a regional/multi-national level, is there multilateral regional jurisdiction for MPAs? for fisheries management? Is there a need for the creation of new regional organizations with all-inclusive mandates?
4. Would greater integration within national and international agencies/departments be beneficial, to serve fisheries management and marine conservation goals? If so, how can overall policy be made efficient and well organized?
5. Is there a need for an overall policy or plan for use of spatial restrictions for fisheries management (or for other [broader] management goals) within the EEZ?

6. Is an ‘integrated management’ approach (e.g. Integrated Ocean Management or Integrated Coastal Management) useful for MPAs in fisheries management contexts? How is this best linked to the Ecosystem Approach to Fisheries?
7. Does harmonization exist between MPA and other fisheries management legislation and existing legal frameworks? How can synergies between fishery legislation and environment/conservation legislation be promoted and strengthened? Have the requirements of existing fisheries legislation been incorporated into MPA management plans wherever possible? (Martin *et al*.)
8. With respect to international coordination, is there a need for an internationally accepted definition of an MPA? Is the IUCN definition sufficient for marine situations, i.e. MPAs? Is it encompassing of fisheries management areas? What categories of MPAs should be envisioned, in terms of interactions with fisheries management? Do the IUCN categories apply well enough to MPAs in general, and to interactions with fisheries management in particular?
9. *On the high seas:* In considering high seas MPAs, if this option is pursued, is there a need for a different definition that more closely reflects the high seas situation? Do the IUCN categories fit high seas MPAs? Is it relevant to categorize such MPAs, and if so, are new categories needed? How do these questions relate to the interaction of high-seas MPAs and fisheries management?

I - B.2 <u>Generic MPA Issues</u>

1. In cases of combined marine and terrestrial protected areas, how can management be made effective?
2. Is there a need to recognise the MPAs of varying scales, governance regimes, and locations (i.e. distance from shore) in a legal sense?
3. Are appropriate policy mechanisms in place to address the maintenance and enforcement of an MPA? If not, how can this be addressed? [*On the high seas:* What international legal framework is needed to address compliance, enforcement, and implementation on the high seas?]
4. Has integration of MPA-related governance instruments and approaches, both in and beyond national jurisdiction, taken place where necessary? [*On the high seas:* Integration of instruments could prove to be particularly important, given the necessity for cooperation among all ocean users.]
5. From a legal standpoint, has there been adequate consideration of the three-dimensionality of marine spaces (i.e. the seabed, water column, ocean surface, and even the air column above – which contrasts with the typical 2-dimensional terrestrial situation), and how MPAs fit into that?
6. On the high seas: *How is it best to deal with the reality that none of the available international instruments include all the main ocean user countries as parties?*
7. Are the laws and legislation dealing with MPAs effective? Have indicators of excellent legislation been identified? Have these been put into practice? [Ingredients may include clear and direct legal authority, relationship between mandate and the nature of provisions selected, direct connection between the proposed legal approaches and practical objectives, etc.] (Young)
8. Have existing mandates and instruments been taken into consideration?
9. Is the legislation controlling an MPA consistent with relevant international instruments?

10. *On the high seas:* Are there significant gaps regarding the management of high seas resources for RFMOS, and if so, how can these be addressed? What is the extent of RFMO jurisdiction, and to what extent can MPAs be established for different purposes within the potential RFMO jurisdiction?
11. Have the possible gaps been addressed in MPA legislation and instruments (in addition to the gap of incomplete accession) for surface activities, demersal fisheries and other biological resources, seabed biodiversity and resources? (Young) If not, what are appropriate methods through which to manage or correct the identified gaps?

STAGE II –DESIGN

STAGE II, SECTION A: GOALS AND OBJECTIVES

1. Do the goals for the scope and purpose of MPAs reflect a balance between scientific and human (social and economic) needs and realities? (Pomeroy *et al.*)
2. Are the goals and objectives well-defined and stated in a clear way?
3. Are possible conflicts and trade-offs in objectives taken into account (e.g., between biodiversity conservation and fisheries management)?
4. If fisheries management is a secondary rather than a primary goal, how is this taken into consideration? Is there communication and coordination between the different departments or agencies involved? Is there confusion between spatial areas of differing names [e.g. MPA, MMA (marine managed areas), FMA (fisheries managed areas)]? Is it necessary to choose one of these, or is a mix desired?

STAGE II, SECTION B: CRITERIA

1. What are the criteria for identifying priority areas/habitats for MPAs, and the amenability to spatial management of species and fisheries within the area in question? What is the appropriate balance of scientific, social/economic or management-related criteria? Indeed, is there sufficient understanding of the various values (e.g. the genetic, ecological and socio-economic values of marine biological diversity) to develop appropriate criteria and set an appropriate balance? Do the criteria include amenability of species within the area in question to spatial management? If so, are adequate data available to determine feasibility?
2. Is there a need for identification of biogeographic areas/distribution, e.g. possibly for ensuring representativeness of the MPA? If so, who will address this?
3. Do MPA selection criteria address and coordinate relevant legal frameworks regarding tenure, durable resource-use rights, and the rights of offsite persons (coastal landholders, marine resource users, users of general rights regarding shipping and passage, NGOs, conservationists, researchers and others)? Do the selection criteria reflect the different needs, objectives, and legal issues of marine protection? (Young)

STAGE II, SECTION C: SCOPING FOR DESIGN

II - C.1 <u>Stakeholders and Participation</u>

1. How can issues of communication be addressed in order to avoid conflict? Has communication about the purpose and intent of the MPA been clear and transparent and presented early in the process (thereby allowing any misperceptions to be addressed)?

