Marine Protected Areas (MPAs) in relation to Fisheries Management
Challenges and Experiences from Developing Countries
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Foreword

A seminar was held on 24th-25th October 2006 on board the Norwegian coastal steamer "Trollfjord" while sailing from Trondheim to Bergen. The topic was “Marine Protected Areas (MPA) – a useful tool in fisheries management? Challenges and experiences from developing countries”. The seminar was arranged by the Norwegian Fishery Forum for Development Cooperation and funded by Norad.

The purpose for the seminar was to debate different views and raise awareness about the role of MPAs in relation to fisheries management, as elaborated in the Foreword by the editors of this book.

Following this event, the organising committee requested Ian Bryceson and Julius Francis to produce a book based upon the papers presented from, and relevant to, developing countries. The presenters from the seminar subsequently rewrote their contributions to fit a publishable format. Funding was provided by Norad.

The publication of this book has been delayed for multiple and complex reasons. However, I am very pleased to see these interesting articles published and believe they will be of good use in fisheries management in many countries. A sincere thank you to the editors for their good work.

Brit Fisknes
Senior Adviser, Department for Climate, Energy and Environment, Norwegian Agency for Development Co-operation (Norad), Oslo, Norway.
We wish to dedicate this book to Chandrika Sharma who participated in the seminar that gave rise to it. Chandrika’s presentation at the seminar was most inspiring, as she highlighted the rights of small-scale fishers and fishworkers in relation to marine and coastal conservation. Her valuable contribution is included as a chapter in this book, and is based upon her longstanding work as Executive Secretary of the International Collective in Support of Fishworkers.

Chandrika was one among the two hundred and thirty-nine passengers and crew of Malaysian Airlines flight 370 who all went missing on 8th March 2014, and are still unaccounted for. Until now, no plausible explanation has been provided regarding the disappearance of all these persons and the huge aircraft in which they were travelling.

This tragic event left thousands of family members and friends grieving deeply, and with many unanswered questions in their minds. Among the families and friends are Chandrika’s daughter, husband, mother, her wider family and very many friends who all miss her profoundly. We express our sincere sympathies to them, and join them in sadness at the loss of Chandrika. Simultaneously, we offer our solidarity to them, as we continue to draw much inspiration and joy from memories of Chandrika’s wonderful personality, outstanding intellect, exemplary work, compassionate spirit and tireless enthusiasm.

We also warmly remember Chandrika’s participation in a workshop with fishers, fisheries officials and scientists in Dar es Salaam and in Zanzibar, as well as the seminar in Norway, and in other meetings and correspondence with her over many years.

Chandrika’s contributions in support of the struggles of small-scale fishers and fishworkers all over the world towards securing their rights, are and always will be, deeply appreciated and cherished. Her exceptionally strong, yet soft-spoken, personality continues to inspire many of us, and her ideas will continue to be deeply respected in international fisheries forums.

In sadness and in solidarity, Ian and Julius.
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Marine Protected Areas (MPAs) in relation to Fisheries Management
Introduction

By Ian Bryceson and Julius Francis

A seminar was held on 24th-25th October 2006 on board the Norwegian coastal steamer “Trollfjord” while sailing from Trondheim to Bergen. The topic was “Marine Protected Areas (MPA) – a useful tool in fisheries management? Challenges and experiences from developing countries”. The seminar was arranged by the Norwegian Fishery Forum for Development Cooperation and funded by Norad.

The purpose for the seminar was to debate different views and raise awareness about the role of MPAs in relation to fisheries management.

After the seminar, the organising committee held a meeting and requested Ian Bryceson and Julius Francis to produce a book based upon the papers presented from and relevant to developing countries (although presentations were also made about Norwegian experiences with MPAs, it was decided to focus the book upon developing countries only). Later additional funding for this purpose was applied for and granted by Norad, and the respective authors were requested to revise their presentations into papers in a publishable format for the book.

Most of the persons who made presentations agreed to prepare chapters, and these chapters now appear in the same logical sequence as they did orally at the seminar itself. However, aspects of Razack Lokina’s presentation are included in the chapter by Julius Francis (now co-authored by Milali Machumu), and contributions by Maria Pinto and Paula Afonso are included in the chapter by Simeão Lopes. However, two presenters, namely Carl-Gustav Lundin (IUCN) and Svein Erik Hårklau (WWF) declined the invitation to write chapters for this book.

Following this Introduction, an overview and historical perspective on MPAs is provided by Jessica Sanders and Kevern Cochrane to set the scene for subsequent chapters. In the next chapter, Jeppe Kolding insightfully analyses the biological evidence for MPAs effects and he convincingly shows that while there may be increase in fish biomass within MPAs, evidence is lacking for any “spill-over” or other effect that would increase fish productivity in areas adjacent to MPAs, in fact overall fish catches are probably reduced: artisanal small-scale fishers appear to generally utilise fish resources optimally with little evidence to support claims by managers and conservationists about “overfishing” (in contrast to clear problems of overfishing by industrial fisheries occurring in some parts of the world).
Introduction

The chapter on governance in relation to MPAs by Svein Jentoft, Thijs van Son and Maiken Bjørkan is reprinted with generous permission from Human Ecology, Springer, from an article already published in 2007. They show interesting interactions between the “governing system”, the “system-to-be-governed” and the “governing interactions” in which MPAs are demonstrated to be complex embedded social institutions. Thereafter Chandrika Sharma’s (ICSF) chapter highlights the crucial importance of small-scale fisheries in developing countries. She also gave examples of the responsible practices of fishers regarding sustainable utilisation of fish resources and their opposition to damaging methods and pollution, but she showed how many fishing communities justifiably oppose the establishment of MPAs through non-participatory, externally-led, and top-down conservation initiatives.

Mozambican MPAs are analysed by Adaoma Wosu with a detailed analysis of the costs and benefits of the Quirimbas National Park in Northern Mozambique. The costs appear to be mainly borne by poor fishers, including women and children, whilst the benefits are quite uncertain to determine.

Tanzanian MPAs are analysed first by Wahira Othman with a resilience analysis of two mangrove areas in Zanzibar: she convincingly shows how an unprotected area turns out to be more resilient ecologically and socially than a protected area, presumably due to the fact that the latter was not instituted in a legitimate manner with genuine participation and co-management. Kjersti Thorkildsen contributes a chapter posing the question as to whether eco-tourism fulfils its promises, based upon her insightful case study of Chumbe Island Coral Park, Zanzibar.

Thereafter Julius Francis and Milali Machumu provide an updated analysis of recent trends in MPAs along the coast of Tanzania.

Lastly, Ian Bryceson discusses and critiques the relevance of the concept of “resilience” in relation to understanding the social and ecological impacts of MPAs in developing countries. He examines a number of studies and concludes that MPAs may provide biological and social benefits within some positive examples of protected areas which have been formed with local involvement and consent, but that in many cases neo-colonial inequalities and injustices result in serious negative impacts on people’s livelihoods and create conflictual situations wherever any management interventions may be perceived to be unjust or illegitimate.

This publication of this book has been very much delayed for multiple and complex reasons, and the editors apologise most sincerely to everyone affected by this.
The “Rise” of Marine Protected Areas as a Tool in an Ecosystem-based Fisheries Management Environment

By Jessica S. Sanders and Kevern L. Cochrane

Introduction
As pressure from human activities on the natural world intensifies, and as humans become more aware of their impact on the environment, our interest in and need for protection and planning for sustainable use of our environment has increased tremendously. Numerous traditional societies developed an understanding of the limited resources of the natural world, in fisheries in particular where societies were dependent upon ocean resources, and understood the need for sustainable use and effective management. Management schemes from such societies often included protection of marine areas such as closed areas or seasons (Ruddle, 1994). Today we have come to know spatial measures in various forms by numerous names; marine reserves, closed areas, refugia, fisheries management areas, no-take areas, and marine protected areas are just a few. However, the predominant term that, today, tops the list of frequently mentioned marine managed areas is marine protected area (MPA). This paper discusses the definition of the term MPA but does not make a rigorous distinction between no-take reserves and multi-use reserves in which some extractive use is allowed. Both have a role to play and the literature reflects experiences from a mixture of both. In practice, the choice will depend on the objectives for a particular MPA or network of MPAs and the local human and non-human ecological context. This paper will attempt to provide an overview of MPAs and to consider, both within the context of the international instruments and beyond, what roles MPAs are likely to be able to play in fisheries management, while also taking into account their potential contribution to biodiversity conservation.

MPAs have also become an important tool within the broader management of integrated ocean management (IOM), ecosystem-based management (EBM) and the ecosystem approach to fisheries (EAF). Many of these larger planning frameworks have come about
in the last few decades in response to the realization that the long-term sustainability of fisheries and marine ecosystems has, in general, not been adequately addressed by conventional approaches to fisheries management. The goal of such ecologically aware frameworks is to ensure that, in addition to other objectives, management addresses “conserving the structure, diversity and functioning of ecosystems through management actions that focus on the biophysical components of ecosystems” (FAO, 2003). Integrating a wider ecosystem approach into fisheries management necessitates the inclusion of biodiversity perspectives, and the inclusion of tools that are able to encompass multiple objectives. This will often include the use of protected areas.

The escalating interest in and advocacy for MPAs that has contributed to international agreements and the global proliferation of the use of the tool, has been driven by a mixture of conceptual reasoning, scientific experience and investigation, and almost certainly some measure of political opportunism (Cochrane, 2006). This paper seeks to present some of the relevant background on the politics, science, and issues associated with the use of marine protected areas as a tool in fisheries and conservation based management.

**What is an MPA?**

Definition. Considerable debate surrounding a standard definition of marine protected area (MPA) has taken place at a number of international fora, within national agencies, and between organizations to name but a few. Despite the fact that an internationally accepted definition has not been decided on, there is a high degree of commonality in the different definitions. The most widely accepted may be that produced by the IUCN:

“Any area of intertidal or subtidal terrain, together with its overlying 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)

In addition, a definition was developed through the Convention on Biological Diversity’s Programme of Work on Marine Biodiversity. It was adopted by the Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas, although it has yet to be formally agreed upon by the CBD as a whole.

“ ‘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 its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.” (CBD, COP 7, Decision VII/5(note 11)).

Confusion over whether or not areas managed only for fisheries objectives should be con-
The "Rise" of Marine Protected Areas

Challenges and Experiences from Developing Countries

The need for and advantages of a single, internationally accepted definition is debatable. The definition of MPAs was discussed at a FAO Workshop in June 2006. That group avoided attempting to provide a new and precise definition of an MPA, as the participants thought that, with the existing general level of agreement, this would be time-consuming and counter-productive. However, it did agree on five features that would characterise an MPA as a fishery management tool. Such MPAs:

- 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; and
- are usually expected to have resource conservation and sustainability benefits, other ecological benefits, and/or social benefits, beyond the boundaries of the MPA. (FAO 2006).

Types

Marine protected areas vary widely in purpose and application. They may have different objectives such as a focus on fishery management goals or biodiversity conservation goals, varying spatial dimensions, and divergent mandates from ministries or organizations.

Many MPAs have been and will be established to address a mixture of two of the major goals, sustainable use and biodiversity conservation, and many of the relevant ecological and socio-economic principles apply, to a lesser or greater extent, in both cases. Similarly, many of the insights that have been gained on MPAs have come from examples that, in practice, are being used in attempts to achieve both goals. The primary difference between MPAs for biodiversity conservation and sustainable use lies in the objectives and it will be necessary to consider and apply the principles and the lessons being learned in a way which maximises the likelihood of achieving the specific objectives in each case (Jones, 2006).

One method of categorization of MPAs is the category system developed by IUCN, based on overall objectives (IUCN, 1994). Though the seven categories are not as widely known as the IUCN definition of an MPA, they are becoming more prominent in the international arena of marine management and policy. Two of the seven categories are obviously relevant to fisheries management MPAs: Category IV – Protected area managed mainly for conservation through management intervention (Habitat/Species Management Area); and Category VI – Protected area managed for sustainable use of natural resources (Managed Resource Protected Area).1
In addition to the call for an increased number of MPAs there has also been support for the establishment of ‘networks’ of MPAs. Indeed, the World Summit on Sustainable Development (WSSD) Plan of Implementation calls for the establishment of “marine protected areas consistent with international law and based on scientific information, including representative networks by 2012” (Section IV, para. 32 (c)). Though there is little peer-reviewed literature on MPA networks, much less a commonly identified idea as to what constitutes a “network”, many countries are now initiating processes or have already established MPA networks (e.g. The Great Barrier Reef in Australia; the Marine Life Protected Act process in California, United States of America; and the network of MPAs in Belize). While this is becoming a common theme in MPA related discussions, much debate surrounds definitions, identification, management, and best practices regarding MPA networks. In reality, some groups of MPAs referred to as networks have few linkages, either ecological or social. The CBD Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas emphasised the need for an established link or connectivity between MPAs if the network is to function as such:

“The aim of the MCPA [marine and coastal protected areas] network should be to create a coherent whole, with emergent properties and values, not simply a collection of individual MCPAs and regulatory controls.” (CBD, 2004a)

Based on the outcomes of the FAO Workshop on MPAs and Fisheries Management (June 2006) networks can be considered on three levels:

- “more than one MPA;
- a collection of MPAs either as representative networks or with some degree of connectivity which could be ecological or social, including sharing of governance resources; and
- a synergistic system of MPAs with the ‘whole greater than the sum of the parts’ relative to objectives” (FAO, 2006).

Up until now, the key linkages have usually been considered to be ecological; though, it has now been suggested that networks should function to accomplish both ecological and social goals (Christie and White, 2007b). Ecological networks of MPAs are often designed to cover portions of a coastline with the possible benefit of protecting a greater range of habitats and species, facilitating the distribution and survival of larvae, juveniles and adults of different species and possibly lessening impacts of marine reserves on local communities by dispersing zones where fishing is limited or prohibited (Botsford et al., 2007). Social networks would, perhaps, function as links between managers, resource users, and stakeholders, merging common knowledge and experiences for greater effectiveness and efficiency.

The WSSD and the Vth IUCN World Parks Congress refer to representative networks. This is most likely referring to ecological representivity, which has been defined by a variety of groups. A scientific workshop on criteria (6–8 December, 2005, Ottawa, Canada) (CBD,
2006b) identified the term ‘ecological representivity as, “the measure of whether a given area contains habitat / biotope types, species assemblages, ecological processes or other natural features that are characteristic of the larger marine region.” Much discussion persists concerning how to identify or plan representative networks but no predominate definition or set of guidelines has yet been developed.

**Historical and Political Background of Marine Protected Areas**

*Historical background*

Clear spatial measures for fisheries management can be seen in 10th century fisheries practices in Sicily, Italy where, “precious red coral was fished by rotation over a 10 yr cycle between 10 zones established near Messina, which corresponds fairly well to the time needed for the colonies to reach commercial size.” (Caddy and Cochrane, 2001)

Traditional management arrangements in many parts of the world, but particularly in the South Pacific, have also long since included measures such as closed fishery areas or taboos on fishing in specified areas. One example is a temporary fishing ban, a method used in traditional societies in Fiji to allow certain stocks to recover (Kunatuba, n.d. cited in Ruddle, 1994; Cinner et al., 2005). Closed areas or closed seasons (particularly for protection of spawning grounds) have a long history throughout the South Pacific region where traditional fisheries management measures were used long before they became part of Western management regimes (Doulman, 1993). The majority of these traditional management techniques and systems have all but disappeared today; however, many countries (and organizations or agencies) in the South Pacific and elsewhere are developing modern MPAs based on or taking into consideration traditional cultural values and regimes associated with marine tenure and fisheries practices (Lam, 1998).

Early marine managed areas identified as MPAs include; Maquinna Marine Park in Canada, established in 1955 solely on marine aesthetic values (Jamieson and Levings, 2001); Tsitsikamma National Park (TNC) in South Africa, was established in 1964 and covers nearly 60 km of shoreline (Attwood, 1997); in 1974, the Sumilon Island fish sanctuary in Cebu, Philippines was initiated (White, 2002). In New Zealand, in 1977, Leigh Reserve was established mainly for research purposes (Ballantine, 1999). The Great Barrier Reef Marine Park in Australia was progressively established between 1980 and 1983, to cover an area greater than 340,000 square kilometres. (Kelleher, 1984)

As discussed in the next section, ‘Political background,’ the interest in and creation of MPAs globally has increased tremendously in the last decade or so. Countries such as the Philippines, with the support of local and national government legislation, and outside support, had established, by 2001, over 400 MPAs (Pollnac et al., 2001). As another example, the early 1980s in Belize saw the establishment of the first marine protected area, while today the country claims over 14 MPAs (not including other marine managed areas
that are referred to by different terms) and one of the few existing national networks of MPAs comprised of seven MPAs – the Belize Barrier Reef Reserve (Cho, 2005).

**Political background**

Since the adoption of the United Nations Convention on the Law of the Sea (UNCLOS) in 1982, and its coming into effect in 1994, widespread interest in MPAs has arisen around the world. Recognition of the use of regulating areas as a conservation measure to promote optimal utilization of living marine resources tool appears under UNCLOS Article 62 (Para 4 (c)). The FAO Code of Conduct for Responsible Fisheries, a voluntary instrument adopted in 1995, specifically implies the use of marine protected areas, for example, in Article 6.8 which emphasizes the importance of protection and rehabilitation for all critical habitats, and particularly protection against human impacts such as pollution and degradation. The Code, in an effort to promote its goal – sustainable fisheries—addresses protected area measures in Article 7.6.9: “States should take appropriate measures to minimize waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species. Where appropriate, such measures may include technical measures related to fish size, mesh size or gear, discards, closed seasons and areas and zones reserved for selected fisheries, particularly artisanal fisheries.”

In addition to many agreements and codes that specifically deal with sustainable use, momentum for the increased creation of MPAs also stems from international legislation focused on biological biodiversity. The most significant of these conventions, the Convention on Biological Diversity (1993), calls for in situ conservation through the establishment of “(a) ...a system of protected areas or areas where special measures need to be taken to conserve biological diversity” and also for Parties to (as far as possible and appropriate) “(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use; (d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings” (CBD, 1993, Article 8).

The above instruments have all added to the increased interest in spatial protection; however, the biggest boost to the establishment of MPAs in recent decades has been the Plan of Implementation of the World Summit on Sustainable Development (WSSD) (26 August – 4 September 2002, Johannesburg, South Africa). In that document it is stated that it is essential to:

“In accordance with chapter 17 of Agenda 21, promote the conservation and management of the oceans through actions at all levels, giving due regard to the relevant international instruments to:

(a) Maintain the productivity and biodiversity of important and vulnerable marine
and coastal areas, including in areas within and beyond national jurisdiction...
(c) Develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012 and time/area closures for the protection of nursery grounds and periods....” (para. 32)

The section of the WSSD Plan of Implementation relating to MPAs can be interpreted very broadly. It is apparent from paragraph 32 that the signatories were referring to the use of MPAs for both conservation and management, which must refer to management of human impacts on the oceans, including but not limited to fisheries (Cochrane, 2006). The list of sub-paragraphs then presents a mixed set of final goals (i.e. to maintain productivity and biodiversity); encouragement to deliver on commitments (e.g. the Jakarta Mandate and the Ramsar Convention); application of tools (MPAs, time and area closures) and the use of broader approaches (e.g. the ecosystem approach and integrated marine and coastal area management). The call specifically addresses the establishment of MPAs (consistent with international laws) and representative networks. Though the wording in the document relating to MPAs may seem quite general, it is, perhaps, most useful to view the sections from the Plan of Implementation in light of the overall goal, that is achieving sustainable development of oceans. When taken in this context MPAs should be seen as one of the tools in achieving this objective.

Supporting and supplementing the WSSD agreement, the Vth IUCN World Parks Congress, Durban, South Africa, 8-17 September 2003 (IUCN, 2003), called for the establishment by 2012 of a global system of “effectively managed, representative networks of marine and coastal protected areas...” that, amongst other characteristics, “Greatly increases the marine and coastal area managed in marine protected areas by 2012; these networks should be extensive and include strictly protected areas that amount to at least 20-30 percent of each habitat, and contribute to a global target for healthy and productive oceans”.

Participants at the Vth IUCN World Parks Congress recommended that the international community apply the ecosystem-based approach to sustainable fisheries management and marine biodiversity. Caution was also suggested in that MPAs be used as an “integral component” of sustainable fisheries management, and form a complement to not a substitute for “normal” fisheries management practices (WPC Rec. 5.22 (para 2 and 2(c))

Current Issues – Intensified interest and potential difficulties
Recently, advocacy for a global increase in the use of MPAs has intensified. In 1998, a statement was issued by a group of 1 605 scientists and managers, coordinated by the Marine Conservation Biology Institute, USA, entitled “Troubled waters: a call for action” which called for an increase in the number and effectiveness of marine protected areas to cover
20 percent of the EEZs and the high seas by 2020. A further appeal for an equal amount of protection (20-30%) of the marine environment came from international fora such as the World Parks Congress described above. The calls for increased use of MPAs continue and in March 2006, Greenpeace International published a proposal for protection, through marine reserves, of 40 percent of all marine habitats and biogeographic zones. The proposal was based on the argument that “Marine reserves are highly protected areas that are off limits to all extractive and destructive uses, including fishing. They are the most powerful tool available for the conservation of ocean wildlife.” (Greenpeace, 2006, p7).

Due to the inability of a ‘one size fits all’ technique to suit all habitat types, objectives, or problems, blanket targets of this nature must be treated with caution. MPAs may well be a compelling tool to use in fisheries and conservation management regimes but they are subject to the same pitfalls and difficulties related to management, enforcement and poor design as any other available tool. Poorly-informed and over-optimistic implementation of MPAs will result in more failures arising from inappropriate use, faulty design, poor implementation or all three. Therefore the establishment of MPAs must be seen as one of the tools to be considered in the overall goal of achieving sustainable use of oceans. A major risk of excessive emphasis being put on MPAs as the tool that can solve the problems of conservation of the oceans is that it will, and probably already has in some cases, diverted limited and already over-stretched international, national and local capacity and resources from other priorities and approaches that, in many cases, may have been more effective and appropriate for the problems being addressed (Cochrane, 2006).

There is a further risk that MPAs could come to be seen as goals in their own right, with proponents forgetting that they are just one tool, undoubtedly a potentially useful tool, amongst a number of possible options for achieving sustainable, equitable and optimal use of marine ecosystems. To avoid this, the promotion of careful planning, a basis in sound science, and a focus on management effectiveness must occur in tandem with increased interest in the establishment of MPAs.

MPAs, applied in conjunction with other available management measures, are becoming increasingly common in both fisheries management and conservation based regimes. When properly designed and implemented they are making a valuable contribution to both goals. However, there are still uncertainties about the contribution of MPAs to particular objectives and a brief discussion of some current issues associated with MPAs is presented below.

**Biological benefits and high expectations**

The intensified push for the use of MPAs has resulted in the enhancement of scientific knowledge and many studies are currently being conducted. Though much research is still nascent and many areas are in dire need of thorough study in order to inform MPA design
and implementation, certain benefits have been demonstrated in studies on MPAs. However, as has been found with other fisheries and conservation management tools, there are issues to be addressed and problems to be taken into account.

**Biological benefits**

The impact of marine reserves in which there was no known harvesting has been examined, with convincing evidence that reserves ‘were associated with’ higher densities, biomass, mean size of organisms and diversity of species (Halpern, 2003; Mosquera et al., 2000; Botsford et al., 2006; Micheli et. al., 2004; Hawkins et al., 2006). In one such study the authors concluded that fish abundance was three times higher on average within reserves compared to outside but with large differences in response between the different species included in the study (Mosquera et al., 2000, cited in Botsford et al., 2006).

MPAs may also be used as a means of ensuring protection of critical habitats (Fogarty, 1999). One example comes from the case of the North West Shelf region of Australia (Sainsbury et al., 1997) where a decline in the abundance of high valued fish and of epibenthic organisms occurred with the development of the trawl fishery. After careful study it was concluded that habitat had a large impact on the relative species composition of the fish community in the region and that habitat protection, for example closing areas to damaging trawling, would enable yields of the high value species to be restored in this case. Other examples of the role of MPAs in preserving habitats include studies on mangrove habitats in Belize and Mexico (Mumby et al., 2004) and sand habitats on Georges Bank in the North West Atlantic (Lindholm et al., 2004).

A key aspect of MPAs or MPA networks in relation to fisheries management objectives is the export of biomass of fished species from within the MPA to areas beyond the reserve where they can be fished. This export can potentially occur either as early reproductive products which will subsequently lead to higher biomasses of exploitable fish outside the MPA, or as ‘spillover’ of adults from the MPA to fishing areas. Spillover was determined to have occurred in a coral reef reserve in Kenya were the catch per unit of effort (CPUE) was found to have increased by approximately 50 percent over seven years (Botsford et al., 2006 citing McClanahan and Kaunda-Arara, 1996; and McClanahan and Mangi, 2000). In another study, in Apo Island, Philippines, the mean CPUE increased approximately 10-fold from the time the reserve was established in 1982 up until 2000/2001, the latest year reported (Maypa et al., 2002). However, there was no increase in total yield from the area, which has remained constant for two decades. Effort declined substantially during this period possibly because of the higher catch rates being achieved and the fact that additional income is being earned from tourism in the area. The authors of a review of spillover from closed areas on the North East Shelf of the USA concluded that planning of reserves needs to take into account the species being protected, the objectives for which the reserve is created, and the suitability of other management tools for the purpose...
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The “Rise” of Marine Protected Areas (Murawski et al., 2004). Another study of small MPAs in the Philippines (Balicasag and Pamilacan) indicates the importance of controlling activities outside of the MPA boundaries in order to see effects of spillover, particularly when the MPAs are small in size and scattered (Christie et al., 2002).

Such empirical information is valuable but often only indicative and inconclusive. Attempts are being made to supplement empirical evidence with modelling studies, an approach that allows for rapid testing of different scenarios and for replication, both commonly impossible in practice in empirical studies, but the results of modelling studies are very heavily influenced by assumptions and other modelling uncertainties. Overall, the ability to forecast the effects of marine closures on yields outside protected areas is likely to be very limited in the foreseeable future. Responsible use of MPAs for this purpose will require precautionary use of the best available information, objective and thorough evaluation of the positive and negative aspects of different tools, and an adaptive approach in order to maximise the chances of success and minimise the risks of unexpected problems (Cochrane, 2006).

Enthusiasm surrounding MPA implementation and high expectations

Factors that have hindered successful management of fisheries include high biological (and ecological) uncertainty, conflicts between conservation and sustainability goals and shorter-term social and economic goals, poorly defined objectives and institutional failures, in particular related to access rights and participatory management (Cochrane, 2000). Implementation of MPAs is likely to encounter the same problems and the use and advocacy of MPAs need to take account of this reality.

Over-selling MPAs will introduce serious risk to achieving the goals and objectives of an MPA, and to the establishment of MPAs elsewhere. Biological benefits have often been promised to fishing communities without proper explanation of the uncertainty. Repeated experiences of this nature could lead to a backlash of suspicion and resistance from stakeholders, making it harder to gain acceptance for MPA developments in the future, even where appropriate and well-considered (Sale et al., 2005; Agardy et al., 2003). In the initial process for consideration of a network of reserves within the Channel Island National Marine Sanctuary (California, USA) difficulties hindered the discussions and included, among other factors, a failure to properly account for the uncertainty in MPA benefits for fisheries, resulting in a perceived over-selling of benefits to fishers (Helvey, 2004).

In so far as MPAs will serve to supplement and boost existing fisheries management and biodiversity conservation efforts, and the evidence available does indicate this potential, increasing awareness and action must be recognised as a positive achievement. However, if the claims and expectations are over-simplified or over-stated, and many consider that they have been (e.g. Hilborn et al., 2004; Agardy et al., 2003) there is a serious risk that they
will become counter-productive. A further area of concern is the advocacy of blanket targets for percentage cover. Agardy et al. (2003) caution against this approach, stating, “The blanket assignment and advocacy of empirically unsubstantiated rules of thumb in marine protection provides dangerous targets for conservation science and may inflate expectations of end results, risking the abandonment of MPAs by decision makers as a management tool that was tried and failed.”

**Management effectiveness**

The Philippines has experienced unprecedented growth in the number of MPAs implemented across different levels of governance and, comprising multiple purpose MPAs (conservation and sustainable use), is one of the best studied examples. These examples have given good evidence of the benefits that may be obtained from MPAs but they have also helped to highlight some of the potential problems. The Coastal Conservation and Education Foundation (CCEF) surveyed 235 MPAs in the Philippines between 2001 and 2006 and found no MPA that rated 5 on a management rating scale (from 1 to 5 with 5 being the highest rating for management effectiveness) only 9% of the MPAs managed to achieve a rating of 4. (CCEF, 2005) The Caribbean faces a similar situation, where a recent study identified 285 designated MPAs in 35 States and territories in the Caribbean with only 6 percent of the total considered to be effectively managed and 13 percent to have partially effective management. Of the remainder, nearly half were considered to have ineffective management and thus offered little protection, while the status of management in the remainder was unknown (WRI, 2004).

The World Wildlife Fund (WWF) reported that less than 10 percent of MPAs at a global level were achieving their management goals and objectives though they did not specify how the number was estimated. The organization determined that some of the main reasons for failure were conflicting objectives from a range of different users and inadequate budgets and staff. Such management issues result in fundamental management functions such as monitoring, control and surveillance (MCS) not being carried out effectively in most cases.

Reflecting the common problem, particularly in developing countries, of sustaining MPAs once they have been established, it has also been recommended that to enhance effectiveness and overall success in achieving objectives the use of MPAs needs to be approached as a long-term venture, rather than pursuing a short-term, project-based approach (ICSF, 2006).

Efforts to mitigate such problems have been spread across national and international organizations and communities. Numerous initiatives to analyze management effectiveness are underway: the World Commission on Protected Areas (WCPA) (A Global Analysis of Protected Area Management), Conservation International (Global Marine Management
Area Management Effectiveness Analysis), WWF United States (MPA Management Effectiveness Meta-Analysis), and the University of Rhode Island in the United States (studying marine ecosystem governance in the context of Caribbean MPAs) are a few of the recent programs (MPA News, 2006). Important tools have been evolving in some countries such as the Philippines where a MPA management rating system established in the MPA report guide measures key indicators for improved management and enforcement (Christie and White, 2006). The results of these studies will be very important if the success rate in future use of MPAs is to be improved.

Stakeholder participation
Over-reliance on top down approaches is widely recognised to have been one of the primary causes of the frequent failures in conventional fisheries management (Cochrane, 2000) and the same problem applies to MPAs (Christie and White, 2006; Pomeroy et al., 2006). A crucial flaw in such an approach is that it often fails to sufficiently involve stakeholders and can result in lack of community support, often a cited cause of MPA failure (WRI, 2004; Pollnac et al., 2001).