2. Do the stakeholders and the local and national governments sense a need for and understand the process of implementing the MPA? (Christie and White)
3. Is stakeholder participation incorporated in all stages from goal-setting to evaluation? Have the best processes been determined to meaningfully engage all stakeholders? Is responsibility and authority being shared, by bringing diverse stakeholder groups, including resource users, into MPA decision-making and management processes? Have people, individually and as a group, been made to feel that they have been part of the decision-making process of the MPA, and been able to actively participate in and influence the process? Has there been attention to determining the best mechanisms to gain acceptance of the MPA? (Martin *et al.;* Pomeroy *et al.*)
4. Is appropriate information available on socioeconomic issues? Has a socioeconomic assessment been done that can be used to learn about the social, cultural, economic and institutional context and conditions of individuals, groups and communities, and identify the potential impacts of the MPA? (Pomeroy *et al.*)

II - C.2 <u>Management System</u>

1. Have cultural traditions and values – which will shape perceptions and attitudes towards MPAs – been kept in mind? (Pomeroy *et al.)*
2. Have traditional and/or local forms of management, governance, and knowledge systems, including informal or customary resource use rights, been taken into consideration? (Pomeroy *et al.)*
3. Have the means by which households adapt to reduce their risks, the incentives that drive the decisions of resource users, and the sources of vulnerability to stresses and shocks been properly investigated and understood? (Pomeroy *et al*.)
4. Since legal tools for MPA management will facilitate their development, acceptability and implementation, have these been developed or embedded within existing legal frameworks as far as possible? (Martin e*t al*.)
5. What other fisheries management tools, determined to be useful in the preliminary stage and relevant to the type of fishery and type of MPA, are already in place or being considered for use in combination with the MPA? Has research on the species present in the targeted area been adequate to determine the type of protected area or fisheries management tool most efficient for the species present? (Gell and Roberts 2003) Is there a role for a 'moving' or temporal protected area, if these are both feasible and necessary to provide protection of fish species? Are there highly migratory species that require special attention in terms of the potential for spatial management through MPAs or other means?
6. Is adequate information available in terms of trade offs and strengths between or among conventional management techniques and MPAs? Has a comparison been done of yields possible through implementation of MPAs and yields through a change in conventional management, or use of different management schemes, as well as the costs of management by each method? (Botsford *et al*)
7. Is the MPA and the entire fisheries management portfolio designed to be robust, i.e. to produce reasonably good results across a range of scenarios considered likely? (Botsford *et al*.)
8. Does the management process attempt to keep costs to a minimum while planning for long term sustainability of the project? What options are available for long-term or sustainable financing? If outside financing is available for short-term costs, what other opportunities exist to support the sustainability of the project?
9. Is it feasible and desirable to regulate activities outside the MPA, i.e. around the boundary or in areas close enough to affect the area (e.g. land-based pollution, point-source pollution, seabed disturbance, etc.)?

10. Has the combination of resource management with livelihood opportunities been considered? (Pomeroy *et al.*)
11. Is a monitoring plan in place? Does it encompass monitoring of the fisheries and their associated bio-physical and socio-economic context in and around the MPA? Is monitoring being done both before and after establishment of the MPA? How can the monitoring plan be most effective? (Martin *et al.)*

II - C. 3 Structure, Information, Uncertainty

1. How can the design and location of the MPA most effectively combine a scientific basis, stockholder's needs, economic concerns, etc.?
2. Is the importance of communication of the specifics of placement of the MPA given due consideration? Has the area been assessed and mapped so that everyone concerned knows the location and condition of resources and the potential boundaries for an MPA? (Christie and White)
3. Have the possible negative effects of increased fishing activity along the borders of the MPA been taken into account and mitigated for?
4. What are the relative benefits and costs of implementing an MPA in a wider management framework of Ecosystem Approach to Fisheries and/or Integrated Coastal and Ocean Management?
5. How should decisions be made with respect to multiple smaller MPAs versus fewer larger ones? Is the information available to decide? For MPAs focused on fisheries management or including related objectives, has the contribution of larval spillover been analyzed (Botsford *et al.*)? Have such analyses and research been incorporated into design?
6. Has the data situation been accounted for in design of the MPA, and in the decision to implement either an MPA on its own or in conjunction with other fisheries management tools? (Is the situation data-poor, data-rich, or with no evaluation?) (See Botsford *et al*.)
    a. *Data-rich situations*: Have uncertainties been identified and explored within this situation? Has performance of different MPA designs combined with other conventional management tactics been compared under different scenarios that represent the existing uncertainty? (Botsford *et al.*)
    b. *Data-poor situations*: Have "influences of management costs, practicality of implementation and enforcement and uncertainties on the decision of whether to implement reserves or conventional quota or effort management, or any combination of conventional and spatial controls been considered? Has the type of gear and its various influences on species been assessed? Are proxy reference points available, to be utilized in design decisions in data-poor situations? What assumptions are appropriate about the type and level of uncertainty associated with implementation of different regulatory schemes?" (Botsford *et al*.) In small-scale artisanal fisheries where data-poorness contributes to lack of compliance with fishing regulations, has consideration been given to the possibility that conventional fisheries assumptions may be untenable? (Botsford *et al*., In: Parma *et al.* 2003).
    c. *Situations with no evaluation*: What rules of thumb can be followed in situations with limited or no data? (see Botsford *et al.* for background)
7. Has the particular placement of the MPA (i.e. near the coastline, offshore, or high seas) been taken into consideration in terms of the affect on fishers combined with the effectiveness of management of the species in question?
8. What trade-offs are made when choosing between using larger MPAs offshore, to benefit more mobile species, versus having smaller coastal MPAs?

9. Has implementation uncertainty been considered in the decision framework? Have the merits of different regulatory techniques involving both reserves and conventional management been assessed in terms of the ability to implement harvest targets? (Botsford *et al.)*

STAGE II, SECTION D: THE DESIGN PROCESS

II - D.1 Stakeholders and Participation

1. Does the design of the MPA reflect the goals and objectives, and deal with possible conflicts between objectives?
2. Have efforts been made to minimize disruptions to lives and livelihoods through impact assessment and preparing strategies to address the disruptions? (Pomeroy *et al.*) In this regard, has the MPA been established in combination with an appropriate adjustment and compensation package for those negatively affected?
3. Is the design of the MPA adequate to avoid the 'trap' of producing minimal benefits while giving managers/fishermen a false sense of security?

II - D.2 Management System

1. Is the MPA appropriately designed (e.g. with respect to size, spacing, location, etc.) in accordance with available biological, social and economic data, and according to defined objectives, and stakeholder and/or community needs? Are there multiple uses to be accommodated within the MPA? How is zoning used?
2. How can the boundaries being considered be most effectively marked and/or known to stakeholders, are they sufficient to meet management goals, are they in accordance with the habitat assessment, and are they widely agreed upon by key stakeholder groups? (Christie and White)
3. Given that clear rules governing resource often foster compliance and simplify enforcement, has establishment of such rules been considered or implemented? (Pomeroy *et al.)*
4. Have the design and implementation taken into account the diversity of coastal people and communities, especially in relation to their livelihood strategies? (Pomeroy *et al.)*
5. How can appropriate mechanisms for maintenance and enforcement of the MPA best be incorporated into the design?
6. Are there synergistic effects of implementing an MPA together with other fisheries management tools (benefits greater than solo use of individual tools)? If so, with what other tools?
7. *On the high seas:* How can the issue of combining appropriate or effective fisheries management tools with high seas MPAs be addressed?
8. What are the relative advantages of MPA networks or larger single MPAs? How does this relate to considerations of (a) improved ecological functioning, (b) representativeness of different habitats, (c) the need to meet national/international network goals?
9. Is the utility of large-scale and centrally-planned MPAs for biodiversity conservation and/or high seas areas taken into consideration? (Christie and White) How can the particular need for adequate long-term funding and strong institutions in large-scale MPAs be fulfilled?
10. Are accountability mechanisms (e.g. elections, consultative sessions, or open meetings) incorporated into the design and implementation? (Pomeroy *et al.*)

II - D.3 <u>Structure, Information, Uncertainty</u>

1. Is adaptive management incorporated into the design? Has it been taken into consideration from the initial planning stages? Is it being used appropriately (i.e. is research being incorporated into action)? (Martin *et al.)* Are the environmental and social dimensions of MPA performance being tracked in order to provide the basis for adaptive management? Are the MPA rules linked to the state of social and environmental systems, so as to foster adaptive (and more socially and environmentally sustainable) management of these systems? (Pomeroy *et al.*)
2. *On the high seas:* What are the relative benefits and costs of implementing a high seas MPA within a wider management framework of an Ecosystem Approach to Fisheries and/or Integrated Coastal and Ocean Management? Is it feasible or desirable to also manage threats/issues outside of spatially managed areas on the high seas?
3. What are the effective and efficient means for monitoring and evaluation?
4. *On the high seas:* What is necessary to use or redesign zoning for high seas MPAs?

STAGE III-IMPLEMENTATION AND REVIEW

STAGE III, SECTION A: MANAGEMENT

III - A.1 <u>Stakeholders and Participation</u>

1. How can a mechanism for conflict management and conflict resolution best be integrated into management/design? Is training for conflict resolution available for managers and/or stakeholders? Do individuals feel that the benefits to be obtained from participation in the MPA, including better compliance with rules, will be greater than the costs of such activities? (Pomeroy *et al.)*
2. Are the impacts on community members (e.g. of economic changes in the community, loss of their traditional way of life, etc.), and the distribution of those impacts, taken into consideration? (Pomeroy *et al*.)
3. Has a functional core group that represents various stakeholder groups been identified and empowered, so as to manage the MPA at the appropriate local level? (Christie and White)
4. Are the objectives for management clear to all the stakeholders and generally agreeable to the majority of the affected stakeholder community members? (Christie and White)
5. Are formal and non-formal institutional mechanisms in place that distribute MPA management responsibilities across relevant organizations? Are incentive (and sanction) structures in place that encourage long-term buy-in? (Christie and White)
6. What is the impact of the MPA on fishers? How are negative impacts best mitigated? Has displacement occurred? Is there conflict between user groups? Have issues of equity been addressed? What are the traditional arrangements? Have they been violated? Taken into account?
7. Has the magnitude of the benefits or costs for individual fishers been examined (taking into consideration the size, objectives, location, allowed uses, and level of compliance)? (Pomeroy *et al.*)
8. What strategies can be put in place to address increased occupational risks to the fishers due to shifts in fishing grounds and travel time as a result of the MPA?