It has frequently been suggested that local communities be involved in both the planning process and management of the MPA. Examples of stakeholder involvement in MPAs range from contributing to the initial management plan and discussions, to being employed as interpreters or in monitoring, to being given full responsibility for management (Salm and Clark, 2000). The importance of early and thorough involvement of the local community and stakeholders is often held up as a key ingredient to a successful MPA, “Participatory, fair and transparent plan preparation leads to stakeholder compliance because they have a “stake” in the plan” (Christie and White, 2006). The Philippines, for example, has implemented co-management on a wide scale and has generally experienced higher levels of compliance (Christie and White, 2006). Examples of the importance of stakeholder involvement are the MPAs established in the early 1980s and 1990s in the Gulf of Aqaba in the Egyptian Red Sea. These MPAs have enjoyed relative success due to local support from the outset of the project. In contrast, the MPAs later gazetted in the Hurghada area of the Egyptian Red Sea did not utilize stakeholder involvement to the same degree resulting in less community support, and with the eventual consequence of a difficult management situation requiring mitigation measures (Fouda In Belfiore et al., 2004).

Stakeholder involvement, in some communities, has extended to participation in enforcement and compliance initiatives leading to greater compliance. Mohéli Marine Park has been established in the Union of the Comoros, in the Indian Ocean and has been set up to be inclusive of co-management practices. During the implementation period the villages nominated “ecoguards”, members of the community who would be responsible for monitoring, reporting information back to the community and enforcement (Granek and Brown, 2005). This example and others, such as in Ahus Island, Papua New Guinea where
communities are highly dependent on marine resources and compliance with MPA regulations has been relatively high, indicate the importance of community involvement in marine management measures for compliance and enforcement (Cinner et al., 2005).

**Issues of equity**

In a review prepared to assist FAO in the development of Technical Guidelines, Pomeroy et al., (2006) wrote that MPAs are likely to have consequences for the four primary dimensions of poverty (wealth, health, political empowerment and education) but that there is variability about the impacts. Pomeroy et al. also highlighted the paucity of studies available on the social impact of MPAs on poverty; however, poverty eradication is recognised in the WSSD Plan of Implementation to be one of three essential requirements for sustainable development (the other two are changing unsustainable patterns of production and consumption, and managing the natural resource base). The elimination of poverty is one of the crucial elements that may lead society towards a more lasting, global reconciliation of natural resource use and conservation (Cochrane, 2008). In the numerous countries where MPAs are being established and where poverty is a significant factor the design and implementation must take social impacts, and poverty alleviation in particular, into account.

An important property of MPAs is that the costs of MPA establishment tend to be concentrated (in space and in people affected) but the benefits are commonly diffuse (Hanna, 2004 cited in Pomeroy et al., 2006). As occurs in limiting access in fisheries, those who benefit from MPAs by retaining or gaining access to its resources may receive increases in income and food security once the others have been excluded while those who lose access are likely to lose those benefits (Cochrane, 2006). Two examples of the types of problems and conflicts that can arise from contested distribution of benefits can be found in the Philippines. Fishing interests had been excluded from control and an equitable share in benefits in both Twin Rocks and Bunaken National Park, and by contrast tourism interests gained substantial advantage from the establishment of the MPAs. An additional dimension to the problem in both cases was that the tourism beneficiaries, particularly dive operators, tended not to be from the local communities while the fishers were locals. (Christie, 2004; Trist, 1999)

A paper considering the role of MPAs in sustainable coastal livelihoods in the Caribbean questioned why, when tourism in the region was booming, there had not been a parallel reduction in poverty (CANARI, 2005). That paper reported that MPAs could either benefit or harm coastal communities but that valid assessments of the impact of MPAs on local inhabitants had not been a part of official planning. Thus, for example, development programmes boosting high-return uses such as tourism and high-income housing frequently had negative impacts on the poor. As in the Philippines, one consequence of this was frequent conflicts between fishers and the planners and state agencies. Similar results have also been reported from cases in Africa and it has been suggested that problems had been experienced in achieving the right balance between conservation and people’s livelihoods.
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An important component of achieving that balance will very often be the need to find acceptable alternative livelihoods, thereby reducing peoples’ dependence on marine and coastal resources.

These examples highlight the concerns and vulnerability of fishers and fishing communities in our rapidly changing world. While it may not always be possible or appropriate to give priority to fishers and their interests, in any fishery and coastal zone management decisions it will be essential to assess the impact on the fishers, and other dependent stakeholders, and take steps to avoid or mitigate negative impacts (Code of Conduct for Responsible Fisheries 7.6.6; CANARI, 2005).

**Governance issues**

Christie and White (2006) identified four fundamental governance systems that are of relevance to MPAs: traditional, bottom-up management, co-management and centralized management. Bottom-up approaches have a number of important advantages including: they engage resource users leading to a sense of trust and ownership by participants, thereby increasing collaboration; as a result of the very good local knowledge of participants they are more tuned to local conditions; and they should lead to sustainable, long-term management systems. However, these authors also described some major challenges in using bottom-up approaches including the widespread unfamiliarity of resource users with such approaches and the need to create incentives for them to participate; the length of time and the external support required to develop a functional and sustainable system; and the difficulties of scaling up local, bottom-up approaches to cover larger scales (for example scaling up from local management of nearby coral reefs to an integrated ecosystem approach across the entire coastal shelf). Christie and White (2006) proposed that co-management, a compromise between bottom-up and centralized management, has the potential to be the best approach. A co-management approach combines the advantages of local buy-in and participation with the capacity and authority of the government. However, co-management must be able to address, satisfactorily, power struggles and conflicts and is also susceptible to failure (World Bank, 2006).

Inspired by the idea of co-management, Management and Exploitation Areas for Benthic Resources (MEABRs) have emerged in Chile. These areas are established through the rights-based approach of Territorial Use Rights in Fishing (TURFs) which assigns rights to fishing communities traditionally exploiting benthic resources (Fernandez and Castilla, 2005). These co-managed protected areas enjoy relative success in many cases; crucial factors of success include self-organized fishing communities, partnerships with the government, and co-management (Fernandez and Castilla, 2005). Tanzania has also developed an innovative approach to managing coastal fisheries with, what have become flourishing collaborative management areas. Declining fish catches and other environmentally damaging activities were causing major problems within coastal fisheries. In order to improve coastal
and marine health, and to address the fact that numerous villages were using the same fishery resources a collaborative approach to management was implemented. Management plans were developed for each area by both the local communities and the District Council making joint management possible (Verheij et al., 2004).

**Effective enforcement**

Failures in enforcement and compliance are also an important contributor to the high failure rate in MPAs (WRI, 2004; Christie, 2004). Capacity for effective enforcement is typically more limited in developing countries than in developed countries but can still be a problem in the latter, for example in the Great Barrier Reef Marine Park where effective enforcement is a major problem (Jones, 2006). The scale of enforcement often further complicates effective implementation. Jones (2006) pointed out that the frequently mentioned target of 20 – 30 percent protection of marine areas equals between 72 and 108 million km². This would be a major challenge for designated enforcement agencies.

Strategies for increasing compliance rates within MPAs are wide and varied. In situations where co-management or a more bottom-up approach is feasible and appropriate, it has been suggested that the degree of involvement of fishers and other stakeholders in the design and management of MPAs has a major impact on the extent of their voluntary compliance (Jones, 2006; Christie and White, 2006; Pomeroy et al., 2006). Indeed, in Hyogo prefecture in Japan where community based fishery management is the norm, a key factor for compliance has been determined to be the participation of fishers in the setting of regulations and in adopting the management plan (Tokrisna, 2004).

**Integration of MPAs into Broader Planning**

*Fisheries management within the context of EAF*

The Ecosystem Approach to Fisheries (EAF, FAO 2003) seeks to broaden the scope of fisheries management to include not only the fishery, but the surrounding ecosystem and human communities and impacts. The recent emphasis being placed on EAF has arisen as it has become more apparent that the conventional approach to fisheries, which tended to isolate the fishery and its target resource as a closed system, is inadequate to deal with the reality of complex ecosystems frequently being impacted by multiple human uses. EAF recognises that sustaining or, where necessary restoring, the state and productivity of ecosystems is necessary for ensuring sustained quality and productivity of fishery resources. The FAO Technical Guidelines for Responsible Fisheries—the Ecosystem Approach to Fisheries emphasizes the broad approach of EAF:

“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” (FAO, 2003)
MPAs are neither equivalent to nor necessarily essential for EAF. However, they will almost certainly have an important role to play in many and probably most ecosystems through provision of the types of benefits already discussed (NOAA, 2008). These include protecting critical ecosystem components or processes from damage by fishing, protection of fragile bottom habitats from fishing gear and critical life history stages of some species. They may also be established to provide protection to fishery resources from other human activities such as terrestrial development and mining or oil and gas extraction. In all these cases, the use of an MPA would be a result of the implementation of EAF, arising from the realisation that regulation of fishing mortality is a necessary but not sufficient to ensure sustained productivity of the target resources and of the ecosystem.

**Integrated Coastal and Ocean Management (ICOM)**

Fisheries are at the centre of EAF, which considers the impact of fisheries on the environment and the impact of the environment on fisheries. However, the marine ecosystem interacts with and is affected by not only by fisheries, but also by a wide variety of other economic and social activities or human impacts taking place within the coastal zone and marine area. All these activities need to be coordinated and managed as an integrated whole in order to ensure sustainable use of ecosystems. Management that takes all of these activities and associated polices into consideration must consider the place of MPAs within EAF, and then those practices within the broader scale of integrated coastal and ocean management (ICOM). This is argued by many when discussing the effectiveness of marine management:

“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, 2006)

The CBD in its Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) (Recommendation 1/8) recommends further exploration of the integration of MPAs into a larger framework, such as IMCAM (integrated marine and coastal area management) (SBSTTA Recommendation 1/8 para 11 (c)). Such integration of MPAs into larger planning frameworks expands the possibility of controlling and mitigating human impacts in coastal areas where numerous MPAs are presently established. Complementing the international agreements, non-governmental organizations (e.g. IUCN and WCPA, Belfiore et al., 2004) have produced guidelines to promote understanding of the linkages between area based management and larger planning frameworks and the need to establish MPAs within this context.

Integrated management options have worked well for addressing multiple challenges in
many countries. Belize first developed MPAs in the early 1980s but owing to emerging management challenges from the impact of land-based activities such as sedimentation and pollution, began to develop an integrated coastal management approach in the 1990s. Later, during the development process, the scope broadened from marine protection to a multi-sector approach and included partners in a multitude of affected sectors. Belize has become a leader in the region in developing integrated management processes, but still faces future challenges in implementing truly integrated cross-sectoral policy (Cho, 2005). Other good examples can be found in Kenya (McClanahan et al., 2005) and the Philippines (White et al., 2005).

**MPAs in Areas Beyond National Jurisdiction**

*Concern for high seas resources*

The increasing extraction of resources in the high seas and the areas of sea bottom outside national jurisdiction (the Area) and concerns for sustainable use of deep-sea resources and conservation of biodiversity has motivated considerable discussion (FAO, 2004; UNGA 2006 (A/RES/60/30); Molenaar, 2003). The vulnerability of some deep-sea habitats and communities such as seamounts, cold-water corals and hydrothermal vents has prompted discussion as to how to protect and prevent destruction of these fragile areas, which includes debate over the use of marine protected areas in the high seas, i.e. beyond national jurisdiction (CBD, 2006a, Decision VIII/24; UNEP, 2006; CBD, 2006b; UNGA, 2006 (A/RES/60/30)).

The primary legislation covering the ocean in areas beyond national jurisdiction, UNCLOS, provides for the use of these areas, including: the obligation to protect and preserve the marine environment (Part XII) and to conserve and manage high seas resources (Part VII, Section 2); and the obligation to cooperate for the protection of the marine environment and the conservation and management of high seas living resources (Art 117 and 118) (Scovazzi, 2003). However, a challenge in the current application of such requirements is the absence of mandated bodies to cover all areas and human uses. Regional fisheries management organizations and arrangements (RFMO/As), the main bodies that govern fisheries in areas beyond national jurisdiction, do not always have comprehensive mandates for ecosystem-level management, and furthermore not all ocean areas are covered by these governing bodies.

As a result, there is considerable on-going dialogue surrounding the implementation of marine protected areas in waters beyond national jurisdiction and a need for further guidance and action on the protection of resources and ecosystems where appropriate management bodies are not already in place. The WSSD identified a need for MPAs in these areas and there was a recommendation to maintain “the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas within and beyond national jurisdiction” (WSSD Plan of Implementation Para. 32 (a)). The CBD re-
inforced this in the Conference of the Parties Decision 8/24 (Curitiba, 20-31 March 2006) by recognizing and recalling previous statements made by the United Nations General Assembly (UNGA) and the WSSD:

“Recalling that UNGA resolution 60/30...the UNCLOS sets out the legal framework within which all activities in the oceans and seas must be carried out...

Also recalling the WSSD goals to maintain the productivity and biodiversity of important and vulnerable marine and coastal areas, including in areas beyond national jurisdiction and to develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information...”

Beyond the actual design and criteria for high seas marine protected areas (HSMPAs), another important issue remains the widespread lack of effective measures for enforcement and compliance in the high seas (Doulman, 2003). Illegal, unregulated and unreported (IUU) fishing on the high seas and vessels that fly ‘flags of non-compliance’, continue to plague deep-sea fisheries despite international initiatives such as the FAO Plan of Action on IUU Fishing (Gianni, 2005; FAO, 2002; CBD, 2005). Solutions to deal with issues of enforcement and compliance on the high seas must be further developed for high-seas protected areas to enjoy any sort of effectiveness.

The debate on HSMPAs and legal options has yet to come to a clear resolution or statement of concurrence from divergent Parties. The Conference of the Parties of the Convention on Biological Diversity (COP 8 Curitiba, Brazil, 20 - 31 March 2006) recognized HSMPAs as one of the essential tools for protection and sustainable use of deepwater ecosystems but also stated the need, as for coastal MPAs, for consideration of HSMPAs “as part of a wider management framework consisting of a range of appropriate tools, consistent with international law and in the context of best available scientific information, the precautionary approach and ecosystem approach; and that application of tools beyond and within national jurisdiction need to be coherent, compatible and complementary and without prejudice to the rights and obligations of coastal States under international law”(CBD, COP 8 Decision VIII/24 Para. 38). This is consistent with paragraph 74 of Resolution 60/30 of the United Nations General Assembly (A/RES/60/30).

**Existing HSMPAs**

A number of cases of spatial protection have been established in the high seas, though often regulating specific activities and not usually aimed at providing ecosystem level protection. These MPAs, though based on different ecosystems and rules of governance to equivalent areas within EEZs, will most probably face many of the same issues and problems as those within national waters.
Currently, only a few of the examples of protected areas in the high seas that have been established include fishery management and conservation in their objectives, and many are focused on other specific goals. Various international instruments allow for spatial regulation and protection, not inclusive of fishing activities, such as areas where discharge from ships is restricted (MARPOL special areas), Particularly Sensitive Sea Areas (PS-SAs) for activities that fall under the competence of the IMO, and Antarctic Specially Protected Areas or Specially Managed Areas (CCAMLR). The Mediterranean Marine Mammals Sanctuary declared by Italy, France and Monaco (SPAMI under the Barcelona Convention 1995) is comprised largely of an area in the high seas and seeks to protect marine mammals and their habitat (Scovazzi, 2003).

RFMO/As often have the mandate to apply protection to a component of an ecosystem or habitat. The North East Atlantic Fisheries Commission (NEAFC) decided to protect benthic habitat within its jurisdiction by declaring bottom trawling and fishing with static gear to be forbidden in four main seamount areas and in an area of the Reykjanes Ridge (NEAFC, 2004). Others, such as South East Atlantic Fisheries Organization (SEAFo), General Fisheries Commission for the Mediterranean (GFCM) and the Northwest Atlantic Fisheries Organization (NAFO) have also closed deep-sea features in their Convention Areas to bottom fishing for the purpose of protecting vulnerable marine habitats.

An interesting recent initiative is the creation of HSMPAs through industry self-regulation. In the Indian Ocean, the Southern Indian Ocean Deepwater Fishers’ Association (SIODFA), which is comprised of the four main companies with trawling operations in the area, has established its own protected areas known as benthic protected areas (BPA) where bottom trawling is forbidden among its members (SIODFA and IUCN, 2006).

**Factors of Success and Future Directions**

There is a need to examine and synthesise the large amount of information available from experiences in implementing MPAs in order to try to identify the best-practices for design, implementation and testing of MPAs for biodiversity conservation, fisheries management, or a combination of the two. While much remains to be done, progress is being made in this regard (e.g. Pollnac et al., 2001; McClanahan et al., 2006). There will be no recipes that can be followed to guarantee success with MPAs because each case will be unique in terms of its biological, ecological, social, economic and legal characteristics. The wealth of experience and knowledge that is available should nevertheless enable good guidance to be provided on the design and implementation, or improvement of existing, MPAs. There are already a number of comprehensive sets of guidelines on different aspects of MPA design, implementation and management, each publication presenting a particular approach and perspective. A list of relevant guides, though not comprehensive in scope, is provided below.
On the instruction of the FAO Committee on Fisheries (COFI), FAO is now in the process of developing another set of guidelines. This will make use of, update and build on the existing knowledge to assist countries as they attempt to fulfill their WSSD commitments. The FAO guidelines should also supplement the existing guidelines as most of those have focused on biodiversity conservation rather than on consideration of the impacts of MPAs on fisheries and their potential for assisting in fisheries management. There is significant overlap in the principles of MPAs established for the two purposes, but there will also be differences that need to be clarified and explained. FAO will be making use of the available information and expertise, including that of fisheries science and management, both conventional and within the framework of EAF, in order to consider those similarities and differences and provide up to date guidance on the appropriate and effective use of MPAs within the context of fisheries.

Some Guidelines for MPA Management, Implementation, and Effectiveness

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Marine Protected Areas (MPAs) in relation to Fisheries Management

The "Rise" of Marine Protected Areas
MPAs in relation to fisheries – what are the biological and fish stock implications?

By Jeppe Kolding

Summary
The calls for, and implementation of, Marine Protected Areas (MPAs) is growing and has reached pandemic proportions. Their rationale is predominantly based on sweeping generalizations of the failures of fisheries management and the omnipresent perception of overfishing. Effective closures and preservation of at least 20-30% of all aquatic ecosystems is being promoted as the panacea. Small scale coastal fisheries in developing countries are currently the main targets of MPA implementations, despite the fact that they are the least studied in terms of verified evidence of overfishing. MPAs are dispensed on the seductive idea that not only do they conserve aquatic communities, but they include the bonus of providing sustainable fisheries and enhance fish yields. In theory, MPAs will maintain productive fisheries by protecting brood stocks within their borders. These stocks can enhance catches through adults that grow up inside the reserve and then migrate to fishing areas (spillover), or through enhanced recruitment to fishing areas due to increased population fecundity from the reserve (larval transport). In practice, while there are abundant case of MPAs increasing the density and biomass inside the reserves, there are still no empirical studies that convincingly show increased yields from the ‘spillover’ and none on the ‘recruitment’ effect. MPAs work, and should be used, as a conservation tool, but their application as a fisheries management tool is far from compelling from both empirical and model evidence. As densities grow inside the reserves fish stock production in and around MPAs will be reduced due to reduction in the density dependent specific growth rate and the additional yield from spillover must be balanced against the direct loss of yield from the closures. In a fisheries context the issue of MPAs is therefore highly controversial and there are a growing number of publications that challenge the perceived fisheries benefits of the MPA doctrine. This rising trend significantly questions the picture of consensus among scientists, and the most ‘convinced’ proponents of MPAs are now increasingly challenged for losing their scientific ethos.
Introduction and scope
Over the past decade there has been a global wave of environmental groups, politicians and ecologists pushing for the large-scale implementation of Marine Protected Areas (MPAs), with many calls for protecting 20–30% of the oceans (Russ and Zeller 2003, Hilborn et al. 2004) and up to 70% of the fished areas (Lauck et al. 1998, Gell and Roberts 2003) (Fig. 1). The so-called 20% rule, i.e. protecting one 5th of the area has become a commonly cited target (Sale et al. 2005). The rapidly increasing information (Fig. 2) supporting the use of MPAs to save the seas from, among other things, the adverse effects of fishing, has reached epidemic proportions (Grimes and Ralston 2003) and the literature on MPAs or Marine reserves is overwhelming (Ndiaye et al. 2002, Olivera 2006).

Most MPA literature begins with a litany of the failures of fisheries management and the omnipresent threat of stock collapses (Bohnsack 1993, Roberts 1997, Guenette et al. 1998, Roberts et al. 2001, 2005, Gell and Roberts 2002, 2003, Halpern and Warner 2002, 2003, Halpern 2003, Russ and Zeller, 2003, Lubchenco et al. 2003, Bohnsack et al. 2004, Lutchman 2005). MPAs are perceived as a panacea to remedy this, and their advocates have often used the presumed fisheries management benefits of MPAs as a major selling point (Hillborn 2003, Appendix 1). However, there are significant gaps in the scientific knowledge that must be filled if no-take reserves are effective and efficient options as fishery management tools. Unfortunately, these gaps are to a large extent being glossed over by the uncritical and pandemic advocacy (Sale et al. 2005). Apart from the more or less direct marketing of

Fig. 1. Frequency distribution of the fraction of fishing grounds recommended being included in marine reserves, based on 40 studies (mainly theoretical) that examine the question of how much area should be protected from fishing. From Gell and Roberts (2003).
MPAs by most environmental groups\textsuperscript{1}, the scientific literature seems to be largely divided between proponents (from a general ecological background\textsuperscript{2}) and more skeptics among the fisheries biologists and managers (Shipp 2002, 2003, Grimes & Ralston 2003, Hilborn 2003, Hilborn et al. 2004, 2006, Kaiser 2004, 2005). It has become an ideological debate (Agardy et al. 2003) divided to large extends between marine and conservation biologist on one side and resource biologists on the other, where the divergences are based on two key factors: different objectives and different science (Jones 2006b).

While few, if any, resource biologists are principally against MPAs or marine reserves from a conservation point of view\textsuperscript{3}, they generally base their skepticism on the frequently made claim that MPAs will promote sustainable fisheries and enhance fish yields (Nowlis and Roberts 1998, Russ 2002, Appendix 1). In response the MPA proponents often use the ‘precautionary principle’ as their ultimate argument in view of the widespread picture of the fisheries crisis and the increasing high impact literature on stock collapses (Jackson et al. 2001, Baum et al. 2003, Myers and Worm 2003) and dooms day perspectives (Pauly et al. 2002, 2003, 2005). It is a paradox that the resource biologists, who for several decades have warned, coerced and lobbied the politicians against overfishing, are now engaged in an ‘academic dispute’ with environmentalists and conservationist, who use their same justifications towards the same politicians for achieving their (more radical) goals.

So what are the facts and figures in this polemic? What are the objectives and rationale of

\textsuperscript{1} E.g. WWF at http://www.panda.org/about_wwf/what_we_do/marine/our_solutions/protected_areas/index.cfm

\textsuperscript{2} see e.g. “Scientific Consensus Statement on Marine Reserves and Marine Protected Areas” http://www.nceas.ucsb.edu/Consensus/

\textsuperscript{3} Closed areas, closed seasons, moratoria’s etc. are frequently used tools in conventional fisheries management.
MPAs and can all the desired goals be achieved? Are they ‘red herrings’ that distract attention from actual fisheries management problems (Kaiser 2005)? And is there reason to believe that the proponents only are telling ‘half the story’ (Jones 2006b)?

**The definition and objectives of MPAs**

Marine protected areas have a variety of synonyms and definitions: National parks, wildlife refuges, monuments and marine sanctuaries, fisheries closures, critical habitat, habitat areas of particular concern, state parks, conservation areas, estuarine reserves and preserves, and numerous others. None of these really tell the user anything specific about the MPA. Further, terms such as “park” or “reserve” or “preserve” may have different meanings and provide varied levels of resource protection in different situations. The U.S. Marine Protected Areas Center has therefore provided a classification (http://mpa.gov) system to describe MPAs in purely functional terms using five objective characteristics common to most MPAs:

- Conservation Focus
- Level of Protection
- Permanence of Protection
- Constancy of Protection
- Ecological Scale of Protection

The main two characteristics in the Classification System are Conservation Focus and Level of Protection. For the purpose of this review, we shall concentrate on two of the conservation foci: Natural heritage⁴ and Sustainable production⁵, as well as the level of protection in which all resource extraction is prohibited: The No-take MPAs or zones.

Most people associate MPAs, or marine reserves, in this context, and most of the literature (Willis et al. 2003), theory, and calls for action is based on MPAs as permanent no-take zones, equivalent to ‘closed areas’ in conventional fisheries management terminology. In other words, the no-take MPAs are the most restrictive types, equivalent to Category Ia (strict nature reserve) under the IUCN’s protected area management categories (IUCN 1994).

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⁴ Natural Heritage: MPAs or zones established and managed wholly or in part to sustain, conserve, restore, and understand the protected area’s natural biodiversity, populations, communities, habitats, and ecosystems; the ecological and physical processes upon which they depend; and, the ecological services, human uses and values they provide to this and future generations.

⁵ Sustainable Production: MPAs or zones established and managed wholly or in part with the explicit purpose of supporting the continued extraction of renewable living resources (such as fish, shellfish, plants, birds, or mammals) that live within the MPA, or that are exploited elsewhere but depend upon the protected area’s habitat for essential aspects of their ecology or life history (feeding, spawning, mating, or nursery grounds).
According to PFMC (2004) the objectives and rationales of reserves can largely be divided into 5 main groups:

A. Reserves as Insurance Policy
B. Reserves as Source of Fishery Benefits
C. Reserves as Source of Ecosystem Benefits
D. Reserves as Means of Achieving Social Objectives
E. Reserves as Opportunity to Advance Scientific Knowledge

For the purpose of the scope of this review, evaluating MPAs in relation to fisheries, only the two first objectives will be covered here, although the three remaining objectives are at least equally important, and perhaps even the most primary.

The present and desired status of MPAs
According to Jones (2006a) only about 0.04% of the world’s oceans are presently designated as MPAs, of which the Great Barrier Reef Marine Park alone contributes almost three quarters. Most of the presently designated marine reserves are found on tropical coral reefs (Fig. 3), but there is a strong ambition among many conservation scientists, environmental groups, and some political agencies to increase the coverage with as much as up to 60% of the fishing grounds (Fig. 1). The target of IUCN and others of 20-30% of the areas of each marine habitat (WPC 2003) by 2012 is clearly challenging and probably unrealistic within this time frame.

Mora et al. (2006) reviewed the present status of the global coral reef MPAs (increasing with an average of around 40 per year over the last decade) and found that that only 2% of the world’s coral reefs are within MPAs that combine adequate conditions for protection (Fig. 3a). They concluded that existing marine reserves are largely ineffective and as a whole remain insufficient for the protection of coral reef diversity. They advocated an optimum coverage of MPAs to be at least 10 km² and spaced at 15 km from each other (Fig. 3b). Although still in its infancy, also the High Seas are considered a hot spot for conservation and sustainable development. According to WPC (2003) the establishment of a network of Marine Protected Areas beyond national jurisdiction (High Seas) would be a “key mechanism for promoting sustainable resource management and conservation of biodiversity and productivity”.

MPAs and small-scale fisheries
At present, though, the main target of MPAs by most environmental groups are small-scale tropical coastal and freshwater fisheries, which all apparently – almost by definition – are
overexploiting their natural resources by using unselective, indiscriminate fishing methods and destructive gears. Russ (2002, p. 433), for example writes “In most developing nations the fishes on coral reefs are so overfished that there simply is no time to wait [for implementing MPAs]”.

Small-scale artisanal fisheries were reviewed by Misund et al. (2002) who found that the most striking problems in artisanal fisheries are the lack of data and scientific literature. About 25-30% of the world total output of fish, and nearly half of the landings for consumption, come from small-scale fisheries which engage 80-90 percent of all fishermen, estimated at between 12-15 million people. Considering the magnitude of this sector, the relative dearth of research compared with industrial fisheries is astounding and severe. Furthermore, the lack of quantitative data is a particularly acute problem for making meaningful suggestions for research and management, but this may also be one of the reasons for the many unsolicited notions that exist around artisanal fisheries.

Due to the increased marginalization artisanal fisheries are mostly associated with developing countries, and are often perceived as a traditional or even antiquated, poorly equipped subsistence activity. Consequently, as other economic sectors are “advancing”, many small-scale fisheries are left behind with an increasingly negative image of being persistently poor, ignorant, ancestral, and often resource depleting or ecosystem destructive. The overwhelming opinion among many actors in the fisheries sector, particularly within assessment and conservation biologists, economists, and policy makers, is that small-scale fisheries in de-
veloping countries employ inefficient, wasteful and indiscriminate fishing practices, ignore gear regulations and legislation, are subject to open-access “Malthusian overfishing” (Pauly 1994), and therefore need to be managed and controlled one way or the other.

In reality, however, it is an open question how “detrimental” the fishing methods of unregulated artisanal fisheries are (Misund et al. 2002, Jul-Larsen et al. 2003). In fact, non-selective harvesting patterns are in principle ecosystem conserving. All species are preyed upon at various rates during their lifespan, and for aquatic organisms the highest mortality is usually during the early life history phase. Thus theoretically, the ‘utopian’ but optimal exploitation pattern, by which an ecosystem could be maintained in balance, is fishing each trophic level and fish population in proportion to the rate of natural mortality it is subjected to (Caddy and Sharp 1986, Jul-Larsen et al. 2003). Such a non-selective (“utopian”) exploitation patterns can only be achieved by employing a multitude of gears simultaneously, including fine meshed (illegal) gears.

In other words, the multi-gear (overall unselective) fishing pattern employed in many small-scale fisheries, combined with the ability of fishermen to constantly adapt and change their target species, is the closest example of the optimal exploitation pattern that exists. The established fishing practices versus legal frameworks may easily become not only an infinite tug of war, as seen in most instances where small-scale fisheries have resisted the implementation of gear restrictive regulations7, but also a completely futile tug-of-war as seen from the perspective of ecosystem conservation (Misund et al. 2002).

**MPAs as fisheries management tools**

**Reserves as Insurance Policy**

According to some authors the function of marine reserves as insurance policy against future failures and current uncertainty (Fig 4) is their primary objective (Lauck et al. 1998, Murray et al. 1999, Russ, 2002, Pauly et al. 2003, 2005). They see MPAs as a direct implementation of the ‘precautionary principle’ given the bad history of conventional management, the lack of enforcement, and the lack of political willingness to reduce fishing mortality. As Russ (2002, p 442) writes “Marine reserves as fisheries management tools should be viewed for what they are—a healthy dose of the precautionary principle. They are reserves for and of the target fish stocks. They are not being advocated as the only, nor even the optimum, method of fisheries management. They are simply our insurance policy against future fisheries management failures and against overfishing”.

Although this is a valid argument, the difficulties, if not impossibility, of predicting and

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7 This, however, does not include habitat destructive methods such as Muro-ami (used extensively in the ASEAN region, where boulders are dropped on the corals to scare and drive fish out of the reef crevices), explosives, or poisons such as bleach or sodium cyanide.
proving the benefits of MPAs aimed as insurance policy may often be insurmountable. Fishers and their regulators are much more likely to vigorously object to MPA proposals where uncertainty is high and predictability is lacking, and MPAs that are designated in the face of such objections are likely to be more difficult to enforce (Jones 2006a). Another question is how precautionary the precautionary approach should be? The starting assumption appears to be that all, including the many unstudied small-scale fisheries, are by default overfished and thereby threatens biodiversity and ecosystem functions. But is this true?