III - A.2 Management System

1. What are the funding issues? What financing options exist and/or could be developed? How do the funding options or sustainability of funding differ depending on whether an MPA is instituted with a focus on fisheries management objectives, or with a focus on other objectives, but with fisheries components? Or is there a difference?
2. What is the balance of a 'bottom-up' or 'top-down' management approach? What management schemes are effective/appropriate for what situations? What are the difficulties/issues associated with the various options? If a co-management approach is followed, what are the factors needed for success? (see Christie and White)
3. *On the high seas:* What current tools could be used to facilitate information exchange or is there a need to develop specific instruments and legislation for this purpose?
4. How are the various aspects of MPAs managed and by what different management regimes, with what interactions? [What is the level of integration and cooperation between relevant international and regional agencies (e.g. UNCLOS, ISA, CBD, FAO, IMO, CMS, IWC, and regional instruments)?]
5. Is it beneficial to integrate site level management with regional and national policies? If so, how is this best accomplished?
6. How can the mobility of threats from beyond national jurisdiction, and from within national jurisdiction, be addressed? *On the high seas*: How can these particular threats be addressed taking into consideration the issue of freedom of the seas?
7. Does a realistic long-term plan for the institutionalization, financing, and implementation of an MPA exist? (Christie and White)
8. Are the strategies within the capacity of the institution responsible for implementation and reflected in the law legally supporting the MPA? Are consistent laws in place from the local to the national levels that support MPA implementation? (Christie and White)
9. How can issues of capacity building, including long-term funding and training programs in the community best be addressed? (Martin *et al.*)

STAGE III, SECTION B: MONITORING

1. How can timely monitoring of the effectiveness of an MPA allow adaptive adjustments to improve effectiveness and thereby avoid unfulfilled expectations and loss of credibility of MPAs as a management tool?
2. Are the MPA managers seeking suitable advice and expertise for monitoring requirements? Are sufficient resources and technical capacity available for efficient monitoring? Are there resources available for a long-term monitoring programme? (Martin *et al.)*
3. Since MPA usage (e.g., excessive visitation of MPAs, and the development that can accompany tourism), can be damaging to the environment and reduce the biological, cultural and economic benefits obtained from the MPA, is monitoring and management of the MPA being done to ensure that all human impacts – fishing, as well as other activities such as tourism – are at sustainable levels? (Pomeroy *et al.*)
4. Have baseline data on the condition of the habitat and the status of management been updated and changes noted? Has this information been incorporated into a standard database for comparison in the future? Has this information been incorporated into an education program for the community and local and national governments? Have local residents been involved in monitoring and evaluation? (Christie and White)
5. *On the high seas*: How can effective monitoring techniques be developed on the high seas? or what techniques currently exist or are being developed?

6. How can monitoring data best be communicated to stakeholders? Are all stakeholders, including resource users, enlisted in data collection and analysis?
7. Is there sufficient monitoring of possible degradation of fishing grounds external to the MPA, and/or effects on fisheries outside reserves?

STAGE III, SECTION C: EVALUATION

III - C.1 Stakeholders and Participation

1. Who is sustaining losses due to the MPA, at which scales (ranging from individual to community to nation, etc.), and how can these losses be mitigated?
2. Who is benefiting from the MPA, at which scales (ranging from individual to community to nation, etc.)? In particular, are the original resource users benefiting?
3. How can the success of the allocation of resource use benefits best be measured? Has the allocation scheme ensured that the benefits are proportionate to the costs that resource users incur? (Pomeroy *et al.*)
4. Have alternative livelihoods arrangements been adequately addressed? If not, what additional options or opportunities exist? Are 'best practices' available from similar situations or settings useful?
5. How can legitimacy be enhanced? Can distribution of results assist with this issue? If so, is information regarding the social and environmental performance of the MPA being shared? (Pomeroy *et al.*)
6. "Does the education program address the needs of the community and stakeholders so that benefits and trade-offs are highlighted and that questions regarding the need for the MPA are addressed? Are appropriate education strategies used, such as peer sharing, cross-visits, materials in local language that are culture sensitive?" (Christie and White)
7. How can enforcement/compliance be made more effective? Has broad dissemination of information taken place regarding compliance rates and enforcement actions, to enhance legitimacy and foster compliance? Have graduated, context-dependent sanctions been used, to enhance compliance by raising the opportunity cost of non-compliance and enhancing perceived legitimacy of the MPA? (Pomeroy *et al.*)
8. Has appropriate attention been given to social dynamics, trade-offs, and incentives? Have real and potential trade-offs and conflicts been identified in an open and participatory manner? (Christie and White)

III - C.2 Management System

1. What are appropriate evaluation methods? How can flawed/inadequate evaluation methods be fixed, so that a proper evaluation of the MPA can be made?
2. Has the need for long-term institutional support been successfully addressed?
3. Is there an existing MPA rating and evaluation system sufficient for the MPA in question? If not, can one be developed/modified, and/or what models can be explored for best practices?
4. How can achievement of fisheries management objectives and goals be evaluated? Are programmes in place for this? Are management goals being evaluated for fisheries management on a larger scale than the MPA in question, or in cooperation with national fishery management programs?
5. Have the various benefits, uses and values of the ecosystem and species contained within the MPA been quantified adequately?

6. How can the MPA's contribution to poverty alleviation and food security be measured? (For example, what are the long-term food security impacts of restoring degraded marine areas/fishing grounds, and what are the livelihood benefits to artisanal/traditional fishers?)
7. Are the appropriate government agencies supporting the MPA together with the nearby communities and stakeholder groups in a mutually beneficial manner and in relation to the national government? (Christie and White)
8. *On the high seas*: Are enforcement/compliance concerns being successfully addressed? How can related programs be adjusted to better tackle the most pressing issues?

RESEARCH NEEDS/GAPS

This final component of the listing of issues and considerations relating to MPAs in the context of fisheries management seeks to supplement the above with a corresponding list of research 'gaps' and priority areas, in accordance with a goal of the Workshop, to identify key areas in need of further research. The majority of entries are provided by the authors of the background papers; this listing is therefore intended to provide a sample of research needs and should not be considered an exhaustive list.

1. Research on conditions for success [Best Practices (e.g. adaptive management approach)]
2. Research on biological aspects (Sale *et al*, cited in Botsford *et al*.) including: larval dispersion; juvenile and adult movement; ecosystem aspects; coastal circulation; and impact of no-take reserves.
3. Research on MPAs in comparison to conventional management [Empirical comparisons of increases in catch with reserves to increases possible through conventional management (Botsford *et al.)*]
4. Reliable scientific research and data through:
   - 4.1. Initial evaluation/study of potential sites, to be able to compare with later studies, for efficient monitoring (Botsford *et al*.)
   - 4.2. Studies of size and spacing, and level of fishing outside of reserves (Botsford *et al*.)
   - 4.3. *Additional high seas research on: seamounts, hydrothermal vents, cold water corals, and other sensitive underwater features*
5. Studies of the potential benefits of MPAs and the role of habitat protection and restoration in fisheries management. (Martin *et al.*) This is also needed in regard to spawning and nursery site protection.
6. Assessment of the relative merits of different governance systems for MPAs in different cultural, political and socio-economic situations. "A global analysis might reveal interesting models from which guidelines for suitable, integrated legal frameworks for MPAs and fisheries management tools could be developed in particular contexts." (Martin *et al.*) [see Christie and White for background information]
7. Indicators for measuring effectiveness of MPAs for fisheries management. (Martin *et al.*)
   - 7.1. A global meta-analysis of datasets around the world on priority fisheries should be conducted to determine suitable indicators (Martin *et al.*)
8. Research that addresses the current gaps in monitoring design and data analysis protocols.
9. Research and tracking of fisheries management success, and where MPAs or other fisheries management tools have been used. (Martin *et al.*)
10. Assessment of the relative merits of MPAs among the suite of tools employed in managing a fishery area should be incorporated into fisheries models. (Martin *et al.*)
11. Modelling approaches to assess the applicability of MPAs for highly mobile species. (Martin *et al*.)
12. Assessment of suitability of MPAs for different fisheries. In the many fisheries that have not yet used area-based management, the use of MPAs needs to be properly assessed. (Martin *et al.*)
13. Studies of the link between improved livelihoods of coastal communities and MPAs.
14. Analysis of costs and benefits of MPAs – to support identification and definition of the role of MPAs, and in turn identify sources of funding for MPAs. (Martin *et al.*)
15. Assessment of the processes for considering, developing and implementing MPAs in various countries, and the manner by which MPAs are promoted or facilitated by various organizations (case studies).

5.3 Synthesis of issues

MPAs clearly have significant potential benefits as a tool of fisheries management, as well as for broader ocean use planning and biodiversity conservation. However, at the same time, the limitations and appropriate use of MPAs as a fisheries management tool must be carefully considered throughout the various stages of MPA implementation and decision making. Pomeroy *et al.* (2007) reiterates the need to consider MPAs in the context of other tools:

> "In some circles, MPAs have come to be advocated as the solution for all fisheries and ecosystem management problems. In reality, MPAs are not substitutes for fishery management, but are one of several tools in the toolbox."

A variety of issues and considerations associated with MPAs (including high seas MPAs) have been noted in the listing above, which represents an initial effort at identifying key factors to consider in linking MPAs and fisheries management (and areas where further research could be beneficial). The list is extensive, however, and it will be necessary to extract the most central issues. In this section, we briefly review a few major themes around which recommendations on the links between MPAs and fisheries management seem to have been concentrated (e.g., within the background papers). Six key theme areas are reviewed, as follows:

5.3.1 Understanding and monitoring management effectiveness

There has been a recent increase in efforts to investigate the success rates of MPAs. In some countries, studies have shown high rates, up to 80-90 percent, of MPAs that are ineffectively managed or lacked elements necessary for success such as a management plan and management team (Pollnac *et al.* 2001).[1] In order to enhance the positive potential of MPAs in fisheries management and reduce the negative impacts associated with lack of effective management, it is important that successes and best practices in effective spatial management be highlighted within potential guidelines and recommendations. The successful use of MPAs as a fisheries management tool relies on numerous factors, but a key determinant of the ability of the MPA to meet its objectives is the effectiveness of its application. Numerous resources for measuring management effectiveness are available, but analysis of the relevancy of these tools within the context of the interaction of MPAs and fisheries management could prove useful.[2] Various determinants of successful and effective management arise in the Background Papers, some of which are highlighted below. There are also suggested approaches given for overall MPA rating systems, such as the 'MPA rating system for municipal/city MPAs' that is now being used in the Philippines as described by Christie and White (2007):

> "Five stages of MPA governance emerged from the Rating System: initiation, establishment, enforcement, sustained management and institutionalization of the MPA. The activities or processes that must be successfully accomplished to achieve a given level came to be seen as the essential ingredients to successfully managed MPAs."