### Reserves as Source of Fishery Benefits

Marine reserves have been widely promoted as both conservation and fishery management tools. The perceived benefits from reserves (Fig. 5) come from the increase in biomass and individual size within them, resulting in adult migration and/or larval dispersal that would replenish fishing grounds (Bohnsack 1993, Guenette et al. 1998, Murray et al. 1999. Ward et al. 2001, Roberts et al. 2001, 2005, Gell and Roberts 2002, 2003, Pauly et al. 2002, Russ et al. 2003, Lubchenco et al. 2003, Bohnsack et al. 2004, Luchman 2005, Abesamis and Russ
2005). In a fisheries context, one can define seven basic expectations of marine reserves. Five concern effects on the fishes inside the reserves, and the other two relate to the fishery continuing outside the reserve (Russ 2002).

The seven expected effects (Fig. 5), are as follows (Russ 2002):

**Effects inside reserves**

1. Lower fishing mortality ($F$), or even $F = 0$.
2. Higher density of target species.
3. Higher mean size/age of target species.
5. Higher production of propagules (eggs/larvae) of target species per unit area.

**Effects outside reserves—fisheries enhancement**

6. Effects 1–4 above result in net export of adult (postsettlement) fishes (the “spillover effect”). This may occur by density-dependent movements (e.g., space limitation and territorial interactions) or may simply arise because higher densities of larger than average-sized target species in the reserve lead to increases in export of postsettlement recruits from the reserve to the adjacent fishing areas.

Fig. 5. A visual representation of the seven basic expectations of marine reserves as fisheries management tools. Inside reserves, one expects significantly lower fishing mortality and significantly higher density, mean size/age, biomass, and production of propagules per unit area of target species, as compared to fished areas. Reserves are expected to become net exporters of postsettlement fishes (spillover effect) and propagules (recruitment effect). Fisheries outside reserves may be enhanced by these two mechanisms. Modified from Russ (2002).
average fishes occur in reserves and these fishes flux randomly across the unfished–fished boundary.

7. Effects 1–5 above result in net export of eggs/larvae (the “recruitment effect”). The result is an enhanced supply of recruits to fished areas.

Do MPAs work?
The literature on MPAs is dominated by papers reviewing or modeling what marine reserves could do as fisheries management tools. There seems to be a remarkable paucity of good empirical studies telling us what they can do as fisheries management tools (Russ 2002). So what is the empiric knowledge? Halpern (2002, 2003) and Halpern and Warner (2002) reviewed 80 MPAs worldwide in terms of their effects compared with either before establishment or compared to similar fished reference areas. The results are shown in Figs 6–9.

Figs. 6–9 are robust demonstrations of the expected effects inside the reserves. Overall average population densities double, biomass triple, average size increase by a third and biodiversity by a fourth (Fig. 8). The results are independent of reserve size or age, and the higher values inside reserves grew rapidly, reaching mean values within 1–3 years after protection with the highest increase in the first year (Fig. 9). Although often quoted, these results, unfortunately, are not evidence that MPAs benefit fisheries outside the reserves.

The doubling of density (Fig. 6) and the rate of increase (Fig. 9) is a typical indication of density dependent response. Density dependent models, such as the logistic growth function would have predicted the same results. Furthermore, a prerequisite for density dependent mechanisms is that any population will have to be reduced in order to produce a surplus (for exploitation). According to the logistic growth model the maximum regeneration rate

![Figure 6](image-url)

**Fig. 6.** Overall average effect of 80 marine reserves on population density, standing biomass, average size of organisms and species diversity inside the reserves. Modified from Halpern (2002)
(MSY) is around half the undisturbed population density and will decline monotonously at higher densities until net production reaches zero and the population growth will stabilize. In this context it is interesting to notice that the average increase in population inside reserves (Fig. 6) is almost exactly equivalent to a pre-reserve (or fished reference) population level that would have produced the highest surplus. In other words, the average population densities in the 80 reserves studied would have been fully exploited, but not over-exploited, so were they in need of protection? In addition, when the populations, inside the reserves, reach their average maximum density (and regeneration in general is fast, Fig. 9), the net production rate will have been substantially reduced (close to zero) and there will be little surplus biomass available for the ‘spillover’ effect.

While the expected effects inside the reserves have been clearly demonstrated (Halpern 2002, 2003, Halpern and Warner 2002, Williamson et al. 2004), two questions remains: One is whether there was any need for protection in the first place, given the rapid regeneration rate and doubling of densities, the other is how much the outside fishing grounds have benefited? What is the empirical evidence for fishery enhancement effects outside the reserves?
Marine Protected Areas (MPAs) in relation to Fisheries Management

Evidence of the ‘spillover’ and the ‘recruitment’ effect of MPAs

While there are robust demonstrations of conservation benefits, the fishery benefits remain controversial and often poorly documented (Roberts et al. 2001, Ward et al. 2001, Halpern 2003, Sale et al. 2005). Figs. 10-13 illustrate some of the often cited examples of ‘empirical evidence’ for the spillover effects of MPAs.

Fig. 10 shows the development in overall biomass between a protected and an adjacent non-protected area in St. Lucia (for details see Roberts et al. 2001, Gell and Roberts 2003). The simultaneous increase of biomass in the non-protected area is attributed to spillover from the MPA. However, there are two immediate questions to this conclusion: One is why there is no time lag between the two areas as one would expect if the increase in the non-protected areas was a direct effect of spillover for the MPA (Hillborn 2002). The second is why increase is attributed to the MPA, while decrease is attributed to the environment (hurricane)? Such an explanation seems overly simplistic and even wishful. When was the previous hurricane,
Fig. 9. The sigmoid growth trajectory of a population, or community over time. Standard logistic theory predicts the highest growth rate at around half the asymptotic carrying capacity, equivalent with the population density that returns the highest yield per time unit (MSY). In a meta-analysis of Halpern (2003), the average density increase inside reserves ($N = 80$) was a doubling after fishing ceased (Fig. 6). The grey area is redrawn and superimposed from Halpern and Warner (2002). It contains cumulative values of density in 7 marine reserves for which successive temporal data were collected. The greatest rate of increase in density occurs during the first time step, and this step is the only one where the slope of increase is significantly different from the rest. These results indicate that rebuilding to carrying capacity is fast.

and what is the natural range of fluctuations? Could the observed build-up in both areas not equally be environmental driven. All the data show is an increasing difference in biomass between a reserve and a fished area, but no convincing evidence for ‘spillover’. 
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Fig. 11. Cumulative world records for game fish in the 200-km coastal section adjoining the Merritt Island refuge (open circles) compared to records from all the rest of Florida (filled circles). Asterisks mark the time of protection from fishing within the refuge. Vertical dashed lines show a period of rapid accumulation of new world records after addition of new line classes by the International Game Fish Association. Arrows mark the points at which there was a rapid increase in accumulation of new records for each species from areas around the Merritt Island refuge. From Roberts et al. (2001).

Fig. 11 is also an example to empirically show the spillover effect (for details see Roberts et al. 2001, Gell and Roberts 2002, 2003). After more than 30 years of protection of the Merritt Island refuge, anglers fishing along the edge or in the vicinity are catching world record trophy specimens of 3 species of Scianidae.

While these results undoubtedly could be ‘spillover’ of large specimens from the reserve, it is a question whether this can be used as an example of fisheries enhancement in terms of yield. Trophy size specimens are indications of a population that has reached it carrying
capacity (after 30 years). At this stage, according to density dependent theory, the net productivity is practically zero and the population would have to be reduced (to around half the density) in order to maximize the surplus.

Fig. 12 shows the last example of reported spillover evidence. This example is from a tiny (400 m long) MPA at Apo Island in the Philippines, which is well described in a series of articles by Russ and coworkers. Mean density of the Bignose unicornfish (*Naso vlamingii*) increased threefold inside the reserve between 1983 and 2003 and approached an asymptote inside the reserve after 15–20 years of protection. Modal size in the reserve increased from 35 to 45 cm total length (TL) over 20 years of protection. In addition, both density and modal size increased outside the reserve close to (200–300 m), but not farther from (300–500 m), the reserve boundary over the 20 years of reserve protection. According to Abesamis and Russ (2005) this represents some of the best evidence available for density-dependent home-range relocation of fish from a no-take reserve.

![Fig. 12. Top: Mean density of *Naso vlamingii* in the no take reserve (solid circles) and a fished non-reserve site (open circles) at Apo Island (Philippines) from 1983 to 2003, corresponding to 1–21 years of protection in the reserve. The increase was significant for the reserve but not for the non-reserve. A logistic growth curve fitted to the data on mean density of *N. vlamingii* inside Apo reserve suggests an inflection between 6 and 9 years of protection, and approaches an asymptote of 15.88 fish/1000 m² after 15–20 years of protection. Bottom: Size (total length, TL, mean ± SE) of *Naso vlamingii* caught at three distances from the Apo reserve boundaries (north and south). Mean size was highest nearer than farther away from the reserve boundaries (Abesamis and Russ (2005)).](image-url)
While this example (like the one in Fig. 11) can be used to describe a certain amount of ‘spillover’ of individuals from a reserve, the results are far from impressive in terms of fisheries benefits. The effects are localized to a tiny margin around the reserve and there are no estimates of any gains in yields compared to the losses from the reserve. Again this example, like all the above, only illustrates what is now already known, that density and sizes increase inside a reserve, but what are the fisheries premium?

There is no empirical evidence to support the ‘recruitment effect’ of fisheries enhancement from MPAs. Most of the anticipated results are therefore based on theoretical deductions and models. Fig. 13 shows an example of such theoretical deductions.

The huge variations observed in most fish stocks are considered one of the biggest obstacles in fisheries modelling where an attempt is made to relate recruitment with stock size. Empirically, very few stocks have a well-defined stock-recruitment relationship, which indicates that environmental stochastic mechanisms on the larvae stages are most likely the most important determinant of recruitment success, more than the spawning stock size. In fact, if a well-defined stock-recruitment relationship did exist on any given stock, we would have few problems in predicting future scenarios and consequently removing most of the uncertainty that impedes current management. In that case even the calls for MPAs as insurance policy against uncertainty would also no longer be necessary for exploited stocks. It is therefore a paradox that nearly all model studies on the fisheries effects of MPAs are using a deterministic recruitment relationship.

Fig. 13. Beverton–Holt style stock-recruitment relationship showing the range of variation in stock sizes in an unfished system, in a system with marine reserves and in a system where there are no refuges from exploitation. Marine reserves can help sustain maximal levels of recruitment by keeping stock sizes above levels at which recruitment limitation occurs. Theoretical work suggests that this mechanism leads to more stable and predictable catches. From Roberts et al. (2005).
Still, assuming that such a relationship does exist over the long term, then most theoretical studies predict only modest, if any, potential improvements in yields using reserves and only for fisheries that have been already overexploited, and mainly for species with a more sessile adult phase (Gerber et al. 2003, Hillborn 2003). In general the model studies show MPAs are unlikely to increase yield when open area fishing mortality is at or less than that which produces MSY (Gerber et al. 2003; Gärdmark et al. 2006, Hart 2006, Hillborn et al. 2006). According to Smith (2004) most Yield-per-recruit models systematically overstate the yield gains (or understate the losses) from creating a reserve in a heavily exploited fishery.

Conclusions

Marine protected areas are the most radical tool in fisheries management to prevent overfishing. That they ‘work’ in terms of rebuilding the density, biomass and increasing average size of individuals inside the reserves should therefore hardly come as a surprise. While MPAs are fulfilling the objectives of conserving populations and ecosystems, and may be promising tools for addressing uncertainty, MPAs are not likely to sustain fisheries and to replenish fishing grounds due to density dependent population mechanisms. Increases in biomass within MPAs do not necessarily imply enhanced yields because the additional yield from spillover must be balanced against the direct loss of yield from the closures (Hart 2006). On the contrary fisheries yield will generally be reduced as the overall catch level cannot be sustained on the fishing grounds outside the MPAs. Fisheries managers will have to calculate, and reduce, TAC corresponding to the reduced fishable areas. (Shipp 2002, 2003, Grimes & Ralston 2003, Hilborn 2003, Hilborn et al. 2004, 2006, Kaiser 2005).

None of the empirical studies from existing MPAs are showing any compelling evidence of fisheries benefits, except perhaps for trophy hunting anglers. This is supported by an increasing number of theoretical studies that show that MPAs are unlikely to increase yield when open area fishing mortality is at or less than that which produces MSY (Gerber et al. 2003, Smith 2004, Gärdmark et al. 2006, Hart 2006, Hillborn et al. 2006).

For small-scale artisanal fisheries, where presently most of the MPA work is focused, the implementation therefore is not a win-win situation as most proponents tend to assert. Whatever the benefits, most MPA come with a cost in terms of lost yields. If this cost is not adequately balanced, by e.g tourist revenues, it is likely that the fishermen will be as little complying as they have been to conventional fisheries management regulations. It is a question whether the precautionary principle, and simplistic solutions, in such cases should only be reserved for the fish stocks? An equal amount of precaution should be warranted to the local communities which livelihood depends on the resources; particularly – as is mostly the case – there is no proven evidence of overfishing. Where doubt exists regarding the likely outcome or benefits of the use of MPAs this needs to be clearly stated so that all stakeholders can understand the risks and uncertainties involved (Kaiser 2004).
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MPAs: A Governance System Analysis

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Abstract
Marine Protected Areas (MPAs) are promoted as an important marine ecosystem management tool. However, they are complex systems that, from a governance perspective, raise serious challenges with regard to their effectiveness. In this paper, drawing on recent contributions to the so-called “interactive governance theory,” we argue that marine and coastal governance is basically a relationship between two systems, a “governing system” and a “system-to-be-governed.” The former system is social: it is made up of institutions and steering mechanisms. The latter system is partly natural, partly social: it consists of an ecosystem, and the resources that this harbours, as well as a system of users and stakeholders who, among themselves, form political coalitions and institutions. We need to be concerned with the relationship and the interaction between the governing system and the system-to-be governed, which forms a system in its own right. Governance theory argues that both systems and their interactions share similar attributes—they are diverse, complex, dynamic and vulnerable. This raises serious concerns as to their governability. There may be limits to what the governing system can do, limits attributed to one or all three systems. But such limits are themselves issues and concerns for planning and institutional design. In this paper we present, in the form of a governance matrix, the relevant issues and concerns with regard to the governability of MPAs.

Key words
Marine protected areas . governance . system theory . ecosystem management . fisheries . coastal zone . resilience

Introduction
Marine Protected Areas (MPAs) come in many forms—closed areas, no-take reserves, multiple use, zoning of oceans (Charles 2001) and under different names: parks, reserves, sanctuaries (Pomeroy et al. 2004). Typically, they attempt to protect and conserve the functioning and integrity of marine and coastal ecosystems. They are tools for preserving endangered species (e.g., fish, turtles, and birds), biodiversity and habitats (e.g., spawning/
breeding grounds, mangroves, and coral reefs). MPAs often have an explicit socioeconomic purpose to maintain or enhance a resource base for human use. MPAs are generally managed according to the current move away from species-by-species-based management towards broader ecosystem management regimes (Rudd et al. 2003). Furthermore, MPAs have different governance modes: centralized or decentralized, co-management or community-based (Carter 2003; Pomeroy 2003). Sometimes they are formed from the top down, i.e. from the state, sometimes from the bottom up, for example from local communities (Chuenpagdee et al. 2004). In some instances, their creation results from interaction between the local and higher levels (Alcala and Russ 2006).

MPAs are commonly perceived as a “simple yet elegant solution” (Anonymous 2006, p. 2) to ecosystem management and an effective remedy to previous governance failure, which has been pervasive in fisheries and coastal areas (Pomeroy 2003). Despite a lot of uncritical advocacy (Agardy et al. 2003; Sale et al. 2005), MPAs are not necessarily a bad idea. But there is a risk of misfit if the contexts within which MPAs are supposed to function are not taken into careful consideration. MPAs may be a good solution in some situations, but not in all. Thus, in reality, they are anything but a simple solution (Degnbol et al. 2006).

We discuss MPAs from a governance perspective, tapping the literature on both MPAs and governance theory. The paper is a literature review as well as a methodological contribution, as it presents a framework for analyzing MPAs. Governance theory applies a systems perspective on MPAs, both as a “governing system” and as a “system-to-be-governed.” In improving the effectiveness of MPAs, solutions are likely to be found in both systems and in the way that MPAs interact with their ecological and social environment. Still, we must assume that there are limits as to how governable they are. They may not always lend themselves to full control. Then the question to be asked is how can these limits be stretched? We hold that the prevalence of such limits makes MPAs less of a ready-made solution, and instead a reform that requires careful planning and design. They are, after all, complex social institutions that aim to influence human behavior and that is never a matter of straightforward technical engineering.

Any attempt to review the now vast and rapidly growing literature on MPAs is bound to be a daunting task. Governance theory does, however, provide some guidance for reading that will make it more achievable. We start by clarifying some points, perspectives and issues within governance theory that are relevant to MPAs. Next we present the analytical framework in terms of a matrix that will allow us to assess them from a governability perspective. The matrix then forms the basis for a review of the literature on MPAs.

**Governance and Governability**

Governance theory was introduced into fisheries and marine resource conservation literature by Jan Kooiman et al. (1999, 2005), Jan Willem van der Schans (2001), and the so-
called FISHGOVNET (an international network of social and natural scientists, based at the Centre for Maritime Research (MARE) at the University of Amsterdam with Jan Kooiman as Chair), through which the term “interactive governance” was conceived. Interactive governance theory emphasizes an integrated, communicative and politically informed approach to societal reform, where basic social values and ethical principles are issues of consideration, deliberation and decision-making. It is also sensitive to contextual factors and appreciative of local knowledge contributions. The theory stresses that no single institution alone is capable of addressing governing challenges effectively. Therefore, the engagement of stakeholders representing the state, market and civil society is essential. Kooiman et al. (2005, p. 17) then define governance as “the whole of public as well as private interaction taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them.” The governance concept thus invites a metadebate rooted in ethics on what constitutes good goals and practices in fisheries and coastal governance, whereas the management concept is more instrumental and tool-oriented. The theory involves both a deeper and more extensive discourse than the one usually pertaining to fisheries and coastal management, where ethical arguments are taken as read (Van Houtan 2006).

In general, governance and governability may be seen as a relationship between a governing system and a system-to-be-governed (Kooiman and Chuenpagdee 2005). The governing system is social; it is made up of institutions and steering mechanisms such as organizations, legal rules and economic incentives. In fisheries and coastal governance, the system-to-be-governed is partly natural, partly social: it consists of ecosystems and the resources they harbour, as well as a system of users and stakeholders who, among themselves, form political coalitions and institutions. In order to assess the governability of fisheries and coastal zones in general, and MPAs in particular, we need to be concerned with the relationship and interaction within and between the governing system and the systems-to-be-governed.

According to governance theory, the governing system and the system-to-be-governed, as well as the interactive system they form together, share similar structural traits: they are all diverse, complex, dynamic and vulnerable (Jentoft 2007). Diversity is about spatial and organizational variation, the fact that ecosystems and social systems have different characteristics, which vary from place to place. Complexity is about interconnectedness and interactions that occur between system elements (e.g., species, habitats, actors, and rules). Dynamics is about process and change, for instance the fact that systems may have no equilibrium (or perhaps several) or that they follow cyclical, linear or non-linear patterns. Finally, vulnerability is about the risk of system damage or collapse or, conversely, robustness and resilience, i.e., a system’s ability to insulate itself from pressure, or to recover from having been exposed to a shock.
These system characteristics provide basic conditions for governability. At the end of the day there may be limits as to what a governing system can possibly do, and these limits may be inherent in each of the systems. The governing system may, for instance, lack the proper management tools, the existing knowledge of ecosystem and social system functioning may be less than sufficient, and some realms of the system-to-be-governed may be out of its reach if, for instance, the users resist interference in their activities. However, what is impossible today may become possible tomorrow. Those who govern may get better at doing what they do. The working relations with stakeholders may improve. Therefore, limits to governability are not a given but are issues and concerns for institutional design and capacity building.

There are general questions that may also be raised with regard to MPAs. Do MPAs reduce or enhance governability? Do they add to, or subtract from, systems characteristics such as diversity, complexity, dynamics and vulnerability? We argue that in order to answer such questions MPAs must be analysed both as governing systems and as systems-to-be-governed. There may, for instance, be limits as to how structurally diverse, complex and dynamic the governing system can be before it becomes ungovernable itself. Thus, one might anticipate a tendency to make the governing system less diverse and complex, as well as more stable and robust. However, robustness has the propensity of making systems less flexible and adaptive, since threats to their stability would more easily be shrugged off.

Interactive governance theory applies an “open rational systems model” (Jentoft 2007; Scott 1992). This model depicts governing systems as complex, heterogeneous networks, as political coalitions of more or less numerous and powerful stakeholder groups, who are partly internal and partly external to the system. Goals are not given ex ante and once and for all, but are relative to and shift with particular stakeholder compositions and interactions among stakeholder groups. The model works on the assumption that each group has interests to defend and contributions to make, and that their demands on the system depend on the ratio between input and output. Since interests are partly plus-sum and zero-sum, the negotiation of conflict and the building of compromise or consensus are central to governance. Consequently, governance is not so much about the exercise of authority as about political brokerage. Also, this means that the governing system is intrinsically unstable and dynamic. Governability would therefore be an outcome of an ongoing sociopolitical process that may break one way or another, depending on the relative bargaining power of stakeholder groups, individually or by coalition, at a particular point in time. Still, one might expect institutional patterns to exhibit some degree of inertia and for arrangements that were initially negotiated to have a tendency to stay on and withstand pressure for change (Stinchcombe 1965).

**MPAs from a Governability Perspective**

Kooiman et al. (2006) define governability as “the overall capacity for governance of any system that is governed (SG), its governing system (GS) and the governance interactions (GI) between this SG and its GS.” Capacity in this context relates to matters such as or-
ganization and leadership, enabling legislation, planning tools, power, implementation, means of enforcement, conflict resolution, and monitoring among others (cf. Ehler 2003; Lane 2006).

The interactive governance theory and the governability concept provide an elaborate and coherent analytical framework for the evaluation of MPA performance. Firstly, it involves looking at MPAs from the inside out: How do MPAs work as instruments of management? How effective are they? Do they attain their goals? In governance terms this means perceiving MPAs as a governing system (GS), as subjects of governance. Secondly, MPAs may be studied as systems-to-be-governed (SG), and thus as objects of governance. As such, they are partly social constructs that must be designed and operated according to various principles and rules, i.e., as organizations. As systems-to-be-governed, MPAs may also be regarded as natural systems, i.e., ecosystems, habitats and resource pools. Finally, MPAs form interactive systems (GI) with their socioecological environment (see Fig. 1). Here we are mainly concerned with the means by which MPAs relate to, communicate with and learn from their social and natural environments as a part of what they do, both as governing systems and as systems-to-be-governed.

Each of these systems (GS, SG and GI) forms columns in the matrix presented below (Table I), whereas the structural features mentioned earlier—diversity, complexity, dynamics and vulnerability—form the rows. This leaves 16 cells containing analytical propositions for MPA governability research, as well as benchmarks for literature review, such as our own. As indicated in Table I, with regard to diversity, MPAs can be large or small, either detached or connected with other MPAs as networks. Their objectives regarding conservation and use may vary from case to case. They may be organized in various ways, depending on their particular settings and circumstances. Collective choice and operational rules (Ostrom 1990) may differ from one MPA to another, as may the ways in which MPAs are linked to and interact with their socioecological environment.

Complexity is here concerned with how MPA system components are interdependent and covariant, and embedded in socioecological systems of variable scales. MPAs are both receivers and producers of various services. As natural systems they often harbour a variety of habitats and marine organisms that interact and form food webs. Socially, they comprise multiple, heterogeneous stakeholder groups with conflicting or compatible interests, values, ethics and hence, coping strategies (cf. Gupta et al. 2003). Thus, when responding to the particular needs and demands that stakeholders bring to the table MPAs often employ “mixed” governance modes (Kooiman et al. 2005)—top-down and bottom-up.

Dynamics is about how the MPA system alters rapidly, unpredictably and irreversibly. Incidents in one part of the system may trigger processes that spread and magnify, sometimes beyond the system of origin. Cause-and-effect relationships are often indirect, as when
some stakeholders exercise power controlling some of the basic conditions that MPAs depend on. In some instances changes follow a cyclical pattern, as with the seasons. As a result, MPAs are adaptive, interactive learning systems that alter according to internal and external pressures or shocks.

**Table 1** Governability matrix of marine protected areas

<table>
<thead>
<tr>
<th>Governing system</th>
<th>System-to-be-governed</th>
<th>Governance interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal achievement: How PAs work as steering instruments</td>
<td>Governance structure (natural): How MPAs maintain healthy marine ecosystems</td>
<td>Governance structure (social): How MPAs work internally as organizations</td>
</tr>
<tr>
<td>Diversity</td>
<td>MPAs come with different agendas and in different forms and sizes</td>
<td>MPAs should cover as many ecosystems as possible within an ecoregion</td>
</tr>
<tr>
<td>Complexity</td>
<td>MPAs are part of, interact with, and are dependent on other governance systems</td>
<td>MPAs can include high biodiversity with complex function and interactions</td>
</tr>
<tr>
<td>Dynamics</td>
<td>MPAs learn from and respond to changes in their environments</td>
<td>MPAs productivity and species composition changes with time</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>MPAs rely on legitimacy from their environments in order to be effective</td>
<td>MPAs are susceptible to external changes such as climate change and natural catastrophes</td>
</tr>
</tbody>
</table>

**Fig. 1** The figure portrays the MPA both as a governing system (GS) and a system-to-be-governed (SG), the latter being partly social and natural. The arrows indicate relations and interactions between systems that are keys to governability. The figure also illustrates how MPAs interact and form systemic relationships (GI) within a broader socio-ecological environment, which need to be taken into account when considering the governability of MPAs.
Finally, MPAs are vulnerable to such pressures. Things may go wrong and threaten their existence. As governing systems, a lack of goal attainment may erode their support. Ineffectiveness may exacerbate rather than curb resource overexploitation, and lead to biodiversity loss. Coastal communities may be harmed beyond repair because human relationships are damaged. Their internal structures and routines may get rusty, turning them into empty shells. Then the political backing from the society at large may evaporate.

**MPAs as Governing Systems**

So far, MPAs have been sponsored primarily by ecologists. A specialized disciplinary perspective can easily lead to tunnel vision (Degnbol et al. 2006). For the most part, the goals of MPAs are stated in ecological terms, as, for example, by Lubchenco et al. (2003, p. 6): “The goal of marine reserves is to ensure the persistence of the full range of marine biodiversity—from gene pools to populations, to species to whole ecosystems.” The human benefits are usually described in general terms, as an anticipated secondary effect, as goods and services. The governability of MPAs might therefore benefit from a more precise definition of socioeconomic goals with regard to their impact on human communities.

If humans are to be considered part of an ecosystem, a broader perspective would be relevant, one that also draws on the social and humanistic sciences, including economics and law. It should then be stressed that humans do not form part of an ecosystem on a purely individual basis. Humans form their own systems, such as communities or groups, and they interact with the natural world as members of such. The design and functioning of MPAs are prominent social science issues because they involve people and their social relationships and institutions. Institutions are essentially ways of systematizing and authorizing, and sometimes formalizing, such relationships (Jentoft 2004). Thus, their success or failure may be attributed not to MPAs as such, but to their particular design, for instance their shape, location, number, linkages, rules and decision-making arrangements. MPAs may therefore still be a good idea, regardless of their problems. Rather than abandoning them, the proper response would be to try to fix them by improving their design and functioning. Years of experience, summarized in the research literature, have taught us a lot about what works with regard to how to structure and operate MPAs. Putting these lessons into practice would then help to enhance their governability.

The ecological and sociocultural processes and linkages suggest that MPAs must be able to do several things at once. MPA governors should also consider how the pursuit of one goal has consequences for the pursuit of other goals. Conservation and use typically involve a conflict that needs a balanced and flexible approach. The same is true of different uses. MPAs may easily come into conflict with legal ramifications regarding, for instance, innocent passage and the freedom of navigation. Along these lines, one of the classic problems with MPAs is their size and boundary. Are they big enough? Are they in suitable locations? As governing systems, therefore, MPAs are confronted with some hard choices where tech-
Marine Protected Areas (MPAs) in relation to Fisheries Management

Marine Protected Areas: A Governance System Analysis

Marine Protected Areas do not always achieve their stated goals. For instance, Kelleher et al. (1995) found that less than 31% of the MPAs they surveyed achieved their stated goals (cf. also Alder 1996). The functioning of MPAs is determined by both ecological and social factors. Thus, “a particular MPA may be both an ecological ‘success’—resulting in increased fish abundance and diversity and improved habitat—and a social ‘failure’—lacking broad participation in management, the sharing of economic benefits, and conflict resolution mechanisms” (Christie et al. 2003, p. 22). Christie and colleagues hold that we need to look out for the relationship between ecological and social goals, and the risk that ecological gains may disappear unless social issues and concerns are adequately addressed. They propose an agenda for social science MPA research, focusing on the social and political dimensions of MPAs and the importance of adapting them “to the exigencies of local situations, recognizing that each location has its unique social, cultural, and ecological contexts that influence the trajectory of MPA implementation and impact” (Christie et al. 2003, p. 24).

Lack of resolve to secure effective ecosystem protection may be one reason why MPAs often fail and become “paper parks” (Jameson et al. 2002) rather than effective instruments for ecosystem and fisheries management. Sometimes they are established out of political expediency rather than socioecological needs. MPAs may be located in areas where they have few ecological and social benefits (Lynch 2006), and sometimes their governability is reduced due to resistance from negatively affected stakeholders. Not only do MPAs curb fishing practices, every so often they ban them altogether and exclude some users from access to the resources. This may force them to move to areas that are fully occupied by others. Consequently, MPAs raise issues of income distribution and social justice, such as when one kind of resource use is banned while another is permitted (Christie et al. 2003; Oracion et al. 2005). Involving stakeholders in the particular design and operation of MPAs is therefore crucial for governability.

**MPAs as Systems-To-Be-Governed**

Now we look at MPAs as objects of governing initiatives and mechanisms. MPAs do not only aim to control the structure and functioning of social and natural systems within their domain, they themselves become embedded within these systems, possibly to the extent that one might ask which system controls which. Thus, governability may be as much an issue pertaining to the system-to-be-governed as to the governing system. As governing systems, MPAs cannot access the natural system-to-be-governed directly but must go through the social system. After all, since people are the primary agents of environmental change (Castilla 1999), fisheries and coastal governance is about the regulation of human behavior; it is the resource users within the MPAs who will experience the intervention in their action space. There is no reason to assume that users will remain passive, that they will automatically and willingly identify with what the MPA is attempting to do, or that they will always adhere
to the rules. Rather, the disturbances caused may lead to strife and noncompliance unless user-groups and stakeholders are involved in the construction and operation of the MPA. As Fraser (in Norse 2003) maintains, “(a)pplyed broadly without meaningful participation by stakeholders in the fishing community and other interest groups, they will engender conflict and resistance.”

**Natural system**

The natural part of the system-to-be-governed relates to how MPAs can preserve vital biophysical properties of marine and coastal ecosystems. In order to achieve a healthy marine ecosystem, ecological integrity and biodiversity must be maintained and the natural rate of biomass production preserved; all naturally-occurring habitats must be in good physical shape, and naturally-occurring biological, physical and chemical processes need to work appropriately. Letting the ecosystem find its natural balance is likely to provide important goods and services for humans to consume in return (cf. e.g., Stanley 1995).

MPAs are located in a wide range of different biophysical settings, ranging from tropical ecoregions, typically dominated by reefs, to kelp-dominated temperate and ice-covered polar ecoregions. No single technical design will be able to handle such differences in biophysical properties (Agardy et al. 2003; Degnbol et al. 2006; Hilborn et al. 2004). In order to achieve the goals with regard to the natural part of the system-to-be-governed, MPAs have to cover a full range of ecosystems and habitats within an eco- or biogeographic region (Roberts et al. 2003). In order to achieve this, the CAR principles (Comprehensiveness, Adequacy and Representativeness) have been compiled for guidance (see TFMPA 1999). Application of the CAR principles seeks to ensure that all types of habitats (working as surrogates for ecosystems) within an ecoregion are represented in a network of MPAs. The inclusion of a full range of habitats aims to protect each of the niches inhabited by all kinds of species.

MPAs often include high biodiversity, leading to complex functions and interactions. A healthy ecosystem contains many biophysical parts that are interconnected in an intricate manner. In order to preserve ecological functioning and integrity, efforts must be made to maintain these interactions. Certain species (such as keystone species or umbrella species), certain physical properties (such as currents, vertical circulation and upwelling) and certain chemical properties (such as the resuspension of nutrients that are important for algal production) may be key components in making a system resilient to external stressors. Such external stressors are mostly man-made. From a governability perspective, flow of information and education on how to preserve these complex interactions is crucial.

Since all three aspects mentioned above are dependent on natural processes of a stochastic character, the productivity of an MPA changes over time. A system is not likely to produce the same amount of biomass on a continual basis (White et al. 1991). Hence, to enhance governability, it is important to identify indicators over a range of biophysical properties and see
how these relate to each other in a dynamic way. For example, comparing satellite images of surface temperatures with temperature profiles may provide information about the degree of upwelling or circulation taking place at a given time, which again may help to predict the amount of algal production if we also know the distribution of nutrients in the water column. By comparing predicted algal production with actual production, once again using remote sensing, these predictions can be improved by adaptive learning. Coupled with other indicators, it is possible to obtain an image of the MPA’s productivity. However, this requires constant monitoring and expensive state-of-the-art equipment. This highlights the challenge that may be involved in improving the governability of MPAs (Pomeroy et al. 2004).

The resilience of an MPA is susceptible to external change, especially climate change (see Aronson and Precht 2006) or recurring phenomena, such as El Niño or La Niña (see Cantillanez et al. 2005; Sanchez-Velasco et al. 2004; Zamon and Welch 2005). The vulnerability of MPAs to these types of changes depends upon their health. Thus, maintaining a healthy ecosystem will enhance its degree of resilience (Folke et al. 2004; Hughes et al. 2005; Worm et al. 2006) and a resilient system is less likely to turn into an alternative, less desirable stable state. Since healthy ecosystems are anticipated to provide ecosystem services for human consumption, ecosystem resilience may be closely linked with social resilience (Brechin et al. 2003; Hughes et al. 2005).

**Social system**

MPAs are what Boudon (1979) labels “functional systems.” They are formal organizations with a leadership, lines of authority, an arranged division of labour, a constitutive charter, a plan of operation and a defined role structure (managers, guards, users), with ascribed rights and duties. Their governability would thus depend on how their various elements work as a whole. MPAs are different from what Boudon calls “interdependent systems” in which, although there is a mutual impact and dependence among constitutive parts, there is no organization, as within a common-pool natural resource system when resource users compete individually. What MPAs do, then, is to transform an interdependent system into a functional system, thus imposing order and direction on the nature and function of MPAs and their members.

The diversity of MPAs, which can be seen from their various definitions, designs and goals, reflects the many characteristics of their systems-to-governed. None of characteristics are unfailingly given ex ante, but instead are generated through a process in which user-groups and stakeholders play an active part. MPAs are more loosely structured than a typical government agency or business firm. They are often partnerships, allowing user-groups and stakeholders to be involved in decision-making. They are therefore likely to be in a state of flux; what they are and do will change over time, largely dependent on what stakeholders do and demand. As human creations they even possess the capacity to elude the intent of their designers. Hence, from a governability perspective, MPAs should be perceived as a social—or political—process, and as a (political) coalition.
Nevertheless, MPAs and the social processes that they generate occur within a particular historical and socioeconomic context that provides limitations, pressure and opportunities. MPAs are ‘embedded’ systems. They are part of, and draw support from, a larger social system of institutions, rules, norms and values. They also have the potential to mobilize resources and benefit from social capital that already exists in the community (Bennett 1996). In fact, the prevalence of social capital and trust within a local community is perceived by researchers as essential to the governability, and hence the success or failure of natural resource management (Pretty 2003), including MPAs. Therefore, Jameson et al. (2002, p. 1180), for instance, conclude that “the usefulness of MPAs is not in question. What requires closer scrutiny is the institutional and community capacity necessary for effective MPA management to occur.” Similarly, Rudd et al. (2003, p. 65) hold that “In the short term, the amount of social capital that communities possess and the capacity of the state to support the rights of individuals and communities will affect the relative efficiency of marine reserves.”

This affects the ability of MPAs to generate moral support from, and compliance among, resource users. If compliance with MPA goals and rules has to be imposed rather than being voluntarily obtained, monitoring is likely to be ineffective—or costly. Thus, Rudd et al. (2003, p. 77) note that “[...] the suitability of marine reserves as an efficient policy will only hold under a certain set of community and institutional conditions. [...] Where there is community apathy [...] community based marine reserve management strategy is likely to fail due to widespread cheating because there are few internal social sanctions against individual opportunism.” To this it should be added that “opportunism” can also be a collective phenomenon, as Bjørkan (2005) describes in a Mexican MPA case study. Cheating may draw general approval among community members as a legitimate thing to do. Then the community controls the way the MPA works, not the other way around.

Dryzek (1990) says that any complex problem has multiple features, each of particular concern to a specific group of people. MPAs have different implications for different groups, such as commercial and recreational fishers and other users of the marine environment (Agardy 1993), so, it is important to address the fact that MPAs have heterogeneous memberships, who have conflicting interests, needs and aspirations (Sumaila et al. 1999). MPAs do not necessarily level the playing-field since, to a varying degree, MPAs both reduce and restrict the level of activity in a given area and often alter, temporarily or permanently, the relationships among user-groups. Thus, MPAs can easily add to conflicts or generate new ones.

The first step in dealing with such conflicts is to ask who the legitimate stakeholders are. Who has something to lose or gain as a consequence of what MPAs do? Whose needs are more urgent? Who is more powerful than others? Stakeholder compositions may vary from situation to situation, and across scales (Buanes et al. 2005). Thus, the boundaries of MPAs largely determine who they are. With regard to MPAs, Badalamenti et al. (2000)
note that it is important to distinguish between industrialized and developing countries. In the latter the number of people who depend on fisheries and coastal resources to survive is much higher. People who are poor and have no alternative source of food security or employment cannot postpone their needs in anticipation of an MPA augmenting the resource base.

In addition, there are issues relating to distributive justice, as immediate costs tend to be borne by the local users of an MPA, such as fishing families, whereas the benefits tend to be delayed and accrue primarily to non-local users, e.g. tourists (Scholz et al. 2004). In order for MPAs successfully to relieve the pressure on the resource base, banning their use may be less effective than generating other employment alternatives (Badalamenti et al. 2000). What happens outside the MPAs in this respect may therefore be as important as what happens inside them. Again, the need to embed MPAs in the larger socio-ecological system is essential.

**MPAs as Interactive Systems**

MPAs are usually part of larger governing systems and one of several means by which fishing and other coastal or ocean activities are managed. Thus, they are not established in a vacuum and do not start with a clean slate. Instead they are “profoundly affected by the larger ecological, social, economic, and political context of the coastal/ocean areas of which they are a part” (Cicin-Sain and Belfiore, 2005:850). Thus, one key point from an FAO workshop on the role of MPAs in Fisheries Management (June 2006) concludes that “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” (Key Point 23 d). This clearly transforms MPAs into what Scott (1987) calls “open rational systems”, although the degree of openess may vary from case to case.

Key issues with regard to governability include how MPAs interact with their environment, which relations are established to facilitate such interaction, and the degree to which MPAs depend on these interactions and relationships in order to remain viable. As Cicin-Sain and Belfiore (2005, p. 847) put it: “If managed in isolation, coastal and marine protected areas (MPAs) are vulnerable to natural resource development and exploitation occurring outside these areas—in particular, over-fishing, alteration and destruction of habitats.” In a similar vein, Kelleher (1999, p. xiii) says that “an MPA will rarely succeed unless it is embedded in, or is so large that it constitutes, an integrated ecosystem management regime.” In Chile, for instance, Fernández and Castilla (2005) argue that in order to increase the effectiveness of MPAs, a broad management plan in which MPAs have a designated role, should have been developed. They explain the delay of such an in-

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The governability of MPAs then largely depends on what happens outside their borders (cf. Lovejoy 2006). For example, fish that move in and out of an MPA territory may still be exposed to outside over-fishing. Furthermore, coral reefs and estuaries are vulnerable to hinterland soil erosion and pollution, leading to sedimentation and eutrophication (Carr et al. 2003). Expanding MPA boundaries may help to control such activities and impacts. However, boundary extension may also just relocate these activities. The literature suggests that in order for MPAs to become more effective, they should be built as regional networks (Mahon et al. 2005). In the case of the Western Solomon Islands, Aswani and Hamilton (2004) contend that a network of small MPAs is a more effective and socially attainable strategy than establishing a few large ones. Large MPA networks are now established in some parts of the world, such as those that comprise large parts of Philippine and Indonesian coastal waters. Which works better, large-scale MPAs or systems of several small-scale MPAs, is a governability research issue: the FAO workshop thus concluded that “consideration should... be given to the relative advantages and disadvantages of a single large-scale MPA compared to a network of smaller MPA.” (Key point 23 h).

From a governability viewpoint, the relationships between MPAs and their ecological and sociocultural environments require the same attention and care as those pertaining to the internal structures and interactions of MPAs. External relations can of course be loose or firm, regular or sporadic, hierarchical or collaborative, formal or informal, simple or multifaceted. Governance theory, which recognizes the complexity of governing interactions, would expect these relations to have a mixture of all of these traits (Kooiman et al. 2005).

Scott (1992) distinguishes between institutional and technical environments, the former comprising rules, regulations, other organizations such as government agencies, corporations, civic associations and communities, as well as the stocks of resources and sources of information that they hold. Concerning technical environments, Scott mentions sources of input and markets for the output of goods and services, competitors and stakeholders. He concludes that “the greater the heterogeneity, the higher the rate of instability, the greater the threat, the greater the interconnectedness, and the lower the coordination within the environment, the higher the uncertainty facing the organization.” Furthermore, “the scarcer the resources, the higher the concentration, and the greater the coordination exhibited by entities with the environment, the greater the dependence of the organization” (Scott 1992, p. 135). This is likely to apply to MPAs as well. Thus, in order to understand the dynamics of MPAs we have to focus on those items (products, materials, information, rules, expectations and demands) that move across these boundaries, as well as their carriers. Governance theory (Kooiman et al. 2005) stresses that environments are also perceptions, images and symbols of how the systems-to-be-governed work, and which ideals, standards
and principles governing systems should employ. Indeed, MPAs themselves represent an image of the why and how of sustainable governance of fisheries and coastal resources. The idea of the MPA and the values it represents are more often imported from elsewhere than home-grown.

The MPA literature is fairly univocal about the need to involve user-groups and stakeholders in the decision-making process, and that MPAs should preferably be comanaged. In other words, user-groups and stakeholders should be integral to MPAs as governing systems, both as a means of empowerment and as a way of providing information and facilitating learning. This should also be a two-way process: the MPA concept and rationale needs to be communicated to affected parties so that they can understand and appreciate what MPAs are all about. As Elliott et al. (2001) conclude, if local people have little information regarding the MPAs it is likely that misconceptions will exist, and stakeholders will be less willing to participate in the monitoring or enforcement of regulations that they believe to be ill-advised. According to Jameson et al. (2002), an MPA cannot exist or function without the general support of the user-groups and communities affected, as well as the public at large. For this to occur, “there needs to be much more active outreach to the local community (Lovejoy 2006: 331)

In addition, MPAs need to tap into the local knowledge base that users and stakeholders possess and represent (Stead and McGlashan 2005) as a means of enhancing the rationality of their function. For instance, both in the design of MPAs and as an integral MPA activity, users can be mobilized for participatory research, such as the mapping of habitats (Aswani and Hamilton 2004; Aswani and Lauer 2006; Chuenpagdee et al. 2004; Friedlander et al. 2003). Sale et al. (2005, p. 78) conclude that in order to fill the knowledge gap regarding MPAs, the “development of strong collaborations among the scientific, the management and the fishing communities” is required.

Finally, user and stakeholder participation and power-sharing are also perceived as means of securing legitimacy and support. Like other governing systems, at the end of the day the governability of MPAs rests on their legitimacy, which is largely in the eye of the stakeholder (Jentoft 2000). The issue of stakeholder representation is therefore a crucial design issue. It is also a delicate one that, if not done right, may cause conflicts among stakeholders and damage to the MPA decision-making process (Davis 2005). It makes a big difference whether users and stakeholders are able to identify the MPA as “ours” rather than “theirs” as, for instance, Fiske (1992, p. 39) concludes from a Caribbean case study where “[t]he desire for sovereignty—control over decisions affecting one’s community—was a cultural value in the La Parguera experience.” Notably, ownership and control are important incentives for making people willing to share their knowledge, but may not be sufficient unless the knowledge holders and communities are equitably rewarded by sharing the stream of benefits that the MPA generates.
Although user and stakeholder participation is, as Fiske suggests here, a value in itself, it also serves an explicit governing purpose: governability is less feasible if an MPA is imposed from outside and community members have no sense of ownership. As Aswani and Hamilton (2004, p. 12) argue, MPAs work better if they build upon practices with which community members are familiar, and that this will make it easier for them “to grasp the biological value of the programme and understand the use of restriction it entails.” Ideally, therefore, MPAs should grow out of a locally perceived problem and through an interactive, planning process, starting from the bottom up. Thus, although intuition may suggest that the governability of MPAs is reduced by opening up to users and stakeholders, for instance as a consequence of increased transaction costs (Pomeroy et al. 2004), governance theory contends the reverse, because stakeholders have essential, positive contributions to make.

Summary and Conclusion

Despite the positive aura that now surrounds MPAs, they are not a simple solution to conservation and management. Their implementation is not straightforward, and they often do not accomplish their stated aims. In many instances MPAs are declared but not followed up with good governance measures. Thus the number and area coverage of MPAs globally may be misleading indications of their conservation effect (Mora et al. 2006).

Like any other management tool, MPAs come with new restrictions on user behaviour and they influence people’s ability to sustain themselves. MPAs therefore tend to be contested by the local people affected, who often find their situation impaired rather than improved (Griffith and Valdés Pizzini 2002). Although MPAs may provide opportunities for marine resource users, such as improving fishers’ living standards, the immediate sacrifice may be too much to bear (Bavinck et al. 2005). Often, MPAs have implications for the distribution of access and income among user-groups, and are therefore contested for reasons of perceived fairness and justice.

This being the case, MPAs cannot simply be imposed on people from outside the community. Nor should user-groups or stakeholders be involved just for the sake of making implementation easier. Their participation is not something that should be “allowed” as a MPA cooptation strategy, or as a means of persuasion. Rather, the participation of user-groups and stakeholders is among those principles that, according to governance theory, should underpin marine and coastal governance as a value in itself. Thus, more concern should be given to the communication that occurs prior to the implementation of MPAs (Chuenpagdee and Jentoft 2007). How should a discussion about MPAs be organized? Who should be involved in these initial talks? What needs to be known about the system-to-be-governed and the particular ecological, social and cultural context in which the MPA is to be introduced? These are issues that require serious investigation and guidebooks exist concerning how to do this (cf. for example Pomeroy et al. 2004; Pomeroy and Rivera-Guieb 2006).
It is safe to conclude that MPAs are seldom a quick-fix for marine conservation and management, but instead a tool that requires careful, well-balanced, institutional design, with the broadest possible stakeholder participation (Morin Dalton 2005). Governability, and hence the success or failure of MPAs, relies on their particular design as a governing system. This is largely an institutional and organizational issue, requiring due consideration of contextual factors pertaining to local ecological and social elements, and their interaction. However, MPAs are not a once-and-for-all arrangement. They are regulators and facilitators of human action and interaction. MPAs are what users and stakeholders make of them. Governability is therefore as much about the social process as the structural design of MPAs.

In some instances the system-to-be-governed needs to be reformed as well, e.g., when stakeholders are empowered by legal or organizational means, in order to improve their capability of response to governing initiatives and demands. MPA design and process is also about linking the governing system and the system-to-be-governed, and how these can be made to interact better.

Governance theory encourages us to look at MPAs from different angles, and stresses the need to address the basic institutional principles and values underpinning MPAs. If applied systematically, the theory’s analytical concepts also make it possible to compare MPAs in order to understand how system features enhance or inhibit governability. The cells in the matrix presented in this paper (Table 1) contain analytical points of entry that may be useful in empirical research. For us they have served mainly as yardsticks for summary reading. Our literature review, however, indicates that there are still gaps in our knowledge, that there are cells in our matrix that have yet to be filled. In our estimation, the diversity and complexity features of MPA have received more coverage than their dynamics and vulnerability traits. Relatively little attention has been paid to how MPAs adapt and change over time, and how they are affected by external pressures originating from society at large. As to matrix columns, MPAs as systems-to-be-governed—how they work as organizations or “functional systems”—could benefit from more scrutiny.

Ecologists have so far been at the forefront of MPA advocacy and research but, as Morin Dalton (2005) argues, we need to have MPA discussions that extend beyond ecological theory and cross disciplinary boundaries. In order for this to happen, social scientists must get down off the fence where they have mostly been sitting so far and the two groups need to start collaborating in a research process that ought to be essentially interdisciplinary. There may be several reasons why social scientists—with a few exceptions—have so far remained largely silent about the merits or pitfalls of MPAs. The MPA ‘pandemic’ may have gone unnoticed, or perhaps they do not find MPAs particularly interesting. But another reason may be that social scientists have not yet found a way to study them. In order to trigger interest, the social scientists must be able to draw on the general analytical perspectives
that their disciplines have to offer. If not, they will have problems recognizing what social science has to contribute and what they might learn from MPAs.

As with any other natural or social phenomena, scientists and managers have to be able to see MPAs as something. If not they will go unnoticed, or scientists and managers will not understand what they see. Nor will they know what to do. For instance, once ecologists started to look at the marine environment as ecosystems, rather than as an assortment of species and a reservoir of resources, their science changed and subsequently the management approach as well. MPAs are largely an outcome of this other perspective. If this is how it works in relation to nature, it should also work with regard to how scientists and managers perceive and act upon society, concerning governance, for instance.

Governance theory works from a similar systems perspective to that of ecosystem theory. Thus, when analyzing MPAs from a governance perspective one would study MPAs as a system, or as a system of and within systems. As such, it provides a perspective from which MPAs may be regarded. This involves perceiving MPAs as three open, interactive systems that are structurally diverse, complex, dynamic and vulnerable, not simply as technical instruments ready-made for top-down implementation. Not only will such a perspective offer, in our opinion, a better understanding of what MPAs are and what they do but, as with ecosystem approaches to marine and coastal governance, it should also enable better practice.

Acknowledgments

We are grateful for encouraging and constructive comments from Ian Bryceson, Ratana Chuenpagdee, and Jan Kooiman. We also appreciate the criticisms made by three anonymous reviewers. The work on this paper was partly financed by The Norwegian Agency for Development Cooperation (NORAD).

References

Marine Protected Areas (MPAs) in relation to Fisheries Management

A Governance System Analysis

Marine Protected Areas (MPAs) in relation to Fisheries Management


Importance of small-scale fisheries

Small-scale fisheries are an important source of employment, food security and income, particularly in the developing world—an estimated 90 per cent of the 38 million people recorded by the Food and Agriculture Organization of the United Nation (FAO) as fishers and fish farmers are small-scale. An additional more than 100 million people are estimated to be employed in other fisheries associated occupations. Significantly, these figures are likely to be underestimates—millions of people fishing seasonally/ part-time, in coastal and inland waters are not recorded as fishers. Such predominance, in the face of fundamental and rapid changes in the fisheries sector, highlights implicit innovativeness, resilience and dynamism of the small-scale sector. Small-scale fishing communities also feature institutional arrangements that emphasize use rights, greater equity, and quick conflict resolution. Taken together, these aspects constitute an important store of social capital that exists in the communities. At another level, however, FAO estimates that about 5.8 million fishers (about 20 per cent of the total) can be considered poor, earning less than US$ 1 per day.

Small-scale fisheries

Conservation Concerns

The need for better management and conservation of coastal and fisheries resources, as directly linked to livelihoods, have long been raised by fishing communities and their organizations. There are many such examples from across the world. For example, demands, protests and agitations to regulate/ ban trawling and other destructive gear, such as pushnets, have taken place in countries that include Indonesia, India, Malaysia, Thailand, Brazil, Peru, Chile and Ecuador. There have been agitations demanding the regulation of intensive aquaculture, such as the culture of shrimp and salmon, in India, Thailand, Brazil, Bangladesh, several Cen-
Marine Protected Areas (MPAs) in relation to Fisheries Management

Marine Protected Areas and Impact on Small-scale Fisheries

Central American countries, and in Chile. Fishworker organizations have demanded action to control pollution of coastal waters in countries around the world, pointing to the negative impact of pollution and habitat destruction on fisheries resources, and thereby their livelihoods. There are ongoing struggles in countries around the world against unregulated development and industrialization of coastal areas, due to port development, expansion of oil industry, extraction of sand, rapid growth of tourism, and urban growth, among other factors.

Undoubtedly, coastal and indigenous fishing communities have a long-term stake in the conservation and protection of biodiversity, given their reliance on coastal and marine biodiversity for livelihoods and income. They can be powerful allies in the efforts to conserve, restore and protect coastal and marine biodiversity, particularly if conservation initiatives are based on their priorities and concerns, and are led by them. In several parts of the world coastal fishing communities have traditionally been regulating use of coastal and marine resources, including through setting up conservation zones, restricting entry, rotating access and so on. Small-scale fishers do have a keen understanding of the ecosystems to which they relate, an understanding that is manifested in numerous ways, as in the diversity, selectivity and ecological sophistication of the craft and gear used. Several small-scale fisheries are thus often managed and regulated in ways that are compatible with the sustainable use and conservation of biological diversity. There are numerous examples of self-regulation and conservation efforts undertaken by fishing communities, as in Brazil, Thailand, India, Philippines and South Pacific. Several east African countries have seen the emergence of co-management arrangements, where communities play important roles.

Small-scale Fishing Communities and MPAs

Placing MPAs in Context

An understanding of grassroots realities and of conservation/management concerns of fishing communities themselves is important for defining a responsive conservation agenda. It is important to understand, recognize and draw on the varied conservation initiatives being undertaken by fishing communities themselves. There is then need to listen to communities and respond to their conservation concerns and initiatives, rather than offer top-down, pre-set solutions for marine conservation.

Given that problems facing communities are diverse, diverse interventions are called for. The tools used need to be based on the nature of the problem, the biological features of the resource (sedentary, pelagic, demersal, mobile), and other related factors, and need to be culturally sensitive and specific.

Given this, MPAs would necessarily need to be recognized as only one of the tools within an ecosystem-based management approach, nested within other broader management frameworks for coastal and marine resources management, particularly where non-fisheries factors are affecting coastal and marine resources.
International Legal Instruments and rights of local and indigenous communities

It is worth noting that several international legal instruments recognize various dimensions of the rights of indigenous peoples and local fishing communities (men and women), including their right to participate effectively in conservation and management, as can be observed from the compilation below:

(i) **Stressing participatory approaches to management/conservation**

The need for full and effective participation of indigenous and local communities is recognized by several international legal instruments dealing with conservation of coastal and marine resources, including the Convention of Biological Diversity (CBD), the FAO Code of Conduct for Responsible Fisheries (CCRF), Agenda 21 and the Ramsar Convention. For example, Programme Element 2 on Governance, participation, equity and benefit sharing, under the Programme of Work in Protected Areas (COP7, Kuala Lumpur, 2004) of the CBD, emphasizes the full and effective participation of local and indigenous communities in protected area management. Article 10.1.2 of the CCRF stresses that, in view of the multiple uses of the coastal area, States should ensure that representatives of the fisheries sector and fishing communities are consulted in the decision-making processes, and are involved in other activities related to coastal area management planning and development.

(ii) **Recognizing preferential access rights of small-scale fishers to traditional fishing grounds**

Article 6.18 of the CCRF stresses the need to protect the rights of fishers and fish-workers, particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction. Notably, in the Basic Principles in Annex I on the Elaborated Programme of Work On Marine and Coastal Biological Diversity, under Decision VII/5 (COP7, Kuala Lumpur, 2004) of the CBD, specific reference is made to Article 6.18 of the CCRF.

(iii) **Recognizing role of communities in conservation/community conserved areas**

The above-mentioned Programme Element 2 on Governance, participation, equity asks States to recognize and promote a broad set of protected area governance types, including areas conserved by indigenous and local communities, using legal and/or policy, financial and community mechanisms. Resolution VII.8 (COP7, San Jose, 1999) under the Ramsar Convention on “Local communities and indigenous people” refers to ILO’s Convention C169 concerning Indigenous People and Tribal Peoples in independent countries as well as to the fact that in many contexts, indigenous people and local communities are already involved in managing and using wetlands sustainably, and have long-standing rights, ancestral values, and traditional knowledge and institutions associated with their use of wetlands. The Resolution adopted, as an Annex, the Guidelines for establishing and strengthening local com-
Marine Protected Areas (MPAs) in relation to Fisheries Management

Marine Protected Areas and Impact on Small-scale Fisheries

Communities’ and indigenous people’s participation in the management of wetlands. The guidelines emphasize the need to encourage active and informed participation, and the assumption of responsibility, by local communities and indigenous people in the management of Ramsar-listed sites and other wetlands and the implementation of the wise-use principles at the local, watershed, and national levels. Resolution IX. 4 asks States to systematically collect ecological and socio-economic data including on artisanal fisheries and aquaculture and highlights the importance of participatory management for conservation and sustainable of fisheries resources.

(iv) Protecting customary use of resources

Article 10 (c) of the CBD calls on States to protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements. Similarly, while Article III.5 of the Convention on the Conservation of Migratory Species of Wild Animals (CMS or the Bonn Convention) prohibits the taking of species under Appendix I, Article III.5 (c) notes that exceptions may be made if the taking is to accommodate the needs of traditional subsistence users of such species. The term “management” as used in the CMS includes sustainable use and, therefore, traditional hunting practices, of special importance for indigenous peoples, are allowed under this Convention, subject to conditions of sustainability. Article 7.6.6 of the FAO Code of Conduct for Responsible Fisheries (CCRF), highlights the need to recognize traditional practices, needs and interests of indigenous people and local fishing communities highly dependent on fishery resources for their livelihood.

(v) Respecting, maintaining and promoting traditional knowledge/practices

Article 8(j) of the CBD recognizes the need to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity, and to promote their wider application. The need to encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices, is also highlighted. Section 17.74 b, Agenda 21, emphasizes that States must take into account the traditional knowledge and interests of local communities, small-scale artisanal fisheries and indigenous people in development and management programmes. Article 6.4 of the CCRF stresses the need to take conservation and management decisions for fisheries, based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors. The need to investigate and document traditional fisheries knowledge and technologies, in particular those applied to small-scale fisheries, in order to assess their application to sustainable fisheries conservation, management and development, is highlighted in Article 12.12 of the CCRF.
(vi) Supporting small-scale fisheries and fishworkers

Agenda 21, Section 17.81 asks coastal States to support the sustainability of small-scale artisanal fisheries by integrating small-scale artisanal fisheries development into marine and coastal planning as well as by recognizing the rights of small-scale fishworkers. Section 17.94 asks States to provide support to local fishing communities, in particular those that rely on fishing for subsistence, indigenous people and women, including, as appropriate, the technical and financial assistance to organize, maintain, exchange and improve traditional knowledge of marine living resources and fishing techniques, and upgrade knowledge on marine ecosystems. Article 24.2 (b) of the United Nations Fish Stock Agreement (UNFSA) requires States to avoid adverse impacts on, and ensure access to, fisheries by subsistence, small-scale and artisanal fishers and women fishworkers, as well as indigenous people in developing States, while adopting conservation and management measures for straddling and highly migratory fish stocks.

(vii) Contributing to poverty alleviation

States agreed to eradicate extreme poverty and hunger by halving, between 1990 and 2015, the proportion of population below $1 (PPP) per day, when they adopted the Millennium Development Goals (MDGs) in 2000. The Basic Principles in Annex I on the Elaborated Programme of Work On Marine and Coastal Biological Diversity, under Decision VII/5 (COP7, Kuala Lumpur, 2004), CBD, specifies that this programme of work aims to make a direct contribution to poverty alleviation, in accordance with the Millennium Development Goals.

National Legal Instruments and rights of local and indigenous communities

While the rights of indigenous and local fishing communities are well recognized at the international level, they are not as well reflected in national legislation and practice, with a few notable exceptions. Thus, community tenure/management systems/community conserved areas are part of the legislation of various Pacific island states, and of India, among others. Provisions for active participation of communities in planning and management phases of protected areas is part of the legal framework in Tanzania, Philippines and Chile. In Brazil, rights of communities to manage, use and monitor resources in marine extractive reserves, are recognized. The National Biodiversity Action Plans of China and Mauritania stress the active participation of communities in management.

Small-scale Fishing Communities and protected areas

Experience from several countries indicates that in certain situations communities are taking the initiative to manage/conserve resources through establishing protected areas. For example, the Raiu system and Locally Managed Marine Areas in the Pacific, community-managed protected areas in Philippines, Marine extractive reserves in Brazil, management and exploitation areas for benthic resources in Chile. In all these countries there
is enabling legislation that supports community initiatives. Protected areas are also being seen as tools by communities to secure tenure and check adverse developments (indiscriminate tourism, intensive shrimp/salmon culture, industrial/destructive fishing).

**Small-scale Fishing Communities and protected areas**

*Negative Impacts*

After considerable review of empirical data and evaluation analyses, the World Bank, the African Development Bank and other agencies came to the conclusion that people living in protected areas are made materially worse off and impoverished by the introduction of “restriction of access” to natural resources, enforced as part of conservation projects (Cernea 2006).

Despite the fact that the rights of local communities to participate in management and conservation are recognized at the international level, and communities themselves are taking various initiatives to manage and conserve resources, including through setting up protected areas, as earlier elaborated, establishment of protected areas, through non-participatory, externally-led, top-down conservation initiatives, are having negative consequences for local communities. It is also increasingly clear that alienating local communities is counter-productive, particularly as they can be powerful allies. There is enough experience to indicate that unless communities drive conservation initiatives, these are unlikely to succeed.