5.3.2 Adaptive management and well-informed design

Key aspects of an effective MPA include: (i) a basis in good science, and (ii) well-designed monitoring, evaluation and adaptive management programs with long-term support. These topics are addressed within the background papers on a number of levels: suggestions for further research needed to provide a suitable scientific basis, descriptions of situations requiring varying types of design, problems to overcome in enforcement, the importance of the quality and information produced from

[1] The Reefs at Risk Project in the Caribbean (2004) found that only 6 percent of MPAs (of 285 designated MPAs that were included in the study) were rated as effectively managed, with another 13 percent found to have only partially effective management.

[2] See MPA News, May 2006 for more information

monitoring, feedback of data into continuing evaluation, and overall the key aspects of an effective adaptive management plan and programme.

5.3.3 Context-specific design (species, habitat, country/region, community)

Though further research is certainly needed to inform the design of MPAs in the context of fisheries management, across a range of different settings, there is a growing literature on appropriate design. Recommendations highlight that design should be based on the objectives or goals for the specific spatial measure: broad conservation objectives, species-specific goals, fisheries management measures (i.e. larval dispersion, etc.), poverty alleviation, a combination of many of the above, etc. The specific limitations or needs of communities/countries/regions should also be considered in terms of legislation or policies that are currently in place and the socioeconomic situation of the communities surrounding the proposed MPA.

5.3.4 The importance of stakeholder participation

This is a key to gaining acceptance of the MPA, increasing support within the community or among stakeholders, and therefore strengthening the viability of compliance and enforcement procedures. A need for the MPA must be perceived by those involved with or affected by it, and this requires the continuous participation of stakeholders. Stakeholder participation is important not just in the initial phases of setting up an MPA, but throughout the entire process of establishment, and continuously throughout the life of the MPA. Clearly, for MPAs connected with fisheries management, stakeholders involved would need to include those within the fishery itself. Many authors of the background papers have focused on this as a key to success and suggest not only consultation with fishers, communities and all other stakeholders but actual involvement in management, such as participation of stakeholders in the monitoring process.

5.3.5 Equitable distribution of benefits

In conjunction with participation of the stakeholders, there needs to be a sense of equity in the distribution of benefits among stakeholders, and all those involved with or affected by the MPA. As Christie and White (2007) have noted:

> "Experience and empirical evidence demonstrates that the generation and equitable distribution of benefits from such MPAs is essential to long-term success."

Initial analysis of pre-existing traditional arrangements, governance structures, and socioeconomic assessments can prove vital, among other measures and tools, to ensuring that a group of stakeholders is not experiencing undue costs. Alternative livelihood arrangements are often necessary to distribute benefits equitably across all stakeholder groups, and should be continually evaluated to ensure effectiveness and appropriateness of the programmes.

5.3.6 Integration of legislation and policy

A challenge ahead, but also a key feature in the establishment of effective MPAs, will be the integration of policy and legislation – on a national level within different departments and agencies (e.g., both environment departments and fisheries management agencies), regionally within the various bodies designated to manage resources, and internationally for relevant management regimes. The background papers have reinforced the importance of collaboration, cooperation, and integration in all levels of the policy and legislation process. For example, it has been noted that:

> "The creation and management of an MPA, however, sometimes uses various existing pieces of legislation, each regulating one activity or use. In such cases, it is important to consider harmonization of these overlapping regulations. "(Martin *et al*. 2007)

6. PRELIMINARY-STAGE DECISION-MAKING: MPAs IN FISHERIES MANAGEMENT

As discussed in the previous section, the process of considering MPAs in the context of fisheries management involves three major stages. The first is a preliminary ‘early stage’ which explores specific needs, objectives and constraints relating to fisheries management and to marine conservation, as well as the amenability of the particular fishery and/or ecosystem, including its constituent fish stocks, to spatial management measures, of which MPAs form a part. This preliminary stage can be viewed as one in which the decision whether or not to utilize MPAs has not been made, but must be made as a key outcome of that stage. Subsequently, if such a decision to implement an MPA is made, the other stages of the process proceed: as described earlier, the second stage involves scoping the design of the MPA, and the design itself, while the third stage involves aspects of implementation, management, monitoring and evaluation. These second and third stages have been addressed quite comprehensively in the literature, and the steps for dealing with them match fairly closely with those used in developing a fisheries management plan.

On the other hand, an assessment of the literature on MPAs and fisheries management indicates a relative paucity of information on, and lack of focus on, the above-noted preliminary stage of the MPA decision making process. In any given situation, this preliminary stage involves the assessment of (1) existing aspects of fisheries management and of marine conservation initiatives, (2) the current and/or potential role of spatial management (and particularly MPAs) in the context of fisheries management and marine conservation, and (3) specifically whether there is a need and feasibility for an MPA, and if so, in what manner it can fit within the fisheries management system.

To address these matters, it is helpful to identify the differing situations that may be faced. This section elaborates on these various initial conditions, classifying scenarios according to two major considerations. The first is the question of whether MPAs and/or other spatial management measures are (1) already in place (and thus potentially in need of adaptation to meet additional objectives) or (2) being contemplated (whether proposed or under consideration). The second consideration is whether the actual or contemplated spatial management has its emphasis on (a) meeting fishery management objectives, (b) meeting conservation objectives, pursuing non-fishery aspects and/or emphasizing multi-use management, or (c) implementing a broader approach of zoning or spatial planning.

The first of these considerations reflects the fundamental differences between two scenarios:

- **Situations in which spatial measures are already in place**. These measures may have been (a) fishery-focused in the first place (perhaps a closed area, for example), in which case the issue is whether they are effective in meeting fisheries management goals, or (b) originally implemented with little or no consideration of fishery effects or impacts (perhaps put in place for broad biodiversity conservation purposes, for example), in which case the issue is whether they can be adapted to better meet fisheries management goals.