Protected area targets and agendas are pre-determined, set by international bodies and national governments, and are not necessarily appropriate to the problems being faced by communities. Participation of local communities is thus often reduced to participation in implementation (instrumental participation). Principles of sustainable use and development are, unfortunately, not well enough recognized in protected area design and implementation. Given this situation, the economic, socio-cultural and environmental costs of conservation are often borne by local fishing communities, while the benefits often go to outsider groups, particularly the tourist industry. Compensation for displacement and other costs (including of livelihood opportunities lost), is often inadequate, if provided at all. In general, the record of providing viable alternative livelihoods, remains poor.

**Small-scale Fishing Communities and MPAs**

*Key Issues*

Safeguarding rights to access fisheries resources and to the continuous possession or enjoyment of coastal residential habitats and other lands traditionally used by communities, within the framework of sustainable utilization of living natural resources, is of paramount importance, if fishing communities are to progressively share the responsibility of managing coastal and fisheries resources. To move towards progressive, participatory, equitable conservation policy and practice, it is essential to address some of the current problems areas. It is, therefore, important that:
• Provisions in existing international legal instruments supporting the rights of indigenous and small-scale fishing communities with respect to conservation initiatives, are reflected in national legislation and policy.
• The rights of small-scale fishing communities to access and use biodiversity and to engage in responsible fisheries, in keeping with the principle of sustainable use of biodiversity, are recognized. This is particularly relevant in a context where no-take areas are being indiscriminately promoted.
• Traditional and customary rights of communities to resources (land and sea) are recognized and protected at the national and local level, in legislation, policy and practice.
• Community conservation/ management initiatives (area-based or otherwise) are recognized and supported, in legislation, policy and practice.
• Communities traditionally dependent on the resource base are seen as rights holders, not stakeholders, in decision-making processes.
• The subsidiarity principle—those living closest to the resource and using it for livelihoods, should have a greater say in decision-making processes—is applied.
• The proportionality principle is applied in ecosystem-based management—factors and activities that are causing greatest harm to the coastal and marine ecosystem need to be addressed first.
• Effective and inclusive participation of communities in conservation initiatives is ensured at all stages. This means that the choice of appropriate management/ conservation tool, the objectives of management, the management plan, the governance structure, provisions for community representation, and the implementation and monitoring plan, are decided in consultation with local communities, and that the governance structure itself is representative of the various social groups within the community, including women, and crew.
• Economic and socio-cultural benefits from protected areas directly flow back to local communities (not only the costs), guided by the principle of equitable benefit sharing within community.
• In cases where livelihoods are affected or access to resources is restricted, appropriate compensation and livelihoods is provided, in consultation with the affected people, with their prior informed consent, and appropriate to their needs.
• Detailed gender-disaggregated socio-economic baseline data, to effectively monitor the contribution made by conservation initiatives to improving livelihoods and reducing poverty, is generated and compiled.
• Greater interdepartmental coordination, with due importance given to fisheries departments/ ministries in decision-making, is fostered.

The above issues are important to address if conservation policy and practice is to meet the goals of both biodiversity conservation and improvement of livelihoods of communities traditionally dependent on the natural resource base.
Marine Protected Areas (MPAs) in relation to Fisheries Management
MPAs in relation to fisheries – what are the biological and fish stock implications? Quirimbas National Park, Mozambique

By Adaoma Wosu

Executive Summary
This work was commissioned by NORAD (Norwegian Development Agency) as part of a review of Marine Protected Areas in developing countries to investigate the basis for their establishment and management. This section presents an example of the realities of such with a focus on the biological and fish stock implications of an MPA in Mozambique. The paper is based on Quirimbas National Park in northern Mozambique which contains an MPA situated in the tropical coastal waters of the Indian Ocean. This report briefly summarizes the main conclusions emerging from published literature, grey literature and through communications with researchers in the field. In lieu of the gap in quantitative small scale fisheries data for this region the example of QNP is interwoven with current scientific theory on MPAs to give a more thorough analysis. Research in this region reflects the situation on the ground in many areas of the developing world, which is that unfortunately a lot of the scientific questions remain unanswerable. This means effective evaluations are hard to carry out. However, indirect evaluations through social surveys show that local fisher folk have perceived a reduction in catch in areas surrounding the total protection zone in the MPA. Despite this, the full effect of the MPA in this region can only be inferred after more extensive research is done. In a country such as Mozambique where 42% of the population live on the coast and marine resources are an essential form of livelihood (Schleyer et. al., 1999), the importance of understanding the role of MPAs in sustaining a healthy fishery is vital for the livelihoods that depend on them.

Marine Protected Areas and Fisheries Management
The theory behind their advocacy as a fisheries management tool
Marine protected areas have been used as a tool for decades, initially to protect marine biodiversity, but more recently to act as a tool in fisheries management. There is still
considerable disagreement, however, among fisheries scientists and conservation biologists about why, when, and where MPAs should be used. Uncertainties about the effectiveness of MPAs in meeting fisheries goals abound. For this reason the purpose and design of an MPA is often criticised for not accurately representing either the biological or socio-economic environment in which it is situated.

From the perspective of MPAs as a tool for fisheries management, the theory suggests they maintain breeding stocks of commercial species, increase fish catches through the emigration of adults from total protection zones (McClanahan and Arthur, 2000; Gell and Roberts, 2002), and enhance larval recruitment in fishing grounds adjacent to them (McClanahan and Arthur, 2000; Russ and Zeller, 2001; Roberts et al., 2002 cited by Russ and Zeller 2003). Inside reserves, populations increase in size and individuals live longer, grow larger and develop increased reproductive potential thus benefiting adjacent fished areas through density-dependent spill-over (Bohnsack, 1998). The theory is still being tested however and has not yet been unequivocally proved. It is important to note, the effectiveness of an MPA in meeting its biological and fishery goals is often attributed to the local socio-economic and environmental context in which it is situated, particularly in relation to the level of compliance of regulations by local and migrant populations (Christie and White, 2007; Jameson et al., 2002).

![Map of Quirimbas National Park](image)

**Fig. 1.** Map of Quirimbas National Park. (QNP) Arrows pointing to four study communities: Matemo (1); Ibo (2); Quirambo (3); Quirimba (4). Dark inner line represents the QNP boundary and the outer thinner line represents the boundary of the buffer zone.

**Purpose of establishing an MPA**

**Quirimbas National Park case study**

Mozambique is a signatory to the Convention on Biological Diversity which means it has, as its target for 2012, to establish an ecologically representative network of marine protected areas. This case study of the Quirimbas National Park aims to illustrate the challenges and successes in establishing and managing MPAs for fisheries management.
areas, nationally and regionally (COP 7 Decision VII/28). The Ministry of Tourism under the National Directorate for Environmental Management (DNAC) is the government body responsible for MPA design and creation. The department works under the assumption that biodiversity conservation and poverty alleviation in the region can be achieved through tourism development (Strategic Plan for the Development of Tourism (MITUR, 2004) and that conservation of natural resources play a vital role in poverty reduction, (Plano de Acção para a Redução da Pobreza Absoluta para 2006-2009 (PARPA II, 2004). The Quirimbas archipelago falls within the East African Marine Ecoregion (EAME) and has been included as part of an area of globally outstanding importance for marine biodiversity (WWF Eastern African Marine Ecoregion, 2004). Hence MPA planning is largely driven by both tourism goals (as a link between poverty reduction and conservation) and international (Convention on Biological Diversity) and regional (EAME) conservation targets.

MPA design in Mozambique has had to rely on the porous amount of available data for the region. For this reason, MPA design and implementation has been based on scientific data contained in regional and international conservation plans, evaluation of the local social conditions and community/stakeholder consultations. The Quirimbas Archipelago is an example of this, situated in the province of Cabo Delgado, northern Mozambique. It consists of a chain of 28 islands stretching approximately 800 km from just north of the city of Pemba to the town of Palma. The Quirimbas National Park (QNP hereafter) includes 11 of the southernmost islands and an area of mainland forest. Its total area is 750,639 ha (Figure 1.) The establishment of QNP, as stated in its management plan, was a community-led initiative in response to perceived declining fish stocks in the area. GECORENA, formed in 1999 was the amalgamation of eleven NGOs and represented a community backed initiative for the formation of the Quirimbas National Park. Communities to be affected where consulted and partook in community planning workshops. The park was gazetted in 2002. Approximately 25-30% of the park is a marine protected area and includes the offshore St Lazarus Bank. The area contains four of WWF ecoregions and is regarded as a high conservation priority. The four habitats are: Southern Inhambane-Zanzibar Coastal Forest, East African Mangroves, Eastern Africa Marine Eco-region and Eastern Miombo Woodlands and Savannahs.

The reasons cited in the management plan for the establishment of QNP are its “scenic beauty, high biodiversity of world-wide significance, and important historical patrimony” (Ministério do Turismo, 2004) The biological and conservation reasons sited were raised over concern for the Park’s declining resources and resource use trends. This concern was

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1 “This group included members of the Provincial Forests and Wildlife Departments, the Tourism Department, the marine Administration, the Ministry of Environmental Affairs, and several local and international NGOs” (Ministério do Turismo, 2004)

2 A relatively large area of land or water that contains a geographically distinct assemblage of natural communities
raised by surveys conducted before the creation of the park which reported artisanal reef fisheries to be experiencing an influx of migratory fishermen into the QNP area due to reported over fishing in neighbouring areas of Nampula Province and Tanzania (Whittington et. al., 1997). For this reason it was determined by the local community with WWF providing technical assistance that management was needed to rescue the remaining fish stocks. Hence it was the conservation threat and rural livelihood concerns, which largely drove the creation of QNP. This concern is reflected in the Park’s goal “to conserve the diversity, abundance, and ecological integrity of all physical and biological resources in the park area, so that they may be enjoyed and used productively by present and future generations” (Ministério do Turismo, 2004). The park aimed to mitigate potential conflict between the different user groups of the park through the adoption of a zoning scheme. This involved the creation of four zone types within which particular activities can be practiced (see park rules and regulations below for a description of these zones). The enforcement of QNP regulations is carried out by Park wardens who patrol the Park.

The science behind its creation
A marine biological survey carried by the NGO Frontier in 1997 (Whittington et. al., 1997) documented the marine biology and assessed the conservation threat within the Quirimbas archipelago. The biological and resource use surveys adopted marine biological census techniques using transects for in-situ surveying and social surveys in assessing the threat on fisheries. The pre-MPA survey conducted by Frontier (Whittington et. al., 1997) provides the area with data which could be used for a BACI analysis (Before-After-Control-Impact) (Underwood, 1993). The report concluded the area including the reef and sea bed fisheries were rich in biodiversity using the relative diversity indices3 and total species number as an indicator of biodiversity richness. It also highlighted that the seine net fishery in the area was placing fish stocks and the local biology under pressure due to the technique being highly destructive and highlighted over-fishing as a threat to the local fisheries as a result of an increase in the numbers of fishermen Table 1. This latter information was obtained through commercial fish surveys and interviews with local fishermen. Fish poisoning using organophosphate insecticides was also recorded in the Park causing human fatalities in 1998/1999 (Ministério do Turismo, 2004).

There were also additional scientific studies conducted in the late 1990s prior to the establishment of QNP. In 1999 Schleyer et. al., of the Ministry for the Coordination of Environmental Affairs published a report that found 90% coral death off the islands of Quilalea and Sencar due to the El Niño phenomenon of 1998. Reef monitoring conducted by Schleyer et. al., (1999) and Motta et al., (2000) noted that where corals had been damaged through contact with fishermen recovery rates were near zero, which emphasised the importance of

\[ \text{R.D.I.} = \frac{\text{No. of Reef Fish Observed}}{\text{Total No. of Reef Fish Censured}} \] (Whittington et. al., 1997)
the creation of total protection zones. Pereira (2000) recorded 794 species in 93 families of reef associated fish of which wrasses were the most represented. WWF also conducted an ecological survey in 2001 as part of the establishment of the Park. These studies and others (Gell, 1997 and Whittington et al., 1997) provided the rational for site specific protection in the form of no-takes (Norse 1993) in identifying key habitat areas in need of protection. For example, Table 2 illustrates three key habitats identified by Whittington et al. (1997). For a full description of reasons refer to the QNP Management Plan.

**Table 1.** Destructive Fishing techniques (Ministério do Turismo, 2004)

<table>
<thead>
<tr>
<th>Destructive Fishing techniques</th>
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</thead>
<tbody>
<tr>
<td>Use of small mesh nets</td>
</tr>
<tr>
<td>Use of shark nets</td>
</tr>
<tr>
<td>Seine netting on the sea floor</td>
</tr>
<tr>
<td>Netting over coral beds, coupled with beating of the coral</td>
</tr>
<tr>
<td>Prawn netting with small mesh nets</td>
</tr>
</tbody>
</table>

**Table 2.** Key habitats identified in need of protection (Whittington et al., 1997)

<table>
<thead>
<tr>
<th>Key Habitats</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The sea grass beds of the Montepuez bay</td>
<td>Threats from over-fishing.</td>
</tr>
<tr>
<td>2. The mangroves of the Ibo stand</td>
<td>Represented the largest stand of mangrove in the region.</td>
</tr>
<tr>
<td>3. The fringing reef</td>
<td>Biodiversity of both national and regional importance.</td>
</tr>
</tbody>
</table>

**Extent to which fisheries and biological concerns are addressed**

**Park rules and regulations**

Fisheries concerns in MPAs are often addressed through placing restrictions on users in the form of rules and regulations. This is the approach, which has been taken by QNP. The use of destructive fishing practices has been prohibited, including the use of cyanide; use of explosives for fishing; and fishing with trawling nets from a motorboat. Zones designated for residents address local concerns about the arrival and destructive practices of migrant fishermen, which puts additional pressure on marine resources. These migrant fishermen require a permit from the IDPPE (Instituto Nacional de Desenvolvimento da Pesca de Pequena Escala), now known as IDEPA (Instituto Nacional de Desenvolvimento de Pesca e Aquacultura (National Institute for the Development of Fisheries and Aquaculture)) authorities in their Province and the local Province to fish. As stated in the national park
regulations, local permits are issued by local village authorities, which states where and for how long the fisherman can fish. The zoning system used within the MPA consists of two types of zones which were designed to manage the fisheries and conservation concerns of the area. These are:

1. Total Protection Zones: where there are no extractive activities of any kind
2. Community Development and Use Zones: for use by the residents of the area
3. Zones for Population Use: for use by the residents of the area
4. Buffer zones\(^4\): multi-use zones which aid in the protection of the Park

**Local perceptions of fish stocks and biology**

Although there is an absence of any available biological assessments of the effects of the Park on fish stocks and biology, there are several surveys which have used local perceptions of fish stocks as an indicator of changes. The Quirimbas National Park carried out an assessment of community perceptions of the condition on fish stocks surrounding the Park’s no-take zones under a programme called SocMon (socio-economic monitoring). The SocMon report (WWF Mozambique, 2008) specifically asked fishermen for their perceptions of the state of the marine resources before and after the creation of the no-take zones (a time period of 6 years). In total, four islands were involved in the survey, see Figure 1 for location of study communities in QNP: Ibo, Quirambo, Quirimba and Matemo (Figure 2). The local communities of three of the four islands (Ibo, Quirimba and Matemo) perceived the state of fish stocks to be in a better state prior to the establishment of protection zones than afterwards. However, locals on Quirambo reported that fish stocks had remained the same. The SocMon study also asked participant fishermen whether their catches had increased, decreased or remained the same in comparison to before and after the creation of the no-take zones. The results, shown in Table 3 below, show that for all the islands, catches prior to the no-take zones were perceived to be higher. In addition, the amount of time spent on a fishing trip had increased in all the islands after no-take zones.

In the absence of any thorough analysis, it is impossible to attribute causality to any of these changes. But it is illustrative of the state of knowledge surrounding the marine protected area in this region. However, The QNP-Community consultation (QNP and AMA, 2010) goes a little further in trying to identify the causes for some of these behavioral changes. This consultation took the form of a participatory evaluation by the communities based in the coastal zones of Quirimbas National Park in June 2010. The evaluation indicated that communities which had a no-take zone operating in the marine area around their island reported fish stocks had remained steady or increased in the last

\(^4\) The buffer zone has been established at a distance of 10 km outwards in all directions from the Park boundary (Park Management Plan)
Importantly, communities did not attribute this solely to the existence of a no-take zone, but also to the fact that enforcement had been strengthened over the last 3-5 years by the creation of Community Fishing Councils (Comunidade Conselho de Pesca).

It is important to note that communities lying within the Park boundaries had greater support from national park rangers and local government when dealing with migrant fisheries arriving in the region to fish illegally in surrounding waters. In contrast, a study carried out a few months later, which looked at fishing communities lying just outside the national

However, the report notes that fisherfolk often referred to the fish stocks within the no-take zones, rather than outside of these zones. Fisherfolk gave little evidence which suggested spill-over from these no-take zones was occurring.
Marine Protected Areas (MPAs) in relation to Fisheries Management

Quirimbas National Park (for example Quiranhune and Pangani) reported a decrease in fish stocks which, these communities attributed to increasing numbers of itinerant fishermen from Nacala and Tanzania (CHEC 2010, unpublished).

With the existence of benefits from spill-over from the no-take zones still unknown, it is worthy to note that the fishing restrictions of QNP are borne directly by the fisher folk who used to fish in the total protection zones. In this sense, although the no-take zones theoretically contribute to enhanced fisheries and biology, the current link between MPAs and fishers livelihoods, an essential element of fisheries management, is less clear. Table 4 highlights some of the costs and benefits associated with the marine protected area of QNP. Furthering this, a study was conducted in 2006 by African Safari Lodges (ASL), a development programme. The study aimed to assess the socio-economic impact of tourism lodges on the local community. Part of the report compared the socio-economic profile required of lodge workers to a socio-economic profile of fisher-folk that were surveyed. It found that the two were vastly different, with lodge workers being more educated; speaking English as well as Portuguese; having specific trade skills and/or having a livelihood applicable to the lodge supply chain (e.g. fished crab, prawns or lobsters), see Box 1 below.

<table>
<thead>
<tr>
<th>Socio-economic profile of lodge workers</th>
<th>Socio-economic profile of fisher-folk</th>
</tr>
</thead>
<tbody>
<tr>
<td>• English speakers</td>
<td>• Kimwani speakers with no/limited other languages</td>
</tr>
<tr>
<td>• High level of education (primary 7+)</td>
<td>• Low level of education</td>
</tr>
<tr>
<td>• Previous tourism experience</td>
<td>• No previous tourism experience or understanding of tourism</td>
</tr>
<tr>
<td>• Younger people (18–30 years old)</td>
<td>• Older people (50+)</td>
</tr>
<tr>
<td>• Suppliers to the Lodge (e.g. high quality sea foods, fresh vegetables, materials)</td>
<td>• People without tourism related enterprises or enterprise knowledge</td>
</tr>
<tr>
<td>• Those with specific trade skills (e.g. mechanics, boat captains)</td>
<td>• Those with livelihoods not applicable to Lodge supply chains (e.g. net fishermen, farm (farm) owners, marine harvesters)</td>
</tr>
<tr>
<td>• Those living closer to the centre of town (Bairro Rituto and Cumauamba) or on main roads in the town</td>
<td>• Those without specific trade skills</td>
</tr>
<tr>
<td>• Those living far away from the centre of town</td>
<td></td>
</tr>
</tbody>
</table>

Box 1. Case study finding: Socio-economic impacts of tourism lodge development on Ibo. (Riddell and Wosu, ASL 2006)
Filling the biological knowledge gap
As highlighted in this case study, there is still a lot of biological research which needs to be done in order for MPA science to be fully integrated into fisheries management. While participatory evaluations are useful exercises for engaging communities and understanding linkages between resources and resource-users, these surveys need to be complemented by the collection of scientific data on the fish stocks and biodiversity within the MPA. Table 5 outlines some of the key areas where more scientific research is required. In particular for Mozambique Whittington et. al., (1997) recommend:
- Compilation of taxonomic lists to determine the fish diversity of Mozambique’s coral reefs along with studies on distribution patterns and species composition of reef fish resources;
- Research on interaction of species and how fish assemblages relate to the various reef characteristics in Mozambique;
- Studies on fish standing stocks and current landings to determine future availability of fish resources.

Table 3. Local perceptions of fish captures and time spent fishing. Adapted from SocMon report (WWF Mozambique, 2008)

<table>
<thead>
<tr>
<th>Islands</th>
<th>Perceptions</th>
<th>Captures %</th>
<th>Time spent fishing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Matemo</td>
<td>More</td>
<td>59.1</td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td>Equal</td>
<td>12.7</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>Less</td>
<td>21.4</td>
<td>36.8</td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>6.8</td>
<td>10.9</td>
</tr>
<tr>
<td>Quirambo</td>
<td>More</td>
<td>52.7</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>Equal</td>
<td>25.7</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>Less</td>
<td>19</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>2.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Quirimba</td>
<td>More</td>
<td>58.1</td>
<td>25.0</td>
</tr>
<tr>
<td></td>
<td>Equal</td>
<td>13</td>
<td>7.1</td>
</tr>
<tr>
<td></td>
<td>Less</td>
<td>16.1</td>
<td>67.9</td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>More</td>
<td>68.7</td>
<td>29.1</td>
<td>21.4</td>
</tr>
<tr>
<td>Equal</td>
<td>8.3</td>
<td>11.5</td>
<td>29.7</td>
</tr>
<tr>
<td>Less</td>
<td>20.3</td>
<td>55.5</td>
<td>45.6</td>
</tr>
<tr>
<td>Don’t know</td>
<td>2.8</td>
<td>3.9</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Concluding remarks

The lack of biological research on the marine protected area (MPA) of QNP prevents a thorough understanding of its biological and fish stock implications. Research of this nature is still in its early stages, and is heavily reliant on the theory of spill-over. Social surveys of fish stocks and local biology indicate that the no-take zones within the MPA have not had a clear positive effect on fish catches or surrounding biological health of the marine environment. This may be due to compounding socio-economic factors operating beyond the boundaries of the MPA such as migrant fisherfolk over-fishing; the adoption of destructive fishing techniques by migrants and the local population; and the lack of proper enforcement of the parks rules and regulations as highlighted by the community consultation.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery enhancement – still to be confirmed.</td>
<td>Opportunity cost: Revenue missed out on and compromised livelihood strategy of fisher folk and marine harvesters.</td>
</tr>
<tr>
<td>Injection of donors funds, particularly for training and capacity building, for example CI/UNDP funding to Lodge development for community projects. Introduction of sanitation and water conservation techniques (eg. WWF/Q.N.P. initiative)</td>
<td>Direct costs of establishment administration, monitoring and enforcement.</td>
</tr>
<tr>
<td>Employment opportunities through QNP park related projects</td>
<td>Spatial reduction of available harvesting areas.</td>
</tr>
<tr>
<td>Increased tourism for QNP and associated employment opportunities</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Areas</th>
<th>Scientific rational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larval dispersal/average effective dispersal envelopes</td>
<td>Determines: • Rate of self recruitment • the placing and spacing of a network of reserves will maximise potential fishery benefits on neighbouring fishing grounds • the effect of recruitment subsidy in benefiting neighbouring fishing grounds</td>
</tr>
<tr>
<td>Mobility of the target species</td>
<td>Crucial in determining the extent of spill over from reserves</td>
</tr>
<tr>
<td>Knowledge of the ecosystem impacts of fishing is limited</td>
<td>In order to avoid effects such as trophic cascades occurring in no-take reserves</td>
</tr>
<tr>
<td>Hydrodynamic knowledge</td>
<td>Important in identifying source or sink locations</td>
</tr>
<tr>
<td>Rigorous empirical evidence demonstrating the ‘spill-over’ effect</td>
<td>To demonstrate the benefits to fisheries yield</td>
</tr>
</tbody>
</table>

Table 4. The costs and benefits associated with the MPA in QNP.

Table 5. Filling the knowledge gap.

Concluding remarks

The lack of biological research on the marine protected area (MPA) of QNP prevents a thorough understanding of its biological and fish stock implications. Research of this nature is still in its early stages, and is heavily reliant on the theory of spill-over. Social surveys of fish stocks and local biology indicate that the no-take zones within the MPA have not had a clear positive effect on fish catches or surrounding biological health of the marine environment. This may be due to compounding socio-economic factors operating beyond the boundaries of the MPA such as migrant fisherfolk over-fishing; the adoption of destructive fishing techniques by migrants and the local population; and the lack of proper enforcement of the parks rules and regulations as highlighted by the community consultation. As
is the case in northern Mozambique, local fisheries are a source of livelihood for coastal communities and inject much needed cash income and protein into households. Every effort should be made to fill the biological knowledge gaps mentioned, in order to tighten the links between MPAs, their biological role and the effect they have on local fisheries.

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Marine Protected Areas in Mozambique: Impacts, Concerns and Perspectives

By Simeão Lopes

Executive Summary
The decrease of the level of fisheries’ captures world wide is a well known reality. The reasons and alternative solutions for such problem are being debated amongst scientists from different backgrounds. Such discussions revolve around issues related with the marine environment, protection of the resources and (better) recommendable models for the mitigation of disastrous impacts resulting from human pressure over the relevant ecosystems.

In this context, the present documents aims to contribute for the current debate on the usefulness of one of the marine natural resources management model – the marines protected areas (MPAs) – where scientists, public administration managers, tourism operators, fishermen communities, entities and organizations devoted to nature conservation and others get involved, in most of the cases in a conflictive manner.

The present report reflects the independent point of view of the authors regarding the objectives of protected areas, (their definition, how they were created) and the impacts of the marine resources and fisheries management model in protected marine areas, such as the National Parks of the archipelago of Bazaruto (Inhambane Province) and Quirimbas (Cabo Delgado Province). These parks were chosen for this analysis because of the wide extent of their marine area and also because they have important ecological, economical and social characteristics.

Generally, their creation complied with distinctive methods and procedures (participation levels, use of scientific and local information). Initially, they were created with the main objective of conservation of the ecological biodiversity of the influenced regions. Gradu-
ally, the exploit of the potential for the development of eco-tourism activities, the need to ensure the recovery of the decaying fisheries stocks, the reinforcement of the fisheries management’s actions and the promotion of the sustainable use of the resources with the involvement of the community, gained room in the strategic approach regarding these legally protected areas.

As far as the impacts are concerned, (a) socio-economical, there are some positive aspects related with socio-economical benefits for the communities deriving from this model. Nonetheless, there are still claims and conflicts in relation with disputes with tourism operators related with the access to such areas; (b) coordination, the management of such areas always demand a strong coordination of efforts between the relevant intervening stakeholders, which is not being achieved in an exemplar manner; (c) of the resources management model, the available data do not allow for conclusions to be reached in relation with the granting of the model to the national efforts towards an efficient and effective management of the resources.

Taking into consideration the legal and institutional framework in Mozambique, as well as their socio-economical threshold of development, the complex approach on MPAs suggest a more in-depth consideration of the wide use of such model. Costal Areas Integrated Development model where several interests (social, economical, tourism and conservation) related may be considered as an alternative for management of fisheries resources. According to Mozambican situation, there is a need to consider an approach that the parks and conservation matters are under a non productive sector as it is now a days. A specialized and autonomous entity would be in better position to assure a good level of equilibrium between the conservation and socio-economic needs.

The focus of fisheries economists, and bioeconomists in particular, has mainly been upon the management of commercially important species, using simple one or at most two-species models (for some exceptions to this see Flaaten 1988, Eide and Flaaten 1998). Furthermore, only a limited amount of work has been done with a focus upon small scale or common property regimes in fisheries, often of more relevance in developing countries. Fisheries economists started publishing work on marine reserves towards the end of the 90s, showing an increasing interest in the topic, and often a slightly different approach and attitude to that of the ecologists. Economists have usually been more critical to marine reserves as a fisheries management option than the ecologists (see Hannesson 1998, Smith and Wilen, 2003). However, the economic analysis is still to a large degree done by applying single-species systems (see however Bonceur et al. 2002 and Reith 2006), with issues of biodiversity or habitat seldom being included (see however Rodwell et al. 2003, Schnier 2005, and Upton and Sutinen, 2003), and primarily focussing on private property management as the benchmark with which to compare marine reserves (Hannesson 1998, Sanchirico and Wilen 2001).
Introduction

Geographic Context

The Mozambican territory lies in the southeast Africa, with a 2,700 km (around 1430 nautical miles) long coastline on the Indian Ocean and a land area of about 800,000 square kilometres, where about 19 million people live. It borders Tanzania, to the north, Malawi, Zambia, Zimbabwe, South Africa and Swaziland, to the west, and again South Africa, to the south. It shares the seawaters of the Mozambican Channel with Comoros, Madagascar and the French Islands located on it.

The coastline is characterized by a wide diversity of habitats, including sandy beaches, coral reefs, estuaries systems, bays mangroves and sea grass beds. About 80% (out of which over two thirds live within 150Km of the coast) of its 19 million inhabitants live in rural areas. The country has abundant land, though there is some pressure on the coast, in peri-urban areas and along major transport corridors.

The continental shelf is narrow, averaging 15-25 km in width; however, it can be as narrow as 100 m off Pemba north of Mozambique to approximately 145 km on Sofala bank (Sousa et al, 1997). The coast is a compound shoreline and can be divided into four main natural regions (Massinga and Hatton, 1997). The West Indian Ocean washing the Mozambican coastline including the MPAs is a region of great fish diversity. Few oceans share the same ichthyofauna richness with at least 2,200 recorded species, totalling 15% of the global marine fish world. This richness is due to the large variety of habitats and oceanographic conditions of this region (Smith and Heemstra, 1986; Van der Elst et al., 2005).

Taking into account the continental features and its sea platform but also the sea ecosystems within, we can consider three types of dominant coasts (IDPPE, 2006): The Northern Coast, is an extension of 770 km from the North extreme (10° 32’ S) to the Second and First archipelagos (near parallel 17°). It is a cut beach line, with sandy beaches, coral and rock banks, and some mangroves areas. The continental shelf is narrow and, between the Rovuma estuary and Pemba, there are many coralliferous islands which make up the Quirimba Archipelago and form a fishing protected area. The Central Coast, it is 980 km long, and goes from Namalungo Point (15° 38’ S), in the North of Anoche, to Govuro, in the north of Bazaruto Island (21° 30’ S). It is densely covered by mangroves and it presents a wide littoral and a huge continental shelf. This is extended gradually to the South of Beira, making up the Sofala bank. The South Coast, it covers the remaining 950 km of the coastline, from the north of Bazaruto to the southern extreme of Mozambique (26° 52’ S). The littoral is made of dunes, rocks and corals, and a narrow continental shelf and the sea beds are predominantly soft in Maputo Bay. Almost all along this coast, there are littoral lagoons.

Alongside the coastline there are geographical points which, due to their conditions, provide the gathering of marine species and as a result, more intensive fishing activities. The
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Estuary of the most important rivers and the marine areas thereby, as well as the bays to which they are associated, are by rule, important areas eligible for fishing, especially artisanal fishing. In this area there are small pelagic and demersal species from the soft seabed and some crustaceans. The main areas are at the delta of Rovuma, Zambeze, Pungué, Save, Limpopo rivers and Sofala, Inhambane and Maputo bays and the Maputo estuary. The littoral islands located near the coast of Cabo Delgado, Nampula, Zambézia and Inhambane, have another important geographic feature. On these areas, there is an abundant occurrence/fishing of demersal species from rocky sea beds and some big pelagic species as well.

Socio-economic Context

Mozambique is one of the world’s poorest countries, with 70% of the population living below the poverty line. Yet, the country is rich with under-exploited resources. In recent years, peace, better policies, rising foreign investment and continued external assistance have contributed to encouraging economic performance where the real GDP has grown along years. Growth has been broad-based in all sectors especially in the tourism and industry sectors.

Confidence in the economy has improved and private investment is growing rapidly. Under the Heavily Indebted Poor Countries Initiative (HIPC), Mozambique has qualified for USD 3.7 billion in debt relief, reducing external public debt two thirds. In addition to HIPC initiatives, Mozambique has benefited from a series of debt service relief and moratoria following the floods that occurred in early 2000 and cyclical natural disasters. (BM, 2003).

Fishing is a highly ranked activity not only for the absorption of the local labour force, but also for the provision of aquatic protein products to the local populations and earning hard currency for the country. The estimated total marine products are between 100 - 120 thousand tones per year and consumption is estimated at 7.5 kg per capita. The diversity of species and the variety of habitats generated a wide array of different fisheries in the country. For many years, the offshore industrial prawn fisheries have been a key component of exports for foreign exchange earnings and national incomes.

However, the small-scale fisheries, and the artisanal fisheries in particular, is the main source of income for the local communities and contributes significantly to the informal economy, as well as for protein source. Part of fishing related activities such as collection of shellfish, and fish processing are also practiced by women in such communities. The artisanal fisheries take place throughout the extensive coast mainly in bays, estuaries and islands at different levels of effort made by around 100 000 fishermen distributed in 658 fishing centres along the maritime coastal areas (IDPPE, 2003).

Despite the importance of the coastal marine resources for the local communities in Mozambique, little is known about the assessment and sustainability of the small-scale fisheries. It is probably for this reason that some places were recently proclaimed MPAs with the
aim to recover some fisheries stocks. Nevertheless, the main and traditional fishing areas are at the same time the potential areas for conservation purposes, because of the ecological and biodiversity characteristics.

**Protected Areas In Mozambique**

*Definition*

Marine Protected Areas in Mozambique are areas within the marine environment under protection from various forms of human or extractive exploitation, especially fishing. These were established by the Ministry of Fisheries (BR-Decree 43/2003). Under this definition, the term is synonymous to marine harvest refuges and marine sanctuaries. In these areas, performance of fishing activities is totally or partially prohibited, including subsistence, recreation, sports and/or submarine fishing. As well, closed seasons or prohibition may be declared depending on the resources/species to be protected. This is well within the IUCN definition of marine protected areas.

Owing to the diversity of habitats along Mozambique coastline some coastal areas are under special protection. Quirimbas National Park (750,639 ha) is the largest proclaimed area where 152,237 species are part of marine ecosystems (Mitur, 2004), followed by Marromeu Reserve (150,000 ha) located in the Zambezi River Delta system, comprising mangrove swamps, freshwater swamps and flood plain (Massinga and Hatton, 1997). The other conservation areas are: Maputo Reserve, Inhaca and Portuguese Islands, Bazaruto (1,430 km²) National Park and Pomene Reserve (Massinga and Hatton, 1997).

The National Parks of Bazaruto Archipelago and Quirimbas were established following their large marine area, in addition to their important ecological, economic and social characteristics.

*The Objectives of the MPA’s*

MPAs are been created in different historical and social moments of the country; hence the differences in terms of the objectives and methodologies used to create them. Fundamentally, the creation of MPAs in Mozambique was dictated by the objective to protect specific fauna species threatened with extinction, namely dugongs and turtles. Nowadays the tourism component is been introduced with a special focus on ecological preservation. The concern for the development of the traditional resource users began to emerge. (Engdahl et al, 2001).

The objectives of the Bazaruto and Quirimba National Parks set out in the Management Plans as to “conserve the ecological diversity, abundance, and integrity of all physical and biological resources in the park areas, so as to be enjoyed and so that they can be used pro-

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1 IUCN defines Marine Protected Areas (MPAs) as “area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and manage through legal or other effective means” (IUCN, 2004).
ductively by present and future generations” (PM/PNQ, 2003), fits within the scope of the previous paragraph. In fact, the two protected areas were created with the fundamental objective to:

1. Protect, conserve, and wherever necessary, restore the ecosystem processes;
2. Promote the economic and social well being of the people living in the park;
3. Ensure that all those interested share the benefits and responsibilities of managing the Park;
4. Protect, conserve, and rehabilitate cultural resources;
5. Stimulate and facilitate the growth of ecotourism;
6. Ensure the sustainability of the park.

On other hand the creation of MPAs underlies in the need to strengthen fishing management measures which were deemed to be inefficient due to inadequate investment policies, coupled with the registered institutional weaknesses in terms of monitory and control.

**Institutions Involved**

The current institutional organization of the national parks includes three governmental bodies responsible for direct management, namely Ministry for Environment responsible for coordination of all issues regarding the environment, the Ministry of Tourism dealing with conservation areas, namely national parks, reserves and community programs for eco-tourism development and the Ministry of Fisheries that defines exploitation measures for the fisheries resources (marine fauna and flora) including management, control and surveillance and creation of MPA’s (table1).

Beside these institutions, provincial and district governments, as well as local communities may propose the creation of conservation areas in Mozambique, provided that these fall within one or more criteria described as mentioned before by the Decree 12/2002.

Studies on MPAs management show that the current legal and institutional situation is rather complex, due to the intervention of various institutions with competences that encompass directly or indirectly conservation areas. Competence to elaborate proposals for definition of natural parks as well as the implementation of the respective management and conservation measures for marine areas and resources in particular should be viewed through a historical context of institutional framing of fishing activities, tourism and fauna and flora. Until the year 2000, these activities were under the Ministry of Agriculture responsible for management of land and marine national parks.

The situation has become more complex with the creation of the Ministry of Fisheries and the Ministry of Tourism. Under this new institutional framework nature preservation

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Fig. 1. Map of Mozambique indicating the main conservation areas.
areas\(^3\) (including national parks and reserves) have been put under Ministry of Tourism although they are governed by the fauna and Flora Law, despite the Ministry of Fisheries being competent to adopt any measure meant to protect marine resources, a fact which has been emphasized by the Presidential Decree n. 6/2000 that defines the duties and competences of the Ministry of Fisheries.

**Legal framework**

Several international and regional agreements and statements on MPAs have been already signed with Mozambique being part of, namely, the Convention on Biological Diversity; UN Sea Law; Jakarta Mandate; Cites Convention; Ramsar; the Johannesburg Declaration; Nairobi Convention, and the Arusha Resolution which required that all signatory States part of the Western Indian Ocean establish MPAs in their respective countries.

Based on these instruments efforts have been made in order to contribute to the adjustment of policies and strategically management tools in the country with the sustainable resource use as a key objective. Mozambique is part of marine eco-region in the Eastern African Indian Ocean. To implement this initiative a new international research project referred to as TRANSMAP has been created with the aim to propose policy options for the creation and management of Protected Marine Areas across Mozambique/Tanzania, and Mozambique/South Africa borders in order to maximize ecological sustainability, stakeholders need and management feasibility (Id2\textsuperscript{2}insights, 2005).

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\(^3\) Definition n. 19 of Land Law: “Public property qualifying for conservation or preservation of certain animal or vegetal species, biodiversity, historical landscape and natural
The juridical analysis of the national parks in general and of marine parks in particular lays in the principle that the Constitution of the Republic of Mozambique is the legal provision that legitimates the exclusive control by the Government over all the natural resources found in and underground, inland waters, continental sea, continental platform, exclusive economic zones, and allows the government to define all types of property that may be part of public property, as well as its juridical nature, its management and preservation, with a clear distinction between local government and local community property, and following the principle that public property is not prescriptive and not to mortgage. (CRM, 1990).

In this context, the Fisheries Law has proclaimed under “fisheries management and classification”, fish resources within Mozambique jurisdictional waters as public property with the government having the responsibility to set the terms and conditions of use and exploitation. Thus, all fishing related activities in Mozambique require authorization within terms and conditions fixed by the Fishery Law and other related laws applicable to fisheries. (BR, 3/1990)

Likewise, the Land Law has proclaimed through article 6 totally and partially protected zones as public property. The regulation of the Land Law provides that the rules applicable to areas reserved to activities of conservation and preservation of nature and defense and security of State will be provided for in a specific law.

Thus, the following four types of conservation/preservation areas may be established, in accordance with the biodiversity related law.

- National Parks;
- National Reserves;
- Marine Parks and;
- Marine Reserves.

The first two are provided in the Flora and Fauna Law n. 10/99 while the other two are within the General Fishery Regulation. As to land areas, there has not been registered any conflict of competences among relevant public institutions, whereas marine areas have been subject of rather tense conflicts. Marine park areas are legitimated by the Fishery Law and their creation aims at the protection of the whole marine life.

This framework allows the Ministerial Board to approve, modify or extinguish natural parks and reserves in Mozambique, provided that they meet one or more conditions below: (Decree 12/2002):

- The existence of a unique ecosystem
- The existence of rare fauna and flora, or under threat of extinction

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4 Approved by Law 19/97, of 01 October.
5 Approved by Decree n.66/98 of 08 December
• Existence of fragile ecosystems, as well as of those situated below 45º
• The existence of natural water resources with special environmental characteristics are likely to be recovered;
• The existence of unique landscape conditions

The change of the institutional set up over the time resulted in the enactment of a variety of laws that govern the sectors dealing with conservation/preservation areas (parks and reserves), which in turn has brought about an inevitable negative and positive conflict of competences among relevant public institutions.

On the other hand, the lack of a standardized juridical framework that establishes MPA creation proceedings, including management mechanisms has resulted in the overlapping of norms, with the inevitable rising of conflicts of competence and/or weaknesses in MPAs management process.

Information and Knowledge used

The creation of reserves or sanctuaries is done whenever possible, using the precautionary approach\(^6\), recommended in FAO Code of Conduct, (FAO, 1996). Although, the establishment of the “protected areas” within both parks has followed different methods, the creation of protected areas was further based on the results of some studies done which have indicated zones with highly biological diversity.

In fact, some generic ecological studies have served as a basis for the creation of fishing restricted areas in Mozambique. The research carried out by Darwin Frontier Research Organization, which may be cited as a work of reference for Quirimba area, has highlighted the importance of the islands as areas of high diversity and fundamental for local economy. Other ecological-biological studies such as that carried out by Rodrigues et al, 1999; Gecorena, 1999; Motta et al, 2000 have also recommended the creation of marine sanctuaries in the Quirimba region, with the objective to maintain the ecological integrity of the area (in Daniel, 2005). However, despite these generic studies restricted fishing areas have been established without any further scientific data inputs. Indeed, issues like what resources to protect, how and for how long are important for the success of marine resource management.

The information used and knowledge transfer issue is an aspect linked to MPAs model implementation. The scientists involved and Parks authorities have not been able to utilize, in quite good level, the local knowledge through out the whole process. The governmental

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\(^6\) Precautionary approach: A set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong.
entities have also failed to explain the criteria used to make decisions regarding the zoning and elaboration of the MPAs management plan.

But in case of Quirimba and accordingly with Bechtel, 2001, it seems that community participation all along the process was useful. In fact, participation here should be seen as the involvement of the influent people of the local communities, namely community leaders (traditional authority, religious authorities) and others with economic and political influence. This is clearly the way found to validate the inputs of the studies mentioned above and legitimize the sanctuaries within the community.

As long as there is poor understanding by the ordinary people in the communities and by fishermen about MPAs (its definition, functioning and management), officially stated as a means of safeguarding or improving fishery productivity, this will contribute to the reluctance by these groups to comply with the fisheries management rules set in the MAP’s management plan. In fact, there have been reports of constant violations by artisanal fishermen, which have obliged the park administration to take severe punitive measures. This has obviously resulted in tense and conflict relationship between park administration and the communities.

Another major weakness regarding information in the establishment of marine protected areas is the lack of historical information on fishing statistics that may confirm or not the decrease in fishing resource captures along the time. Basic information is provided by local communities which have clearly stated that capture was decreasing.

In order to monitor fishing activities the fishery sector has developed an artisanal fishing data collection system, based on a stratified fortuitous sampling. The system has been set up in all sea and lake coastlines including the area covered by both national pars under analysis. (Volstad et al, 2004). On the other hand, park administration has also introduced an Oriented Monitory System for Management (SMOG) (Cunliffe, et al, 2005), which may enable to confirm whether the management system may function in fishing areas in both parks.

Unfortunately, due to weak coordination between the Ministry of fisheries and the Park authorities, there is no interaction or complementarity between the two systems, which results in the overlapping of activities at both management and research levels.

*Socio-economic impacts*

The establishment of marine reserves requires not only the analysis of the capacities, knowledge and the social structure of the fishing communities, but also a clear definition of their expectations in relation to the economic and social benefits that may result from the implementation of the fishing management model to implement in the protected areas.
Normally, the community concern relates, on the one hand, with the creation of basic social infrastructure, namely schools, health posts and water sources and, on the other hand, with the possible alternate activities that may generate income for the livelihood.

In general, the management plans of Quirimbas and Bazaruto indicate specifically a number of local community rights, among which we can underline the following:

- Access to 20% of all collected taxes for the benefit of local communities;
- First option for employment in all tourist enterprises;
- The right to decide on who should or should not fish;
- The right to participate in the implementation of Park regulations;
- The right to use marine resources and littoral resources within the use and development zone for their own nourishment, and;
- The exclusive right to collect and sell certain natural resources (fish and seafood, timber, construction material, palm tree leaves, and all forestry products).

The economic benefits of the communities are defined as being the following, (a) for the fishing areas: limit the entrance of migrant fishermen (what is against the law of fisheries), the opportunity to create sanctuary and the growing of new “products”; (b) in Tourism: benefits generated by community tourism, promotion of activities related to tourism and the access to 20% of income generated by tourism; (c) social areas: the construction of schools, environment education, scholarships, literacy sessions and the development of a local curriculum, sanitation of the environment (through programs of ecologically friendly latrines), the construction of a maternity and the construction of pit latrines.

Although the MPA’s of Bazaruto and Quirimbas have been conceived with the objectives of social and economic integration of the people, the majority of fishing communities live and fish within the conservation zone, classified as protection areas, and in practice were not integrated in these “projects” and, as a result, there are no alternatives for their survival.

As a result, there have been registered conflicts related with its setting up, especially regarding the access and use of different resources and the environment, vis a vis opposing interests. These interests are linked to social and economic groups and to the activities that they carry out, for example: fishermen, investors, and maritime administration, park managers and users, namely tourists and the public in general. The conflicts are mainly due to a significant number of communities who live within these protected areas and to a lack of mechanisms to incorporate the groups of interest, ensure the participation of communities in decision making during planning, in delimitations or zoning and in management.

Within NPBA community benefits assumed by the administration are limited to the distribution of park entrance fees paid to the benefit of the communities: job opportunities through tourist facilities available in the national parks; increases in the income of the
fishermen resulting from fish sales to the tourist facilities and tourists; hiring of boats by hotels for tourist trips; sales of products traditionally manufactured by communities, etc.

Recent evaluations made in BNP have revealed some positive aspects regarding community benefits resulting from the projects incorporated in park management, namely school improvement, access to scholarships, literacy classes for adults, facilitated access to the acquisition (important for the purpose of employment, education and right to use park natural resources); training in honey production; support to the creation of social community centers; promotion of associations and group users of natural resources (Cunliffe, R. at al., 2005). Community benefits in the QNP area are not much felt in comparison to BNP, as the park area was recently created.

Despite these positive examples, there have been reports of contest among the communities, as well as conflicts, most of time with tourist operators, around access to spaces, which is a sign of persisting challenges that require deep attention from park administration. Contrary to the agreements, hotels do not call for services supplied by local operators. They do not even buy the products supplied by local communities, including fish captured by artisanal fishermen. Besides, the job opportunities available in the area are not accessible to the local communities, mainly due to limited appropriate academic and linguistic skills.

On the other hand, there have been reports of alleged excess under the pretext to protect both the environment and fish resources in the areas. Indeed, questions have been raised over some illegal attitudes of some tourist operators in the area:

- Community displacement from traditional areas of inhabitance. Restriction and even totally prohibited access of fishermen to potential traditional fishing areas;
- Limited access to the beach site close to tourist complex resulting in difficult fishing activity.

An MPA is a protected area implying some exclusion that may be understandable in the sense that it is necessary to reduce the human impact on natural resources requiring special protection. The problem is when exclusion must affect the most vulnerable strata of society, namely communities. Indeed, any exclusion that does not offer alternate subsistence opportunities cannot achieve the set objectives.

Some Thoughts on the MPA Model

Fisheries Administration and MPAs

According to the legislation currently in force, the local Fisheries administration is a function that depends on the governing body (in this case the Ministry of fisheries) which, in turn, can delegate this function to other institutions which are in a better position to do so. The Fishing Law, passed in early 90’s which gave these administration powers (licensing, inspection and tax and fine collection) to the maritime and agriculture administrations,
for sea and continental waters respectively, is responsible for formalizing these competences. As far as semi-industrial and industrial are concerned this is the responsibility of the fishing administration at central level (DNAP) and at the provincial level (DPP or SPP).

The management of artisanal fisheries was, until the 90’s, based on the access control to fishing approach through administrative measures, licensing of fishing equipment and its regulation, as well as inspection and prohibition (prawns). Different institutions had powers to enforce administrative measures, resulting in overlapping of powers and in inefficiencies in the implementation of these measures as well as in conflicts. Such an approach and consequences came to be inadequate in view of the socio-economic and political changes taking place in the country.

The on going process of decentralization, in force since 1st October 2006, brings about big changes for the management of fisheries, especially with regards to artisanal fishing. The district administrators are now responsible for licensing and inspection of artisanal fishing activities in their respective territory.

There is also an increasing worry over the need to define the biological parameters and socio-economic indicators in fixing prohibition and control of fishing efforts systems. However, monitoring of artisanal fishing and its levels of exploitation has been weak, so has been the knowledge of the potential in accessible resources to artisanal fishing. The lack or the insufficiency of biological information as well as of technical and socio-economic indicators are partly explaining factors of the lack of fulfilment of the defined management measures in that they became difficult to make people aware and persuade them to fulfil.

The above mentioned factors in previous paragraphs and the finding that the government system of fishing management was not per se enough to ensure adequate administration and control of the fishing efforts and of fisheries, included the fulfilment of prohibition periods, led to adoption of a participatory management in the fishing sector in Mozambique. The participatory management in the fishing sector has been legally defined (2003) in a later stage to the definition of local associations and councils as Associations in terms of the water resources law (1991) environment and forest and wildlife law (1999).

The participatory management, through CAP and CCP’s, as it is enshrined in the above mentioned legislation applicable to the fisheries in the maritime waters, is functionally focused on consultation and information activities, but not necessarily the decision making of management in its respective levels. The general objectives of participatory management are, among those legally defined:

- Ensure a registered order of fishing.
- Guarantee a participatory and responsible management of the fisheries.
- Ensure the exercise of the right to the access to the fisheries.
• Carry out the conciliation and mediation of conflicts in fishing, between artisanal fishermen and semi – industrial and industrial operators.
• Fishing promotion and extension.

The management model based on MPA’s is foreseen in the Fisheries Law 3/90, but the reasons for betting on this type of management model now toward the management of the fisheries resources can be found in the growing concern by a weak monitoring of the fisheries, mainly artisanal fishing and the levels of exploitation, as well as the weak the knowledge of the potential in accessible resources to artisanal fishing. The lack or the insufficiency of biological information as well as of technical and socio-economic indicators are partly explaining factors of the lack of fulfilment of the defined management measures in that they became difficult to make people aware and persuade them to fulfil.

The above mentioned factors and the finding that the government system of fishing management was not per se enough to ensure an adequate administration and control of the fishing efforts and of fisheries, including the fulfilment of prohibition periods, led very and boosted by conservation organisations, to the adoption of the MAP model as a new and secure tool to better management of the fisheries resources.

_The Existent MPA’s: Are they having Influence on the Resource_
The creation of these areas aims at the protection of coral reefs, an important habitat for the life cycle of various commercial species. Studies related to BNP have revealed a visible and continuous decree in marine resources such as coral reefs, fish and malapo (sand oysters) on which the community depends for survival. However, progress has been registered as regards conservation of dugongs and turtles; serious reduction in commercial fishing and decrease in the use of fishing net. (Cunliffe, R. at al, 2005).

Despite the lack of published research on QNP there is evidence of a dispersed population of fish species from sanctuaries to fishing zones, which presupposes an increase in capture volume in the area. Within this framework, effort is being made in both Bazaruto and Quirimbas to have confirmation of fish dispersion in these areas and regions.

Thus, the data and information available does not allow for an assessment of the level of success or not of this management system, hence the impossibility to safely affirm that MPAs constitute the right model to be applied for fishing management.

Debates over this issue have been intense, with reserves (or skepticism) on the one hand and moderate opinions on the other, suggesting an adequate resource monitory for better evaluation. The conclusion to be drawn from these debates indicates that biologists have considered MPAs to be a proper solution to resource management systems. Sociologists, however, are of the opinion that integrated development programs in sensible zones sus-
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The economists, on the other hand, have advocated the transferable quotas as the most viable alternative, for an efficient fish resource management.

However, in our opinion, an MPA may be a recommendable tool for nature and resource conservation, encompassing all suggested theories; yet, the resource management factor should not be seen as the exclusive key to success, if one has to assume that man is also part of the ecosystem, with specific priority needs to be incorporated into conservation programs.

Park and marine reserves may be an ideal environment for fishing areas management in so far as their creation provides for the well being of the fishing communities, and offers conditions to promote multidisciplinary agreements related to marine environment, through coordinated actions of investigation and monitory of existing fish resources available in the area of influence. Apparently, the establishment of MPAs does not provide monitoring indicators and criteria to measure the level of success of these restrictions, on the biological and socio-economic points of view.

So, there is a need to clarify and set acceptable scientific bases for an adequate definition of total protection zones (marine parks) in which any type of fishing activity is forbidden, and partial protection zones (marine reserves) where fishing is allowed on specific conditions. Indeed, it happens that these principles are not being rigorously observed. Although sanctuary areas exist in fact, they does not exist juridical, then their existence is yet questionable, which has resulted in various conflicts, hence the need for Mozambique to proceed to the revision of the legal framework regarding conservation areas.

Coordination among key stakeholders

Park management should involve park administration, government institutions, diverse private operators, community representatives, government institutions (environment, tourism and fisheries) and NGOs operating in the region. BNP and QNP management should be based on the co-management principle whereby key stakeholders would better handle, in an interactive manner, resource management related issues, namely fish resources. However, the current communication level and interaction have not corresponded to the expectations, hence the need for both park administrations to review the situation.

One of the factors underlying this situation may be the fact that park management committees established under the park management are not functional, added to the fact that park administration has been using them only as a communication channel to pass information and express recommendations in their interest, rather than a partner with whom there should be consultation in order to approach and find solutions to the common concerns expressed by other stakeholders.
The other factor behind is that local knowledge has not been achieved at a satisfactory level and this has influence in MPAs management coordination process. It is important to note that the communities are having an important influence on fisheries management initiatives in Mozambique and this should be well understood for MPAs propose. The Mozambican experience has shown that the MPAs consultation process is being elitist. For example, the crew members are not an active part of the process although that they are the main actors in the fishing operational field. Only boat owners, traders, community leaders (especially these) and the political and economic elite are considered in the process.

Thus, a number of local community members have questioned the MPAs objectives asking whether these were meant to develop tourism, to promote the multiple use of the natural resource available in these areas, to implement participatory democracy (as required by funding organizations), to achieve better fisheries management, or to implement all these aspects together? At some extent it’s difficult to come up with clear understanding.

Important is also the role of the traditional authorities regarding this matter. Often linked to traditional power structures (customs, practices and beliefs, religious institutions and myths), traditional leaders still play an important role in relation to resource exploitation, and they need to be active throughout the whole process whether by mobilizing the communities towards around the process or contributing in local knowledge and information transfer.

In this scope, (therefore), the involvement of private sector, local authorities, professional communities groups and the use of local knowledge, may serve as means of reconciling political, development, scientific and fisheries management goals regardless of the MPA model. Without a good interaction and coordination amongst the stakeholders the environment may not be conducive to an appropriate solution of the fish resource management issue, thus frustrating an important opportunity.

Likewise, it is important that the relevant authorities look into the protocols of creation of National Parks and Reserves. Indeed, there is no clear definition as to which institution in Mozambique is responsible for national park daily management, due to the fact that all legal related protocols do not clearly provide for specific duties for all involved institutions.

**Recommendations**

Although it can be relevant to adopt MPA as a fisheries management system, the current strategy requires an analysis in view of the reality under way, in order to develop a concept and a co-management strategy among the various stakeholders as partners of fishing resources management, although naturally with distinct functions. This question is above all important if we take into account the existence of the CCPs at the local level. If this situation prevails, the framework of the present functioning of the MPAs in force will constitute a serious constraint to the participation and development of fishing communities.
The integration of maritime fishing resources as well as other relevant resources for the fishing communities, including activities of relative importance such as tourism, particularly the case of parks and reserves, deserves a special consideration of a strategic and coordination nature at the level of management, organization and inspection of the fisheries and the activities with a direct impact on these zones.

The function of mere consultation and support legally defined appears clearly insufficient with relation to the other actors/stakeholders in the protected areas. In the collaboration with the park authorities, it may be good to include at the district level the role of the CCP’s, fishermen associations, private sector and the district administrator, this one due to his/her power to authorize the carrying out of artisanal fishing. The linkages at local level among the several actors/stakeholders, especially the local fishing administration, the local maritime administration and the local administration/district administration of the state (a qualified/capable district administrator to issue artisanal fishing licenses), must be clarified and developed in line with the socio-economic dynamics of the implementation zones of the MPAs.

To make sure that fisheries management measures taken for these protected areas will not worsen the social negative impacts it is necessary to obtain fishing and biological data and monitoring of artisanal fisheries in general and the state of exploitation of respective resources in particular.

Thus, it would seem recommendable to move towards an integrated and broader strategy of water resources and inter-linking activities or reciprocal impacts, which are crucial to the development and sustainability of fishing communities rather than investing in the proliferation of MPAs. In this process, it might be important to consolidate the forums and organizations presently defined in the Fisheries Participatory Management, whose management powers would be enhanced on the basis of the selective recognition of present practices and its legalization, followed by the timely carrying out of linkages, especially at the district level and with park and reserve zones in order to have a greater integration and efficiency in natural resource management.

The required integration should be reflected through the harmonization of aspects like: concepts, creation processes, implementation and management, monitory and evaluation of component impacts. In this line of management, each sector would assume its responsibilities within its specific defined duties. The integrated model should allow for better coordination of activities in all processes (planning, implementation, monitory and evaluation) crucial for its success.

Another option would be to entrust the current conservation related duties to another exclusively specialized sector to handle conservation issues. Indeed, conservation now un-
der the Ministry of Tourism, an entity pursuing economic objectives, has been looking for
great benefits to the detriment of environmental and social causes. A more objective ap-
proach, therefore, would consist of entrusting management of marine conservation areas to
a non productive sector, different from Fisheries and Tourism whose mandate is to ensure
economic input into the State treasury. The current model in force in Mozambique would
suggest that these responsibilities be within the competence of the Ministry of Environ-
mental Affairs.

Finally, in face of a variety of existing interventions and conservation areas related laws,
approval of general regulations governing these management areas is urgently needed. This
should be followed up by specific application protocols for diverse marine and land con-
servation areas. The new regulations should further provide for solutions to all aspects still
requiring clarification. Updating the regulations is fundamental as they will provide solu-
tions in the absence of a specific law governing national parks and reserves.

List of abbreviations and acronyms

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BM</td>
<td>Bank of Mozambique</td>
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<tr>
<td>BR</td>
<td>Government Gazette</td>
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<td>CRRM</td>
<td>Constitution of the Republic of Mozambique</td>
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<td>CAP</td>
<td>Fisheries Administration Commission</td>
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<td>CBO</td>
<td>Community Base Organization</td>
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<td>CCP</td>
<td>Fishing Community Councils</td>
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<td>DNFFB</td>
<td>National Directorate of Forestry and wildlife</td>
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<td>FAO</td>
<td>Food and Agriculture Organizations</td>
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<td>GDP</td>
<td>Gross domestic Product</td>
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<td>HIPC</td>
<td>Heavily Indebted Poor Countries Initiative</td>
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<td>IDPPE</td>
<td>National Institute of Small Scale Fisheries Development</td>
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<td>IIP</td>
<td>Fisheries Research Institute</td>
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<td>IUCN</td>
<td>International Union for Conservation of Nature and Natural Resources</td>
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<td>MPA</td>
<td>Marine Protected Areas</td>
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<td>MITUR</td>
<td>Ministry of Tourism</td>
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<td>ONG</td>
<td>Non-governmental organizations</td>
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<td>BNP</td>
<td>Bazaruto Archipelago National Park</td>
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<td>QNP</td>
<td>Quirimbas National Park</td>
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<td>UN</td>
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Marine Protected Areas (MPAs) in relation to Fisheries Management
Social-Ecological Resilience of Pete and Maruhubi Mangrove Ecosystems in Zanzibar, Tanzania

By Wahira Jaffar Othman

Abstract
This paper compares the social and ecological resilience of two contrasting mangrove forests and the associated human communities of Pete and Maruhubi mangroves in Zanzibar. The roles of management regimes and institutions are assessed in relation to the attainment of robust social and ecological systems. Survey transects and quadrats within the mangroves were used to assess the ecological state of the mangrove ecosystem, while socio-economic data were collected through semi-structured interviews and discussion groups. This study reveals that the mangroves of Pete and Maruhubi have been controlled by sharply contrasting management regimes which impacted their resilience differently. The Pete forest has been seriously degraded in recent years and the mangrove ecosystem has shifted from a mature tree dominated mangrove forest to a stump dominated mangrove stand thereby seriously undermining the resilience of the social-ecological system, despite a purported (but not actual) collaborative management plan to which the local residents originally agreed. This situation is explained by the high degree of dependence of Pete residents on mangroves, the scarcity of other sources of income, and the Government’s lack of legitimacy in the area. In contrast, in Maruhubi, where town-dwellers are not involved in the management system, the forest is flourishing and the ecosystem is shifting into a more resilient ecological state although not entirely socially desired. This has been attributed to the relative economical stability of the surrounding community who attach less value to the resources leading to a low level of dependence on these mangroves. The paper concludes with recommendations for improved management for resilience of mangroves in Zanzibar, allowing local communities to play a stronger actual role in shaping management plans, including more realistic restrictions to mangrove harvesting, and more effective support.
from the Government for implementation of plans and development of alternative sources of income.

**Introduction**

Mangrove ecosystems are among the most important of coastal habitats because of their unique ecological functions and services and their socio-economic value to local communities and nations. Coastal ecosystems are resilient habitats because of their high functional diversity and coastal communities are socially and economically resilient because of the robustness of the ecosystem upon which they depend through the availability of diverse economic activities (Adger, 1997). However, as resilient as mangrove ecosystems appear, these vital forests are also vulnerable and are being quickly depleted due to intensified human disturbances and poor management practices. Uncontrolled harvesting and destruction of mangrove forests can permanently alter these ecosystems (Perce, 2002).