- **Situations in which spatial measures are being contemplated (proposed or under consideration)**. If spatial measures are under consideration (rather than already in place), there may be potentially more flexibility in designing the measures to simultaneously meet specific fisheries management goals and other goals such as protection of endangered non-harvested species, habitat restoration, etc.

It should be noted that in some cases, both of these scenarios may be relevant. For example, an ecosystem may have one fishery within it that has spatial measures in place (e.g. a closed spawning ground for a certain species) but other fisheries without such measures. Within that ecosystem, there may be discussion underway of instituting an MPA (in addition to or incorporating the closed spawning ground) to meet the dual goals of fisheries management and of broader ecosystem protection.

The second consideration above relates to the dominant objective or approach of the spatial management, i.e. which of three realities reflects the actual or contemplated spatial management:

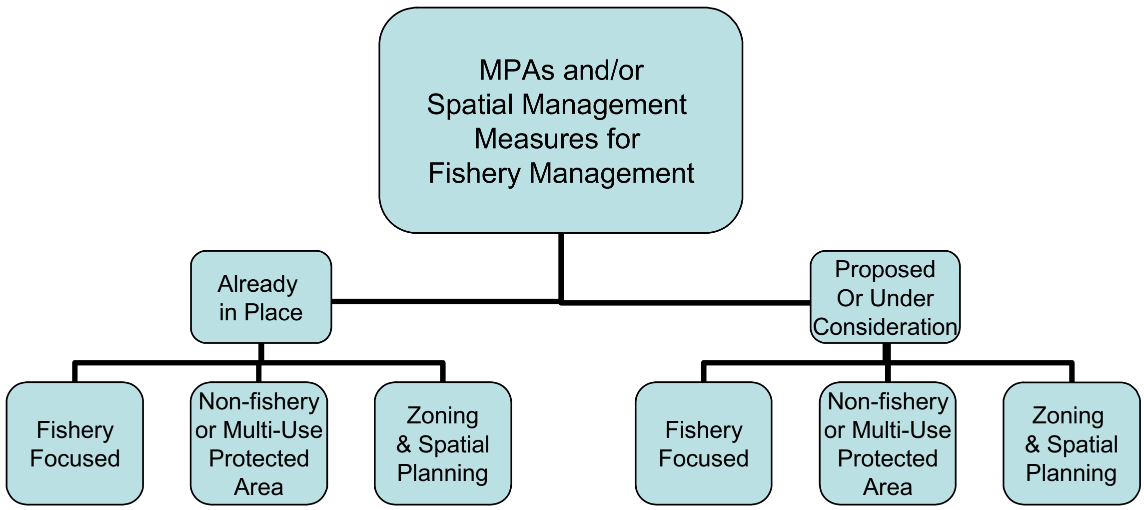
(1) A protected area with emphasis placed on meeting fisheries management objectives (e.g. a closed area designed to protected juvenile fish),

(2) A protected area with emphasis on conservation objectives, on non-fishery aspects (e.g. tourism) and/or on multi-use management,

(3) A broad-based situation of zoning or spatial planning involving a variety of spatial elements within the relevant area, and potentially including both of the above types of protected area, (1) and (2).

With this in mind, the flowchart below sums up some aspects of the 'preliminary stage' decision problem faced in considering the interaction of MPAs and fisheries management, in a situation in which marine protected areas and/or other spatial management, such as zoning, are being assessed or considered.

MPA and Spatial Measures for Fisheries Management



The following provides some further aspects arising in each of the situations – i.e. (1) an MPA (or other spatial management measure) already in place, or (2) a case in which such a measure is being contemplated.

Measures already in place. If the spatial management measure is *already in place*, assessment of its current and potential role in fisheries management might be based on asking a sequential set of questions:

- Is there room for improvement in meeting fisheries management goals? If the MPA is in fact fishery focused, is there room for improvement in meeting broader ecosystem goals and other objectives possibly pursued through MPAs? If neither of these holds, there may be no real need to modify existing management measures (no further action is needed) but if improvements can be made, then…

- Is the species and/or fishery amenable to spatial management? If available data is sufficient to indicate that this is not the case, there is unlikely to be any value in continuing to pursue the adaptation of current spatial management measures to better support fisheries management. If, however, the situation could benefit from spatial management (or if there is a possibility of this being the case, with data limitations preventing a definitive conclusion either way), then…

- Is it feasible to adjust existing arrangements to improve fisheries management? If not, e.g. if the spatial management measures currently in place cannot be altered (perhaps because they are rigidly set in legislation, or they result from lengthy processes of development, etc.), then no further action can be taken. If, however, it is feasible to alter the current measures, then…

- Positive responses to each of these three questions may make it possible to modify current spatial management to better meet fisheries management objectives. Of course, it will be important to do so without negatively affecting the achievement of the objectives previously in place.

Measures under consideration. On the other hand, if spatial management measures are not yet in place, but implementation of such measures is under consideration, then it is important to clearly assess the objectives and the form of the measure (e.g. MPA) under consideration. [For the latter, reference is made to IUCN categories of protected areas, although it should be noted that the utility of these in an MPA setting is under active discussion.] Consider the three forms of spatial management measure listed above:

(1) Protected areas with emphasis on *meeting fishery management objectives* might be grouped into two categories, depending on the specific focus of the area:

- Habitat Protection Focus (e.g. IUCN Category IV)

  Protected areas under consideration may have a fishery focus, with the primary aim of protecting the habitat on which the fish species of interest to the fishery depend. Such MPAs might be linked to IUCN Category IV ("Habitat/Species Management Area: protected area managed mainly for conservation through management intervention").