Whilst, there have been some studies analysing resilience building in social-ecological systems in both terrestrial and marine habitats mostly in the developed world (Adger, 1997; Pastor *et al*., 1998; Folke *et al*., 2002; Kraus, 2002; Holling 1986, 2001 in Walker *et al*., 2002; Carpenter *et al*., 2001; Berkes and Folke, 1998), there has been virtually no research which has investigated the social-ecological resilience of mangrove ecosystems of Zanzibar. This study examines comparative resilience between two mangrove sites, focusing on the roles of mangrove management regimes and relevant institutions in providing the surrounding communities with opportunities for diversified livelihoods as well as for developing appropriate survival strategies in the event of the decline or disappearance of mangrove resources. This study also investigates how these two mangrove ecosystems in Zanzibar are capable of withstanding human disturbances and environmental uncertainties, that is, the extent to which these systems are ecologically resilient.

**Methodology**

**Study sites**

This study was based on the field work carried out on Unguja Island, the main island of the Zanzibar archipelago, focused on two mangrove forests: (1) the open-access mangrove forest at Maruhubi-Kinazini, which lies within Zanzibar Town, the island’s capital, involving people either living or working close to this forest from the “shehia” (administrative units) of Gulioni (2418 individuals), Shaurimoyo (8259) and Muembemakumbi (8212 individuals) (URT, 2003); and (2) the community-managed mangrove forest of Pete, located in the rural Pete-Jozani Shehia in the southern region of Unguja, about 24 km south-east of Zanzibar town (Figure 1).

Maruhubi-Kinazini had a total mangrove area of 1,040 hectares in 1949 but this forest has significantly reduced to 76.5 hectares in 1989 (Taylor *et al*., 2003) and more recently to 56 ha. The cause for the decline of mangrove area at Maruhubi-Kinazini was the conversion of mangrove forest for the construction of a ferry terminal in Zanzibar city. Although the
forest is bordered by large numbers of people, most of them have no economic dependency on the mangroves, but rather support themselves through urban economic activities. The exception is a small number of people working at the Kinazini Boat-making Centre whose economic activities are directly dependent on the collection of boat ribs and other boat components from the mangroves including few women collecting firewood as a source of cooking energy.

Pete “shehia” covers approximately 3,822 ha, and is endowed with diverse natural forests such as coral rag, high forest vegetation and mangrove forests. The shehia has 1161 individuals (URT, 2003) with significant proportion of migrants from mainland Tanzania many of whom now have families born in Zanzibar. These migrants attracted by the marketable forest resources which were easily accessible and traded along the main road in the past four decades. The Shehia’s close proximity to the core forested areas of high national and international interests have resulted in most of the village land being allocated under different land use systems and interventions which have reduced the total village land and the community’s access to village resources. Consequently most of residents have completely converted to woodcutting, reliant on 360 ha of mangrove and few accessible forests, follow-

Fig. 1. Locations of the study sites.
ing the Government’s conversion of their former agricultural land into first; Forest Reserve and now; National Park declared on 27th February, 2004. Pete is one of 8 villages located around the periphery of the Jozani-Chwaka Bay National Park, which have been involved in a co-management program, and prepared management agreements for community managed forests, including mangroves. Until 2002 community-based conservation of the Pete mangrove forest and surrounding Jozani and Chwaka Bay forests were supported by Jozani Chwaka Bay Project; a donor project implemented by CARE and funded by the Ford Foundation, and Global Environmental Facility. This funding ended in 2003 after which the Government was the sole supporter of the conservation initiative while communities engaged on the uses of the resources.

**Methods**

A total of 34 and 30 households from Pete and Maruhubi respectively were involved on structured and semi-structured interviews to obtain social economic information of people around these two mangrove sites. In Maruhubi the interviewees were selected among individuals haphazardly encountered in the area during fieldwork while Pete respondent were selected, following the advice from the Sheha (Government-appointed administrator), from a list of Pete-Jozani Shehia residents. The interviews were accompanied by focus group discussions, observations, personal communication and secondary data from mangrove management institutions.

Field inventories were based on a total of 34 and 21 quadrats of 10 m by 10 m at Pete and Maruhubi respectively, systematically distributed along transects at intervals of 100 m, to assess mangrove ecological conditions, namely diversity of mangrove tree species and associated macro-fauna (especially gastropods and crabs) and their distribution. Also additional recorded information were the diameters of all trees, heights of trees, number of seedlings and saplings, number of stumps and pollution incidences.

Chi squared test and Shannon Weiner index of diversity were used to compare the level of dependence on mangrove resources and species diversity between the two study sites. The adaptive cycle concept as described by Holling (1986) was used to determine the phase of the social-ecological system. The Adaptive Cycle involves the movement of a system through four phases: (Fig 2). Rapid active growth (r) phase; leading to a long passive phase (K) of capital accumulation and conservation of structure; followed by a very rapid active breakdown or creative destruction (Ω) phase and finally a relatively short but passive phase of renewal and re-organisation (α) phase. At reorganisation phase the system may either retains sufficient of its previous capital and gains resilience as before or flip into alternative non-resilient regime as shown on an exit arrow.

The Statistical Package for Social Science (SPSS) program was used to quantify and provide multiple response results for qualitative data while Microsoft Excel was used to calculate
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Biophysical variables such as average volumes, basal areas, stand density, species dominance and harvest rate. The resulting data were collectively used for detailed resilience analysis using a framework proposed by Walker et al., (2002).

Results and Discussion

Current state of the mangroves’ ecological system

Pete mangrove ecosystem has been seriously degraded in recent years (more than 80% of the sampled areas were under high cutting pressure) and currently it cannot sustain maximum supply of ecosystem goods and services of the desired quality to the users. As a result, the status of the social-ecological system of the Pete mangrove has reached the “release” (Ω) stage or phase of the dynamic adaptive cycle shown in Figure 2 above (see Holling, 1986; Gunderson and Holling, 2002).

In this stage, Pete mangroves are characterized by a high rate of mangrove cutting represented by mean number of stumps per ha of 2241, three times higher than its standing density of 677 trees per ha. This is a relatively high rate of degradation compared to the rate of mangrove cutting at Pete over 13 years previously, with 777 stumps per ha observed (Ngoile and Shunula, 1992). Other changes to this ecosystem compared to the above study are relatively lower number of mangrove species and mangrove-associated macro-fauna species of crabs and gastropods represented by 9 and 2 species respectively, and a serious decline of some mangroves species, including Xylocarpus granatum, Sonneratia alba, Lumnitzera racemosa and Avicennia marina. Akil and Jiddawi (2001) reported that A. marina and S. alba were among the five mangrove species found among Pete mangroves, but in this study, A. marina was not found and only stumps of S. alba were identified.

Although the ecological system of Pete had comparatively high mangrove species diversity (species diversity index of 1.02) and a potential for regeneration of mangroves (1159...
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In contrast, the condition of the Maruhubi mangrove forest indicated that the ecosystem was in the “growth” (r) phase of the adaptive cycle (Figure 2), characterized by high rapid growth and colonization of recently disturbed area, higher vegetation cover of mature plants (724 trees per ha), richer in mangrove-associated macro-fauna species of crabs (10 species) and gastropods (9 species), relatively lower number of young plants (924 mangrove seedlings per ha) compared to the Pete mangroves, with relatively low species diversity indicated by species diversity index of 0.85. The cutting pressure in Maruhubi mangroves was less evident with 76.2% of its area either intact or only moderately cut supporting an average of 367 stumps per ha and only 24% of the mangrove forest under high cutting pressure. The current ecological condition of the Maruhubi mangrove ecosystem seems to have shifted the ecosystem into a more resilient ecological state, although not into an entirely socially desired state as much as local people believe that the flourishing mangrove forest provides a haven for criminals and dump site for wastes.

Social state of Mangrove ecosystem

Uses and dependence on mangroves, income and alternatives

At Pete, officially, all major uses of the mangrove ecosystem by the local communities are considered illegal under the Pete Community Forest Management Agreement (PCF-MA, 2002) but in fact most of the Pete community still used the mangroves for varieties of purposes to meet their basic needs, such as charcoal production (31% of interviewees) and building-pole extraction for sale (23%). Other local uses were fishing, coconut rope processing, collection of traditional herbal medicines and tannin extraction. Non-local uses include sites for scientific study and environmental conservation. It is clear that the rural people of Pete depend far more on their mangrove resources than the Maruhubi town-dwellers, a result that was statistically significant (p < 0.05), with p equal to 0.014. The high level of mangrove dependence was attributed to the limited availability of alternative income sources available at the village, despite the commitment and legal responsibilities of the Department of Commercial Crops, Fruits and Forestry (DCCFF) and their partners to develop alternative sources of income and alternative energy sources to replace mangrove usage by the Pete community. Consequently, many villagers were forced to rely on agricultural production (22% of interviewees) even though this livelihood was threatened as was mangrove wood cutting (undertaken by 20% of interviewees). The DCCFF had expended very little efforts to create alternative economic activities, with negligible actual contribution to local household economies, with employment only created for a few individuals (8.7% of the interviewees) and those with business/firms inside the National park (2.6% of interviewees). Examples of businesses supported include monkey-viewing through
the establishment of a tourist facility (the Mangrove Boardwalk), beekeeping through provision of technical advice and modern hives (to 0.9% of interviewees), establishment of a saving and credit program (32% of the respondents) and promotion of the establishment of a small-scale tree nursery and some private woodlots.

While the economic survival of Pete community is heavily dependent upon mangrove resources, people living around the Maruhubi mangroves have low economic dependence on the mangroves but mainly supported themselves through the major town dwelling economic activities like wage employment (27.7% of the interviewees), trade (25.5%) and masonry (25.5%), although none of these were created by the Government institution responsible for mangrove management. Only 2% of the people interviewed relied upon the mangroves as an important income source, mainly through collection of materials for boat construction and repair (Mataruma and Tari), firewood collection for home consumption, provision of small boat landing area, sand extraction site and place for collection of fishing baits. Instead, surrounding communities of Maruhubi attached less value to these resources and viewed the mangrove forest as a wasteland that even negatively impacted their daily lives. Interviewees suggested that the area was mostly used as a latrine and waste-dumping site by surrounding communalities and or municipal authorities, and also used as a hiding area by thieves, drug-users and bandits that rendered the lives of the residents insecure. However, the disposal of organic wastes into the Maruhubi mangrove ecosystem seems to have had no or limited negative effects on the mangrove trees; they may even have benefited from the added nutrients. The ecosystem appeared to be in a fairly healthy condition with high regeneration capacity and stand density. It was also noted that in Maruhubi, alternative sources of cooking energy such as electricity, kerosene or liquefied petroleum gas are more readily available than in Pete.

Mangrove management regimes

Widely different mangrove management regimes were found to prevail at the two study sites. In Maruhubi, the mangrove forest is managed by DCCFF, which is the main institution responsible for protection and conservation of the resources and ecosystem. Other formal institutions are involved as partners in the management of the resources whilst the local communities are viewed as outsiders and excluded from the management system.

In Pete however, a new local institution has been strongly shaped and influenced by the government to prepare very restrictive rules (PCFMA, 2002) to guide them on the “co-management” of the mangroves ostensibly in accordance with the principles of “collaborative mangrove forest management”. While these rules purportedly aim to empower and provide more access and control by giving the local people legal rights to manage and sustainably use the resources, the emerging realities on the ground are quite different. In practice, a special kind of top-down “co-option” management determines how the resources are used. In this arrangement, the people of Pete were used as a means to achieve the Government’s
objectives, among them the interests of biodiversity conservation, by being given legal rec-
ognition to co-manage and protect the mangroves in return for accepting more restrictions
on the uses of the resources, including the total ban on sale of mangrove poles and timber.
Realistic economic incentives from the Government to compensate the people of Pete for
their efforts have been lacking. The social and ecological values of the mangrove ecosystem
had changed and were declining despite the restrictive – though not strictly implemented
– regulations concerning mangrove management in Pete.

Factors contributing to the loss of social-ecological resilience
of the Pete mangrove ecosystem

Overexploitation by local people
Despite the ecological and economical importance of mangroves, the high level of mangrove
exploitation has transformed the mangrove ecosystem from being a mangrove tree domi-
nated stand to one dominated by stumps and seedlings which has negatively impacted the
vegetation structure of the ecosystem and caused an undesired ecosystem shift. Over-har-
vesting of mangroves surrounding the boardwalk threatened the continued revenue earn-
ings of the Mangrove Boardwalk project, reducing the aesthetic value of the forest as well
as its capacity to sustain the wildlife, such as birds and monkeys, which attract visitors and
in turn affects social resilience. The apparently selective targeting of particular species, e.g.
Ceriops tagal (see also Amour, 1993; Akil and Jiddawi, 2001), which are now selectively ex-
tracted, has reduced further the ecological resilience of this mangrove ecosystem through
changes of species composition, which reduces the functional diversity of the ecosystem. A
clear shift in people’s behavior from being farmers to mangrove wood-cutters was evident,
further challenging the ecological and social resilience of the ecosystem.

A number of underlying causes, including an inappropriate and counter-effective manage-
ment regime, poverty and limited livelihood diversification and lack of monitoring and
law enforcement, all fuel the over-exploitation of the mangrove resource.

Management regime
The prevailing “top-down” management regime, purported to be a co-management scheme,
has encouraged the community to undertake destructive practices that result in the serious
decline of Pete mangroves through excessive cutting which affects not only the ecological
resilience of the mangroves but also the social resilience of the people depending on man-
grove resources. The main reason for this is the lack of acceptance by the majority of the
people of the Government-imposed regime in which villagers have little actual influence,
especially in the formulation of the management rules that were intended to support com-
munity interests. Instead, the Government were very insistent that the community should
develop and impose overly restrictive and unrealistic rules with regard to user rights and
the amount of resource units that can be harvested, and introduced permits and large fines
for infraction of rules. This demonstrates that, even if forest management is delegated to
the local level, local managers may not be able to use resources efficiently and sustainably (see also Masoud and Wild, 2000) especially in cases such as Pete where the Government lacks legitimacy, at least in relation to mangrove management.

**Poverty and low livelihood diversification**

Nearly 53% of the Pete interviewees admitted that poverty is the main underlying factor that forces them to harvest mangrove resources at the current unsustainably high level. It has become necessary for people to take advantage of short-term benefits while sacrificing long-term sustainability. This is in line with the facts that Tanzania (including Zanzibar) is ranked among the poorest of the world’s nations (Haroub and Athumani, 2002). In the Pete area, matters have been made worse by Government actions aimed to meet their conservation interests while failing to properly consider local needs, and thus increased the vulnerability of forms of livelihood security and reduced social resilience. The limited Government efforts to date include minor diversification of livelihood security (e.g. tourism), introduction of very few and inappropriate or inadequate alternative sources of income that have made little contribution to individuals’ livelihoods (e.g. the saving and credit program that has the conditions, such as regular repayments, which make it impossible for most ordinary villagers to participate apart from a few regular wage earners in the village) and conversion of former agricultural land into National Park and thus unavailable for farming. These actions have encouraged some people to abandon their normal daily production activities while waiting for periodic modest income from tourists visiting the area. Ecotourism can be a suitable livelihood intervention strategy, among many (Kepe et al., 2002), but it is vulnerable, especially in areas suffering from poor infrastructure, political instability, election-time upheavals or threats of terrorism and attacks on tourists — all of which have impacted the tourism sector in Zanzibar in the recent past. It is argued that involving rural poor in management without providing alternative income earning possibilities is unlikely to be a success, and usually renders the social-ecological system more vulnerable while reducing the resilience of the system.

**Lack of monitoring and law enforcement**

It appears that neither the DCCFF officials nor the VCC, are concerned about regulating and supervising the harvesting of the mangroves despite the agreements made by villagers to play a key role in monitoring the mangrove forest and enforcing the regulations for its sustainable management. The main reason for the inefficiency of the implementation of the management agreement is the lack of support for, or collaboration with, concerned Government agencies following the withdrawal of the donor funds in 2003. Consequently neither privilege nor resources are available from the Government, which provide the local community no motivation to continue to implement PCFMA.

On the other hand, the failure of the Government to monitor and enforce the mangrove management plan in Pete is due to pronounced deficiency of Government staff and lack
of financial resources to effectively monitor and enforce the agreement. Since the Government funds for law enforcement in Zanzibar are simply not available (Skov, 2001), I argue that it is impossible to have effective management merely through the development of a strict set of rules.

Factors enhancing social-ecological resilience of the mangrove ecosystem

The resilience of the Maruhubi mangrove ecosystem has not been enhanced by management regime, but rather, by the forest’s geographical location, which provides the surrounding communities with diverse economic opportunities not based on mangroves and the types of mangrove products the ecosystem provides. Limited availability of suitable wood for charcoal and lime making (due to the dominance of trees which have a relatively small diameter when mature), and the unhygienic nature of the Maruhubi forest discourages its utilization and therefore limits the rate of destruction, which in turn promote the growth and health of the mangrove ecosystem stimulated by the high level of nutrients supplied through sewage seepage and waste disposal, and thus increases its resilience. This illustrates the point that high population density adjacent to the resources does not always result in resource degradation. Lack of enforcement in the use of official waste dump sites and sand extraction areas, and the presence of criminal behaviour have created undesirable social conditions which are not necessarily associated with mangrove ecosystem and hence do not impact on the resilience of the ecosystem. However, Maruhubi is potentially vulnerable to oil pollution if a spill or leakage should occur at the nearby Mtoni Oil Depot: mangroves’ pneumatophores are particularly susceptible to oil and tar blocking their lenticles.

Conclusion and Recommendations

While it is generally accepted that a community-based management approach should be the most successful management regime, this has proved to be the opposite in the case of Pete mangrove forest. With a high rate of mangrove dependence, accelerated by poverty, while lacking appropriate alternative income sources to compensate the villager’s efforts toward mangrove conservation, rules that severely restrict the local people’s uses of the resources (without providing the necessary inputs for its implementation) are bound to fail. Community “empowerment” in this way is inadequate and unrealistic. Rather it is a “co-option” management approach that promotes ecotourism while threatening the limited available livelihood options for the people, thus increasing the people’s burden in meeting their basic needs thus reducing social resilience. The strict rules have weakened the level of trust the people had for the Government which evokes overexploitation, reducing the ecological resilience of the mangroves.

The resilience of the Maruhubi mangrove forest confirms the point that neither management regime imposed by a responsible institution nor high population densities necessarily determines the resilience of a system. The economic stability of the people depending on the resources, strong Government commitments, the availability of inputs even beyond
the responsible institutions for resource management and the types of goods and services provided are crucial factors.

Government attempts to manage the mangroves should therefore aim to build resilience for the ecosystems and the societies that depend on these resources. To attain social-ecological resilience of the mangrove ecosystem, Government should therefore not seek to simplify the complex and diverse portfolio of livelihoods available to rural people, rather Government should provide support that can diversify the people's livelihood based on realistic economic returns, allowing the local communities to play strong and effective roles in shaping the management plan, while concurrently providing the materials and financial resources for its effective implementation. Such measures would increase people's economic capability and flexibility to participate and implement management agreements and to cope with changing conditions, ensure control of access to the resources and provides incentives to avoid overexploitation, which would in turn restore and sustain the lost social-ecological resilience of these mangrove ecosystems.

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of Tanzania.

Can ecotourism fulfil its promises? The case of Chumbe Island Coral Park, Zanzibar

By Kjersti Thorkildsen

Introduction
The Zanzibar Archipelago is part of the United Republic of Tanzania and consists of two sister islands, Unguja and Pemba, and approximately 50 small islets (Feidi, 2005). Here, artisanal fisheries account for 95% of the fish harvest, whereby the majority of local fishers use traditional fishing practices and catch fish close to the shore within coral reef areas (Richmond, 1999; Jiddawi and Yahya, 2003). Although these fisheries are small-scale in nature and involve relatively small amounts of capital and energy, unsustainable resource extraction has been reported, particularly referring to the use of dynamite, poison, spears, guns, beach seining and nets with small mesh sizes (Muhando and Jiddawi, 1998; Zvuloni et al., 2010). Signs of environmental degradation along Zanzibar’s coastline are frequently highlighted pointing to declining fish yields and deteriorating conditions of coral reefs (e.g. Johnstone et al., 1998; McClanahan et al., 2002; Mohammed et al., 2002; Muhando and Kuguru, 2002; Jiddawi and Yahya, 2003). This has been explained by overcrowding of fishing grounds as well as problems with policy implementation and enforcement of fisheries regulations (Nordlund et al., 2013). As a way to address this situation, many coral reefs have been set aside for conservation in marine protected areas (MPAs) in the form of parks, reserves and sanctuaries.

The formation of no-take-areas is an increasingly prevalent approach to coral reef management, inspired by neo-Malthusian views of environmental change. Supporters of the “fortress approach” to conservation argue that the marine environment can recover from degraded states only if protected from human interference (e.g. Russ et al., 2004). It is believed that by prohibiting fishing and other extractive activities, fish stocks have a chance to recover inside the protected area and further enhance adjacent fisheries through “spill-
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over” effects and through larval recruitment to adjoining unprotected areas (Bellwood et al., 2004). In this way, critical functional groups can continue to persist, contributing to enhanced local ecosystem resilience (Nyström et al., 2000). However, deterioration of the marine environment inside designated protected areas has been detected. This has been associated with diffuse and large-scale disturbances, inefficient management, failure of governments to intervene, and marginalisation of important stakeholders who feel excluded and withhold support for the protected area and thereby poach (Adger et al., 2000; Francis et al., 2002; Bengtsson et al., 2003). Many scholars raise concerns about how restricted access to and use of marine resources potentially can undermine livelihoods and resilience of the communities reliant on such resources, leading to resentment from fishers relegated to less desirable fishing grounds after marine park establishment (e.g. Roberts and Polunin, 1993; France, 1997; Young, 1999; Adger et al., 2000; Francis and Bryceson, 2001; Francis et al., 2002; Masalu, 2000; Brockington et al., 2008; Honey, 2008).

As a win-win solution to the many conflicts that have arisen between “people and parks”, ecotourism has in many instances been promoted (Brockington et al., 2008). Although it has been variously defined, ecotourism generally refers to a responsible travel to nature areas that contributes to protect biodiversity and improve livelihoods of local residents (Boo, 1990; Ceballos-Lascuráin, 1996; Wunder, 2000; TIES, 2010). More specifically, ecotourism objectives are to minimise human impact, build environmental and cultural awareness and respect, empower local people, create economic alternatives to destructive use of natural resources and contribute both politically and financially to the establishment and survival of protected areas (Buckley, 2003; TIES, 2010). All the same, Brown et al. (2001) and Hall (2001) argue that the environment and tourists often gain, while local people frequently lose out as they are excluded from financial benefits and thus not compensated for their lost access to and use of land and marine resources. Conflicts between different stakeholders can therefore arise, especially when a greater proportion of tourism revenue becomes profit for only a few individuals, which is often the case in private conservation schemes (Gössling, 1999).

So, can ecotourism really fulfil its promises of protecting biodiversity and improving livelihoods of local people? Or is it just another green-washing and participation-washing pretext to appropriate resources and promote private interests? In order to investigate these questions, an ecotourism enterprise renowned for its success was selected for research; Chumbe Island Coral Park Limited (CHICOP), a privately managed MPA off the coast of Zanzibar. CHICOP has won a number of prizes including the British Airways Tourism for Tomorrow Southern Regional and Global Awards in 1999, the 2000 UNEP Global 500 Award for Environmental Achievement, the Green Hotelier and Restaurateur Environmental Award in 2001, the Responsible Tourism Award and the TODO Award for Socially Responsible Tourism in 2004, the National Geographic Society Geotourism Award in 2008 and was the winner of the Trip Advisor Traveller’s Choice in 2012, 2013 and 2014 for best service.
Can ecotourism fulfil its promises?

In order to assess CHICOP’s status as an ecotourism enterprise, impacts on different stakeholders’ interests and their relationships were investigated (Grimble, 1998; Adger et al., 2000; Mushove and Vogel, 2005) along with the social-ecological resilience of the protected Chumbe reef and nearby fisheries and fishing communities (Berkes and Folke, 1998; Nyström et al., 2000; Berkes et al., 2003).

**Chumbe Island Coral Park**

Chumbe is a 22 ha island covered by a semi-arid coral-rag forest and bordered by a fringing coral reef on its western shore, located 12 km southwest of Zanzibar Town on Unguja Island (6°19'S, 39°32'E) (McClanahan et al., 1999; Riedmiller, 2000). Riedmiller (2003) states that CHICOP was established in 1991 as the world’s first privately created and administered MPA and Tanzania’s first marine sanctuary. Seven government departments were involved in the approval of this MPA, eventually resulting in the leasing of a land area of 2.44 ha to CHICOP for 33 years (Sterner and Andersson, 1998). There was, however, a three-year period of political struggle between the German owner of CHICOP, the Government and local fishers before the Government of Zanzibar declared the reef to the west of Chumbe the Chumbe Reef Sanctuary (CRS) in 1994 (Gössling, 2003). CRS includes 33 ha of sandy shores, seagrass meadows and a fringing coral reef and is closed for all fishing activities, anchoring, recreational scuba diving and destructive or extractive research, complying with the criteria of a no-take-area (Nordlund et al., 2013). Permitted uses of CRS include recreation (swimming, snorkeling, underwater photography), education and non-extractive research activities.

Chumbe has historically experienced low levels of disturbance due to the absence of human settlement as there is no drinking water on the island, and since it was incorporated into a military security zone during the 1960s (Buckley, 2003). Chumbe was chosen for protection and ecotourism as it offered an opportunity to reduce possible socio-cultural impacts and because it hosted a rich bio-diverse reef system. Prior to the establishment of the MPA, Chumbe Island held a lighthouse (erected in 1904) as well as a house and an Indian styled mosque for the lighthouse keeper (Khatib, 2003). The lighthouse is now used for monitoring of illegal activities inside CRS and the lighthouse keeper’s home has been transformed into an environmental education centre and information office. CHICOP has further constructed seven eco-bungalows that can accommodate 14 tourists.

The overall investment in CHICOP from 1991 was about US$ 1.2 million, where roughly two thirds were financed by the project owner and the rest from donors such as GTZ, the EU Fund for Micro Projects and WWF Tanzania (Francis et al. 2002; Gössling, 2003). The donor funds available for private investments have supported several non-commercial project components with small grants for construction of the Visitor’s centre, nature trails, snorkel equipment, teaching material and patrol boats. The 1996 Zanzibar Environmental Protection Act has offered some incentives for private investment in conservation and environ-
mentally friendly technologies, enabling CHICIOP to obtain tax holidays and exemption on some imported goods. Ecotourism was introduced in 1998 as a revenue-generating tool to support conservation management and an environmental education program for local school children and their teachers. Since 2001, the operating costs of CHICOP have been covered by income generated through ecotourism earnings from overnight visits which in 2015 cost US$ 280 per night per person and day visits which costs US$ 90 for non-residents, generating about US$ 500,000 annually (CHICOP, 2015; Nordlund et al., 2013).

Data collection
The primary data presented in this chapter was collected between October 2005 and January 2006 (Thorkildsen, 2006). At the outset, the stakeholders involved in or affected by the establishment of CHICOP and the ecotourism project were identified. 30 open-ended in-depth interviews were conducted with 20 stakeholder groups including CHICOP staff, managers in private organizations, government officials, researchers and local community leaders. These interviews investigated the stakeholder groups’ rights, responsibilities, returns and relationships to obtain insight into the distribution of costs and benefits of CHICOP and thus any conflicts of interest. Furthermore, socio-economic data of fishers

Fig. 1. Map of Unguja, the main island of Zanzibar, showing the location of Chumbe Island and study sites.
and their perceptions of CHICOP were investigated in five adjacent fishing villages/landing sites along the west coast of Unguja in close proximity to Chumbe Island (Figure 1). One of the fishing villages belonged to the Urban district (Kizingo) and four were located in the Western district (Mazizini, Chukwani, Buyo and Nyamanzi). Kizingo and Mazizini were seasonal camping sites and consisted mainly of migrant fishers. In each of the five fishing villages/landing sites, 15 fishers were interviewed using a semi-structured questionnaire. A total of 30 stakeholder interviews and 75 fisher interviews were conducted. All the interviewees were selected using non-probability sampling techniques, including convenience sampling and snowball sampling (Bryman, 2004).

Additionally, four focus group discussions were held in the fishing villages in the Western district to obtain supplementary information about assets, aspects of household economies, dependence and perceptions of marine resource use and conservation, fishing gear and practices, social organisations and access to resources and social services. The number of participants in the focus group discussions held in Mazizini, Chukwani, Buyo and Nyamanzi were 10, 13, 15 and 14 respectively. These were between the ages of 30 and 90 and had used the Chumbe Island and its reef before CHICOP’s establishment in 1991. Focus group participants were gathered by informing the village leader in advance. Insight was also obtained through informal conversations, attending meetings in Nyamanzi and Buyo organised by the CHICOP management, a meeting between different educational authorities and CHICOP and participation in a school excursion to Chumbe Island. Secondary data on macro-benthic cover and fish fauna were used to assess the ecological resilience of the Chumbe reef.

**Findings**

**Coral reef protection**

In 1994, Fiebig recorded 45 genera of corals inside CRS, where species of Acropora dominated (Fiebig, 1994). The CRS has later been shown to hold the highest diversity of coral species and the highest number of unique and locally rare taxonomic units compared to other unprotected and protected reefs in Zanzibar (Zvuloni et al., 2010). Persson and Tryman (2003) found that Chumbe had the highest live coral cover (51%), Acropora cover (28%), substratum composition diversity, complex corals and lowest dead/living ratio (13%) compared to two other adjacent unprotected reefs. Rostad (2005) found that the recruitment of coral larvae of a species of Acropora (Acroporidae) had a higher success rate in CRS than in the unprotected Bawe reef. On the other hand, recruit mortality was also higher, which could be explained by the higher number of herbivores and the associated higher predation pressure on the larvae and by competition for space. According to Mohammed et al. (2002), Chumbe experiences seasonal growth of macro-algae, posing difficulties for coral settlement, eventually leading to algal dominance. The reason for this can be the six times lower abundance of sea urchins in Chumbe than in unprotected reefs, which graze more intensively than herbivorous fish (McClanahan et al., 1999).
Still, the high levels of ecological specialists in the coral reef system and high diversity within functional groups suggest that the Chumbe reef is healthy and in a good position to recover from disturbances. In the El Niño event of 1997–1998, values of bleaching index averaged around 65% inside CRS and the extent of coral cover decreased from 51.9% to 27.5% with particularly high mortality among the fast-growing branching corals *Pocilloporidae* and *Acroporidae* (Muhando and Francis, 2000). Mohammed et al. (2002) found higher loss of live coral cover on Chumbe in this period compared to other reefs along the Zanzibari coast, but according to Daniels (2004), recovery of corals and new growth became prevalent within two years. The low abundance and species richness of Corallimorpharia observed by Muhando and Kuguru (2002) also indicate that CRS recovered quickly, as these tend to establish on degraded reefs and prevent coral settlement.