- Fishery Management Focus (e.g. IUCN Category VI)

  A protected area with a fishery focus may alternatively be under consideration as a contributor, a component, of the overall fisheries management system, i.e. as a 'tool' in the 'toolkit' of fisheries management broadly. Such MPAs might be linked to IUCN Category VI ("Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems").

(2) Protected areas under consideration, if without a particular fishery focus, may instead have primary goals involving (a) conservation objectives, (b) non-fishery considerations, and/or (c) multi-use management. Such protected areas might be grouped into two categories, reflecting the two major forms of such areas:

- Conservation Focus (e.g. IUCN Category Ia, Ib, or III)

  This form of MPA is that perhaps most associated with the protected area concept, the goal being to provide conservation benefits, whether for the full ecosystem in question or emphasizing particular species (e.g., turtles or whales). Such MPAs might be categorized under IUCN Categories Ia, Ib, or III – pertaining respectively to: (Ia) Strict Nature Reserve: protected area managed mainly for science; (Ib) Wilderness Area: protected area managed mainly for wilderness protection, or (III) Natural Monument: protected area managed mainly for conservation of specific natural features.

- Multi-Use Focus (e.g. IUCN Category II, IV, V, or VI)

  An MPA might be considered to serve a range of objectives, and to accommodate a range of marine uses, such as fisheries, aquaculture, tourism, boating, conservation of particular flora or fauna, etc. (while not reaching the form of a broad spatially-planned, zoned, multi-faceted area, described in (3) below). Such MPAs might fall under several different IUCN Categories including II, IV, V, or VI – described respectively as: (II) National Park: protected area managed mainly for ecosystem protection and recreation; (IV) Habitat/Species Management Area: protected area managed mainly for conservation through management intervention; (V) Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation; (VI) Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.

(3) Broad-based situations involving zoning or spatial planning, with a variety of spatial elements, will typically involve more than one of the IUCN categories of protected areas. Given its multi-objective nature, this form of spatial management cannot be classified in the same manner as the two forms above. Instead, from a fisheries management perspective, it is helpful to categorize them based on whether or not fisheries management is explicitly incorporated in the arrangement:

- Fishery Management Role is Explicit (includes IUCN Category IV, VI areas)

  In a broad spatial management scheme, there typically will be multiple marine uses to deal with, and multiple objectives being pursued. In some existing real-world cases within this heading, such as the Great Barrier Reef in Australia, fisheries are explicitly included in the usage arrangements, and fisheries management is thus at least partially incorporated in the overall management of the area. If this is the case for the planned area under consideration, this categorization would apply (if not, the alternative below would be appropriate). This relatively-broad form of spatial management might include either or both of IUCN Categories IV and VI – i.e. (IV) Habitat/Species Management Area: protected area managed mainly for conservation through management intervention; (VI) Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.

- Fishery Management Role Not Included in the Plan for the Protected Area

  Presumably, any sufficiently broad-based spatial management scheme, incorporating multiple marine uses and multiple objectives, should explicitly consider the relevant fisheries, in the usage arrangements and in the management system. If, however, this is not currently the case for the situation under consideration, it is important to recognize that reality, and to deal with it in some way, as the spatial planning or zoning may well end up at cross purposes with the fisheries management arrangements.

7. CONCLUSION

This paper has explored the linkages between Marine Protected Areas and fisheries management. In addressing these linkages, a unifying idea was that of spatial management – MPAs being inherently spatial in nature, and spatial management measures, such as closed areas, being well established in fisheries management. The paper drew on the Background Papers prepared for the Workshop, as well as a range of additional literature, to present a listing of issues and considerations relating to the development and implementation of MPAs, within a fisheries management context – organized according to the three sequential stages involved (preliminary, design and management/monitoring) – together with a summary of related research gaps and priorities. The paper then analysed this listing to produce a set of major recurring themes addressed widely in the literature. The analysis also highlighted the need for additional work on the 'preliminary' decision-making stage in the process, there being an apparent paucity of information in this area. An initial effort is undertaken in the paper to explore the key decision-making elements involved in this 'early stage' of the process.

It is hoped that the examination in this paper of factors relating to the interface of Marine Protected Areas and fisheries management will help to identify key issues and further research to be addressed to provide the necessary understanding of the role of MPAs within a fisheries management context.

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Marine protected areas (MPAs) are being increasingly advocated or conceived as fisheries management instruments. The numerous advantages of MPAs, particularly in conjunction with other management tools, have been widely recognized. However, the limitations and drawbacks have also been noted. To improve the role of MPAs in fisheries management it was recommended that FAO develop technical guidelines on the design, implementation and review of MPAs.

The Expert Workshop on Marine Protected Areas and Fisheries Management: Review of Issues and Considerations, which took place from 12 to 14 June, was the initial activity in a project that will provide information, assistance and guidance on the role of marine protected areas in fisheries management. Experts from a wide variety of disciplines - biological and ecological, social and economic, governance, and legal fields - were convened to review and characterize MPAs as a fisheries management tool.

This publication contains the report of the workshop, key points agreed upon by participants and the commissioned background documents. The work done during this meeting and the background documents developed for it will serve to inform future activities of this project.

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