Fiebig (1994) identified 343 fish species from 49 families inside CRS. McClanahan et al. (1999) found that the total fish wet weight was 3.5 times higher in CRS than in unprotected reefs, and species diversity and predation rates were two times higher. A study carried out by Larson (2004) also showed that the total fish density, number of families and diversity were about twice as high on Chumbe than in adjacent areas. Greater animal abundance and size translate into increased reproductive potential and insinuate high ecological resilience (Gell and Roberts, 2003). The theory that MPAs provide a refuge for large reproductively mature individuals was supported by the above-mentioned studies, yet, coral fish species that respond most quickly to protection are often sedentary. These species are characterised by having a pelagic larval stage, slow growth and limited movement as adults (Holland and Brazee, 1996; McClanahan and Mangi, 2000). As their migration role is limited, larval supply from site-attached species might therefore be more important in enhancing adjacent fisheries than the export of adults. However, a study carried out by Tyler (2006) using tag and recapture indicated that spill-over of fish was occurring within 1 km of CRS.

Since quantitative data on fish and coral diversity prior to the establishment of CHICOP is lacking, comparisons before and after Marine Park establishment, and thus evaluation of protection results, are difficult. When status of the Chumbe reef is assessed, comparisons are therefore made with adjacent unprotected areas which have different historical contexts and uses. As the Chumbe reef was originally chosen for protection due to the original high quality of the habitat and the high biodiversity it harboured, it leaves open the possibility that observed differences are related to the pre-conservation quality of the habitat rather than protection efforts (Zvuloni et al., 2010).

Nevertheless, as CRS harbours higher species diversity of both fish and corals than adjacent areas, it offers an opportunity to conduct research on otherwise rare species (e.g. Muhando and Francis 2000; McClanahan et al. 2002; Mohammed et al., 2002). Also, CRS’s status as a no-take area makes it an undisturbed monitoring and scientific control site. The cooper-
Can ecotourism fulfil its promises?

Challenges and Experiences from Developing Countries

The majority of the neighbouring coastal villages of Chumbe Island rely on fisheries, both in terms of income and as a source of protein-rich food. The Chumbe reef used to be one of the main fishing grounds for the fishing villages/landing sites under study, and 76% of the interviewed fishers had been to the Chumbe Island before the establishment of CHICOP. In the past, the Chumbe reef did also harbour many species of fish and large octopus and lobsters and the fishers used to obtain good catches in the area. Large clamshells, bait and firewood were collected on the island and mangrove poles were extracted for boats and other constructions. Many fishers used to camp on Chumbe to wait for favourable wind conditions or to stop over in cases of accidents or on the way to or from other fishing grounds. When on the island, the fishers often used the mosque for prayer. Furthermore, some local fishers used to take tourists to the island for scuba diving. After the establishment of CHICOP, fishers no longer have access to the reef or the island, preventing them from realising their past activities on Chumbe. However, in times of boat problems or engine failure or during storms and cases of illness, fishers can get assistance from CHICOP’s park rangers. In the absence of marine rescue services in Zanzibar, the park rangers have rescued more than 160 vessels since 1994 (Carter, 2002).

Impacts of CHICOP on local livelihoods

The launching of ecotourism on Chumbe Island raised expectations about employment and compensation for exclusion from access to the island and the reef. Nevertheless, as CHICOP is a small island and has a small workforce, few local fishers have been employed. In 2006, 9 out of 38 employees originally came from affected coastal villages. According to one third of the interviewed fishers and the participants in the four focus group discussions, the German project owner had promised to provide nearby villages with fishing equipment as a means to access new fishing grounds and give support to schools and dispensaries. These promises have, however, not yet been fulfilled. Since the establishment of CHICOP, the poorer fishers in the Western district claimed to have reduced catches and hence decreased income, even though the price of fish had increased. Many of the inter-
viewed fishers did not have the means to buy engines or larger boats to go offshore, and 49% had increased time of fishing. Interviewees further stated that enhanced competition in near-shore waters has led to conflicts between fishers engaged in different fishing practices. As there were multiple uses of the same unauthorised areas, conflicts over marine resources typically occurred between different gear users. These conflicts have intensified with the increased interest in coral reefs from tourists and the creation of different MPAs in Zanzibar. All the interviewed fishers expressed anger towards visiting fishers who were believed to be more frequently engaged in destructive fishing practices. Particularly the fishers from Kojani in Pemba using beach seine were believed to harvest large catches of reef fish outside the boundary of CRS, making it uneconomical for hand-line and trap fishers.

During interviews, some of the fishers claimed that their perception of CHICOP had not been asked for at any stage and stated that the CHICOP management had never been to their village or landing site. CHICOP did in fact organise meetings in several fishing villages in 1991 to present the project and try to win support prior to the establishment of the MPA. However, the use of community meetings in the initial phase served to divulge information about the decision rather than to seek opinions or allow for influence. This type of local community participation has been defined by Pretty (1995) as “passive participation” where administration or project management announce plans of a project or the outcomes of decisions that have already been established without listening to people’s viewpoints and concerns. Many of the interviewed fishers felt excluded from consultation and access to decision-making and as a result withheld support for CHICOP. Moreover, many mentioned that after establishment of CHICOP, the boundary of CRS had been extended with 500 metres without any consultation with concerned parties. This contributed to worsen the fishers’ attitude towards CHICOP. According to the CHICOP management, this was originally a misunderstanding caused by the Zanzibari Government which had initially presented maps with unclear borders and afterwards poorly announced the alterations. CHICOP has later arranged meetings with fishing villages to show maps of the boundary as well as to explain negative effects of poaching. Still, many of the interviewed fishers did not see the benefits of this no-take-area and for this reason did not respect the boundary of CRS. Some fishers stated that they sneaked into CRS to set traps or snorkelled with spear, and some fished during dark moon or hid and poached at night. As CHICOP used to have limited numbers of rangers and boats to patrol, the fishers had the opportunity to go fishing when rangers picked up tourists or got supplies. Nevertheless, the number of detected offences of park regulations, such as the use of destructive gear and methods and the frequency of MPA border incursions, has decreased over the years. Infringements of park regulations reached a peak in 1994/5 with 45 incidences a month, but had declined to less than five in 2003 (Riedmiller, 2003). The attitude of fishers towards the establishment of CRS was ambivalent. The urban fishers in Kizingo were in general positive towards CHICOP, as they recognised the importance of coral reef protection and the potential benefits of spill-over effects. Some mentioned that they had already experienced the benefits of fishing outside CRS in terms of obtaining larger
catches, and stated that the size of the no-take-area was not sufficient to affect them. However, the Kizingo fishers were less dependent on Chumbe as a fishing ground as they had more efficient fishing equipment and 40% used to fish offshore in distant deep waters. They also had significantly higher income than the other villages (ANOVA, \( F = 5.9552, p < 0.0004 \)). Conversely, many of the fishers in the Western district had a more negative perception of the Marine Park. They were in general more dependent on coral reef habitats for fishing and 80% of the Nyamanzi fishers stated that the unprotected part of Chumbe reef still was one of their fishing grounds. These fishers claimed that there was no proof of increased fish stocks after the establishment of CHICOP and that no economic benefits had therefore been attained. Across the villages, young fishers with high income were generally more positive to CHICOP than older ones with low income. Fishers’ views were also affected by their level of participation, as those who had attended seminars with CHICOP or been invited to the island were generally more supportive, showing the importance of local involvement. More meetings with affected fishing villages, seminars and educational trips to Chumbe Island have been arranged in recent years by a new management personnel more committed to local participation, potentially improving the relationship between the CHICOP management and fishers.

The promises of ecotourism

This research set out to examine whether or not ecotourism’s promises of protecting biodiversity and improving the livelihoods of local people could be fulfilled. CRS hosts a higher richness, density and biomass of large predatory coral reef fish and a higher coral cover and structural complexity compared to nearby unprotected reefs, suggesting that it is more ecologically resilient (McClanahan et al., 1999). However, as there is a lack of quantitative data of the Chumbe reef prior to Marine Park establishment, it is uncertain whether the high habitat complexity and community stability detected inside CRS is due to habitat or protection efforts. According to the different responses by interviewed fishers in this research, it is also uncertain whether spill-over of commercial fish species from CRS takes place, making the economic benefits to fishers open to doubt. Nevertheless, protection of the Chumbe Island and the ecotourism project have provided research and educational benefits for international and national researchers, students and tourists as well as the local school children, teachers and fishers participating in seminars. Ecotourism on Chumbe has also contributed to profit earnings for foreign investors and the private sector as well as foreign exchange earnings for the Zanzibari Government, although this is limited as most tourists buy a ready-made holiday package directly from their home countries.

Few direct benefits have, however, been accrued by the local fishing communities in close proximity to Chumbe. The stated objectives of CHICOP in the management plan were to offer employment to people from nearby fishing villages, promote awareness rising and empower the local people to feel committed towards preserving their natural heritage. Few affected fishers have been employed as CHICOP has a small workforce and the manage-
Can ecotourism fulfil its promises?

Marine Protected Areas (MPAs) in relation to Fisheries Management

Programme management is mainly composed of foreigners, and there are few alternative income-generating activities and supporting institutions for fishers in Zanzibar. Fishers are in general aware of benefits of the use of sustainable fishing practices, but the top-down approach of the CHICOP management in the early years caused resentment by some of the fishers and a few stated that they therefore poached inside CRS. Especially some of the fishers in the Western district with lower income felt anger towards CHICOP due to the lack of compensation for lost access to one of their main fishing grounds. By being excluded from financial benefits, their already limited available livelihood options have decreased, reducing their social resilience. This has further been exacerbated by increased competition over marine resource in inshore waters, leading to conflicts between fishers engaged in different fishing practices, though this is not directly linked to the establishment of CHICOP.

Information asymmetry, poor communication, low transparency and lack of community involvement in the planning, implementation and management of CHICOP were the underlying reasons for the mutual mistrust detected between and within stakeholder groups. Rather than being empowered and taking share in benefits, the local people have been held outside the decision-making process as the CHICOP management has exclusive knowledge and influence over the ecotourism enterprise and coral reef management. Many of the interviewees perceived the ecotourism project only as a new marketing mechanism to attract elite tourists and even staff stated that they did not know CHICOP’s true objectives. Francis and Bryceson (2001) have argued that involvement of local people and their knowledge is essential for a successful management regime as they have vested long-term interests in conservation. Based on this and the findings of this research, I argue that only when meaningful participation of local people is attained and the affected fishing communities get a share of tangible benefits accrued from CHICOP can ecotourism’s promise of uniting nature conservation and improved livelihoods be fulfilled.

Acknowledgement

First, I would like to thank all the fishers and other stakeholders who participated in the research for sharing of experiences and knowledge. I also appreciate the help I received from the management of CHICOP in terms of access to the island, invitation to various meetings and a school excursion, interviews with staff and access to secondary information. I am further indebted to my main supervisor Ian Bryceson and co-supervisor Espen Sjastad at the Norwegian University of Life Sciences, my local supervisor Narriman S. Jiddawi at the Institute of Marine Sciences in Zanzibar and my external examiner Stefan Gössling at Lund University for assistance and constructive feedback. Thanks are also extended to my three interpreters; Hamad Khatib, Said Juma and Salum Hamad who played a crucial role in the data collection. The work leading to this chapter has been supported by a publication grant from the Department of International Environment and Development Studies (Noragric) at the Norwegian University of Life Sciences.
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Marine Protected Areas (MPAs) in relation to Fisheries Management
Marine Protected Areas on mainland Tanzania: what is their future?

By J. Francis and Machumu, E.M.

Abstract
This article reviews Tanzania’s experience in planning, establishment and management of Marine Protected Areas (MPAs). There are different types of MPAs in mainland Tanzania including three marine parks, fifteen marine reserves, one national park, six collaborative management areas, some mangrove forest reserves located in the MPAs jurisdictions and six collaborative fisheries management areas. The relevant legislations and strategies that provide frameworks for the establishment and management of these MPAs are examined. These instruments and strategies specify key activities and processes that should be undertaken during the establishment and management of MPAs. These include processes to establish MPAs, how to involve stakeholders, development and implementation of General Management Plans (GMPs), operations of the Marine Parks and Reserves Conservation and Development Trust Fund (CDTF), and enforcement and compliance.

The successes of the different types of MPAs are discussed based on specific indicators such as changes in fishery and non-fishery resources inside and outside MPAs; establishment and maintenance of features necessary for a functioning MPA; improved compliance by users to the regulations and rules associated with the MPA; and the level of support and/or participation in the management by key stakeholders and local community empowerment as a strategy to reduce pressure on resources. Although inadequate availability of relevant baseline information and sufficiently long datasets is hampering systematic analysis of the success of MPAs in Tanzania, there is some evidences emerging which clearly show positive changes in fishery and non-fishery resources, increased adherence and compliance to the regulations and rules associated with the MPA and increased participation of communities in the implementation of conservation activities and decision-making processes of MPAs.
The establishment and management of MPAs in Tanzania have not been without challenges. These include: sharing of benefits accrued from the MPA operations, resistance to the implementation of the park mandates in some villages for various reasons and continued usage of destructive fishing methods though at reduced levels.

A number of recommendations are made, aiming to strengthen the establishment and management of MPAs in Tanzania. One of the key recommendations is that MPAs should set up monitoring programmes to monitor critical environmental and socio-economic parameters within and outside their respective protected areas, as information from such programmes will be useful in ascertaining whether MPAs are achieving their objectives or not.

**Background**

Area closures (selective or complete) through establishment of Marine Protected Areas (MPAs) is regarded as one of the most effective tool for conservation and sustainable utilization of resources. They also provide opportunity for applying specific management techniques independently or in combination as viable strategic measures to hasten the degradation whilst ensuring that community members have viable options to improve their livelihoods (Mangora et al, 2012). Other techniques such as time closures, size and species restrictions and changes or limitations in gear and effort are also adopted in the management of MPAs. Since such strategies involve significant human interaction, MPAs have also introduced collaborative resource management planning systems to maximize conservation and sustainable use of these resources; many solutions require collaboration across with individual mandates, levels of government, and even international boundaries (National MPAs, 2014).

The MPAs in Tanzania are being promoted to mitigate over-fishing and other anthropogenic impacts on marine resources (Machumu, and Yakupitiyage, 2013). MPAs are established as essential tools for biodiversity conservation in the oceans and to maintain biological productivity, especially of fish stocks in response to increasing human pressures (Mangora et al, 2012). Other important functions include; protection of biodiversity and ecosystem functions, controlling over-exploitation of resources and activities in sensitive habitats, and facilitating responsible utilization of coastal and marine resources (URT, 1994). Evidences supporting the positive contribution of MPAs to fisheries management and biodiversity have been published based on research conducted in different parts of the world (Salm et al., 2000; Ward et al., 2001; Machumu and Yakupitiyage, 2013). However, to-date it is still uncertain how effective the MPAs are in managing marine resources on a sustainable basis and contributing to poverty alleviation amongst coastal communities.

The situation in Tanzania is no exception, natural resources have come under increased pressure over the past three decades due to anthropogenic activities (Silva, 2006). Various kinds of coastal ecosystem in the country, especially coral reefs and mangrove forests are under
increased pressure from over-exploitation; coral reefs have been blasted and mangroves have been cut indiscriminately (URT, 2006). The increasing anthropogenic disturbances are attributed to the growing coastal population, as well as unsustainable use of coastal resources (Francis, et al., 2001; Wells, et al., 2004). Over the years, various joint efforts have been undertaken by diverse stakeholders including external partners, non-governmental organizations and coastal communities, with efforts aimed at preventing further degradation of the coastal and marine environment. The government has responded to protect coastal and marine resources by enacting the Marine Parks and Reserves Law of 1994, which allows for the establishment of MPAs (URT, 1994). In 1997, the government developed a national environmental policy to address issues pertaining to exploitation of natural resources followed by enactment of National Environment Management Act (NEMA) of 2004.

Tanzania’s experience in management of MPAs is rather short, about twenty years, from a slow start in the 1970s. However, during the period, three Marine Parks and fifteen Marine Reserves were established under MPRU. Tanzania has gained a lot of experiences in its efforts to conserve its coastal and marine biodiversity, while promoting and facilitating initiatives aiming at addressing the well-being of the coastal communities, particularly the poor. Based on an extensive literature review, as well as interviews with key individuals who have been involved or still play key roles in the management of MPAs in Tanzania, this article summarizes the experiences gained, beginning with a description of the historical background of the development of MPAs in Tanzania. The legal and institutional framework for establishing and managing MPAs in Tanzania is followed by a focus on performance assessment, to determine whether the MPAs in Tanzania are achieving their intended objectives. A highlight of the main challenges experienced during the planning and management of MPAs in the country is presented, concluding with a summary and recommendations for further actions.

History of MPAs in Tanzania

In Tanzania, development of marine reserves goes back to the 1960s, when surveys were conducted of marine habitats, mainly coral reefs (Ray, 1968; UNEP, 1989) and seven sites were gazetted as marine reserves (no take areas) in the mid 1970s. These sites were:

- **Dar es Salaam area**: The islands of Mbudya, Bongoyo, Pangavini and Fungu Yasini. Currently known as Northern Dar es Salaam Marine Reserves System (NDMRS)
- **Tanga Region**: Maziwe Island (off Pangani)
- **Mafia Island**: Chole Bay and Kitutia Reef

Tanga Coral Gardens was one of the site recommended to be designated as a Marine Reserve (Ray, 1968), but this site was not included when the others were gazetted.

The marine reserves were established because of their biodiversity, aesthetic, recreational, educational and research values. They were administered by the Division of Fisheries operated under the Ministry of Natural Resources and Tourism. However, no specific manage-
ment and institutional mechanisms were put in place to effectively manage them. This was attributed to lack of financial resources and human technical capacity to manage them. As a result they became merely “paper” reserves (Bryceson, 1981); without any management interventions.

For almost twenty years, between the mid-seventies and early 1990s, little happened in relation to the establishment of any new protected or strengthening of the then existing seven sites, Tanzania’s first MPAs. Reasons for this neglect include the lack of recognition of the importance of the reserve as effective tool for protection of coastal and marine environment, partly from a lack of technical capacity within management authorities as well as lack of financial means. This period was marked with the start and spread along the entire mainland coast of the use of destructive fishing methods, such as dynamite fishing.

It was not until the early 1990s when the interest to establish MPAs resurfaced after realization that traditional management efforts alone were not successfully protecting and sustaining many of the inshore fish populations, their habitats and other marine resources. Establishment of MPAs also gained support from experts within and outside Tanzania as well as community members, particularly leaders from Mafia Island who started putting pressure on the government to take concrete actions to protect coastal and marine environment of the Mafia Island against the use of destructive fishing techniques (Andrews, 1998). This was after realizing that the Fisheries Act of 1970 did not provide for establishment of the MPAs.

The process to establish the Mafia Island Marine Park (MIMP) went hand in hand with the enactment of the Marine Parks and Reserves Act (MPRA) No. 29 of 1994. The prevailing social and political climate in Tanzania at the time, following the lifting of the ban on multi-party politics and the raising of awareness amongst population of their rights, would have made it difficult for the government to designate new MPAs by government decree, thus the consultative processes in the selection and designation of new protected area became the trend.

The new MPRA also provided for the gazettement of the MIMP in 1995, the transfer of Marine Reserves from the Division of Fisheries to the Board of Trustees for the Marine Parks and Reserves Unit (MPRU) in 1998 and, the establishment of the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) in 2000. MIMP, when established, already included two existing marine reserves, namely Chole Bay and Kitutia Reef.

In addition to the three marine parks and ten reserves established under the MPRA, there is also Saadani National Park, established in 2004 under the National Parks Act of 2002. Saadani National Park contains substantial terrestrial area as well as a relatively smaller marine area consisting of mangroves, two creeks and an offshore reef. It was for this reason
established under the National Parks Act rather than the Marine Parks and Reserves Act, which does not provide for establishment of a National Park, even though it does provide for upgrading of a Marine Park to a National Park.

Following the approval of the MPRU’s Strategic and General Management Plan of Marine Protected Areas, by the Government in 2005, it therefore meant that the MPRU had formally been given the mandate to manage all the uninhabited small islands in the Tanzanian marine waters. In addition, the Dar es Salaam Marine Reserves System was expanded to include four additional small islands, namely, Inner Sinda, Outer Sinda, Makatube and Kendwa. Three small islands in Mafia, namely Shungu Mbili, Mbaranguni and Nyororo (which recently has become a popular spot for whale shark viewing and a long-established marine turtle nesting site) have also subsequently been gazetted as Marine Reserves and placed under management of the MIMP (URT, 2006). More recently, four new marine reserves in Tanga region namely; Ulenge, Mwewe, Kwale and Kirui have been gazetted as Marine Reserves. Those reserves are still under the management of the recently-established Tanga Coelacanth Marine Park (TACMP). The process of gazetting other small islands qualifying to be Marine Reserves is underway.

Thus, currently, there are three (3) Marine Parks and fifteen (15) Marine Reserves operating under the management of the semi-autonomous body, the MPRU (Fig. 1); while the Saadani National Park is under the management of a parastatal, the Tanzania National Parks Authority (TANAPA).

Furthermore, all mangrove areas are gazetted as Forest Reserves under the Forest Act 2002. Currently, the management of mangrove forests has been shifted to Tanzania Forest Service (TFS) from the Division of Forestry of the Ministry of Natural Resources and Tourism. However, some mangrove forest areas within the jurisdictions of MPAs are managed by MPRU. In reality, there are a number of legal activities taking place in mangroves despite their status as Forest Reserves. Restricted harvesting for subsistence purposes takes place in most mangrove forests and salt-making is common in many upper intertidal areas of the forests, on open mud flats, with mangrove timber use to boil the brine in some smaller operations. Most of the salt-making ponds are located in the ‘bare saline patches’ within the mangrove forests. Permits for salt-making are issued by the departments of mining at the regional level.

In the Rufiji Delta there are 24 BMUs and each BMU has a well-defined jurisdictional area on land and sea with a clear boundary agreed in consultation with communities and Local Authorities. Ten BMUs in the Rufiji Delta have come together to form four Collaborative Fisheries Management Areas (CFMAs). The CFMAs are managed jointly by neighboring BMUs who share a common fishing ground. The aim is to work in partnership to manage the shared resources and improve environmental conditions and the livelihoods of coastal
Marine Protected Areas on mainland Tanzania: what is their future?

communities. In addition, two CFMAs that aim to manage fisheries resource exploitation on the eastern side of the Rufiji Delta - Mafia Channel complex, have been established on the west coast of Mafia Island. Through the CFMA process, development of local frameworks

Fig. 1. Marine Parks and Reserves under MPRU. © C.A. Muhando
### Table 1. Different Types of Marine Protected Areas in Tanzania and their Sizes

<table>
<thead>
<tr>
<th>MARINE PROTECTED AREA</th>
<th>DATE ESTAB.</th>
<th>IUCN CATEGORY</th>
<th>SIZE (KM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mafia Island Marine Park (MIMP)</td>
<td>1996</td>
<td>VI</td>
<td>822</td>
</tr>
<tr>
<td>Mnazi Bay – Ruvuma Estuary Marine Park (MBREMP)</td>
<td>2000</td>
<td>VI</td>
<td>650</td>
</tr>
<tr>
<td>Tanga Coelacanth Marine Park (TACMP)</td>
<td>2009</td>
<td></td>
<td>552</td>
</tr>
</tbody>
</table>

**DAR ES SALAAM MARINE RESERVES SYSTEM**

<table>
<thead>
<tr>
<th>MARINE RESERVE</th>
<th>DATE ESTAB.</th>
<th>IUCN CATEGORY</th>
<th>SIZE (KM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bongoyo Island Marine Reserve</td>
<td>1975</td>
<td>II</td>
<td>9.15</td>
</tr>
<tr>
<td>Mbudya Islands Marine Reserve</td>
<td>1975</td>
<td>II</td>
<td>14.22</td>
</tr>
<tr>
<td>Pangavini Island Marine Reserve</td>
<td>1975</td>
<td>II</td>
<td>2.13</td>
</tr>
<tr>
<td>Fungu Yasini Marine Reserve</td>
<td>1975</td>
<td>II</td>
<td>22.90</td>
</tr>
<tr>
<td>Makatube Island Marine Reserve</td>
<td>2007</td>
<td></td>
<td>7.78</td>
</tr>
<tr>
<td>Kendwa Island Marine Reserve</td>
<td>2007</td>
<td></td>
<td>5.30</td>
</tr>
<tr>
<td>Sinda Island Marine Reserve</td>
<td>2007</td>
<td></td>
<td>1.80</td>
</tr>
</tbody>
</table>

**MAFIA MARINE RESERVES**

<table>
<thead>
<tr>
<th>MARINE RESERVE</th>
<th>DATE ESTAB.</th>
<th>IUCN CATEGORY</th>
<th>SIZE (KM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shungu Mbili Island Marine Reserve</td>
<td>2007</td>
<td></td>
<td>4.20</td>
</tr>
<tr>
<td>Nyororo Island Marine Reserve</td>
<td>2007</td>
<td></td>
<td>21.00</td>
</tr>
<tr>
<td>Mbarakuni Marine Reserve</td>
<td>2007</td>
<td></td>
<td>3.80</td>
</tr>
</tbody>
</table>

**TANGA MARINE RESERVES**

<table>
<thead>
<tr>
<th>MARINE RESERVE</th>
<th>DATE ESTAB.</th>
<th>IUCN CATEGORY</th>
<th>SIZE (KM²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maziwe Island (currently Sandbank) Marine Reserve</td>
<td>1981</td>
<td>II</td>
<td>4.50</td>
</tr>
<tr>
<td>Ulenge Island</td>
<td>2010</td>
<td></td>
<td>3.16</td>
</tr>
<tr>
<td>Kwale Island</td>
<td>2010</td>
<td></td>
<td>12.13</td>
</tr>
<tr>
<td>Mwewe Island</td>
<td>2010</td>
<td></td>
<td>0.40</td>
</tr>
<tr>
<td>Kirui Island</td>
<td>2010</td>
<td></td>
<td>36.10</td>
</tr>
<tr>
<td>Saadani National Park</td>
<td>1968</td>
<td></td>
<td>3000</td>
</tr>
<tr>
<td>Mangrove Forest Reserves located within jurisdiction of MPAs</td>
<td>1991</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Collaborative Fisheries Management Areas (CFMAs) in Rufiji

- Mbwekeki                                                   | 2010        |                | 208        |
- Njisopoja                                                  | 2010        |                | 884        |
- Kimsa                                                      | 2011        |                | 306        |
- Mehimchunya                                                | 2011        |                | 356        |

CFMAs in Mafia

- Dokichunda                                                 | 2010        |                | 266        |
- Jojibaki                                                   | 2011        |                | 478        |

Tanga Collaborative Management Areas (CMAs)

- Boma Mahandakini                                           | 100.0       |
- Deepsea Boma                                               | 400.0       |
- Mwarongo Sahare                                            | 300.0       |
- Mtang’ata                                                  | 150.0       |
- Boza Sange                                                 | 559.0       |
- MkwaJA Sange                                               | 405.0       |
for the management and protection of fisheries resources, including marine turtles and their habitats are underway. The entire process has been supported technically and financially by WWF. Of most recently, Rufiji Delta and Mafia Island Sea scape have been included in the Indian Ocean - South East Asia (IOSEA) Marine Turtle sites network. Among other things, the network is intended to enhance the local-to-global scale recognition of the importance of selected sites, while offering conservation benefits that are most readily achieved through a well-coordinated mechanism; optimize use of limited resources and; help to diffuse adverse socio-economic impacts over a wider geographic scale, while promoting ecological connectivity as well as resistance and resilience to environmental stress.

The above descriptions reveal how in Tanzania there exist several types of MPAs or rather Marine Managed Area (MMA), ranging from no-take areas such as marine reserves, national parks and closed reefs, to multiple use areas such as marine parks. Also, those coral reefs are the main ecosystems that are currently protected in most of the parks, reserves, and CFMAs. This is in recognition of their importance to the tourism industry as well as the artisanal fishery sector.

**Legal and Institutional Framework for Establishing and Managing MPAs**

The keystone legislation related to MPAs in Tanzania is the Marine Parks and Reserves Act No. 29 of 1994, as described earlier. According to the Act, the objectives for establishing a marine park or reserve include, but are not limited to, the following:

- To protect, conserve and restore the species and genetic diversity of living and non-living marine resources and ecosystem processes of marine and coastal areas;
- To manage marine and coastal areas so as to promote sustainability of the use, and the recovery of areas and resources that have been over-exploited or otherwise damaged and to rehabilitate damaged ecosystems;
- To ensure that villages and other local resident resource users in the vicinity of, or dependent on, a marine park or marine reserve are involved in all phases of the planning, development and management of that marine park or marine reserve, share in the benefits of the operation of the protected area and have priority in the resource use and economic opportunity afforded by the establishment of the marine park;
- To stimulate the rational development of underutilized natural resources;
- To promote community oriented education and dissemination of information concerning conservation and sustainable use of the marine protected area;
- To facilitate research and to monitor resource conditions and uses within the marine park.

Furthermore, the MPRA gives power for specific MPAs to incorporate additional purposes as required, based on the physical environment of the area where an MPA is gazetted. Finally, it also provides for establishment of the MPRU to manage parks and reserves in accordance with relevant acts and policies.
In Tanzania, there exists four other pieces of legislations that can be used to establish MPAs as well as one government strategy that is relevant. A few of them have already been used for the purpose, while others are yet to be used. The following is a brief description of these instruments:

i) The Fisheries Act, 2003. The Minister is given the mandate in the Act to develop regulations in relation to protection of critical habitats, determining and imposing closed periods, providing for protection of biodiversity of aquatic habitats, ecosystems and endangered species and regulating artisanal fisheries.

ii) The National Parks Act, CAP 284 R.E. 2002. The Act provides for the highest level of protection. This law is supported by other laws, for example, the Marine Parks and Reserves Act under Part VI Section 9 provides for the upgrading of a Marine Park into a National Park. The Minister responsible for establishing and preserving National Parks, may, upon advice upgrade a protected area such as a Game Reserve, Forest Reserve, Marine Park or Reserve to the status of a National Park.

iii) The Local Government (District) Authorities Act, No. 7 of 1982. The local governments are also responsible for licensing artisanal fishing activities and enforcement of fisheries by-laws. They are responsible for revenue collection and proposing biodiversity conservation areas for gazettment as protected areas. In addition, they are in charge of managing village and/or local government forest reserves. They are also involved in overall management of marine parks/reserves, mostly through the advisory committee set under the MPRA. Local governments have the duty to manage MPAs within the local government jurisdiction, other than those established under the MPRA.

iv) The Environmental Management Act, 2004. The Act gives power to the Minister, on recommendation of the National Environmental Advisory Committee, to declare any area of land which is ecologically fragile or sensitive to be an Environment Protected Area.

v) The National Integrated Coastal Environment Management Strategy. This Strategy provides for preparation of the Special Area Management Plans. These will be developed in geographic areas of concern such as areas with existing important economic/infrastructure facilities where resource degradation and use conflicts are occurring; areas where major new economic developments are planned or areas where there is rapid economic transition and substantial resource use conflicts that have environmental implications; and trans-boundary areas where significant coastal management issues exist. Special area management planning is a mechanism that allows central government in partnership with local government to plan and manage geographic areas of particular national concern or interest.

It is clear from the above that the framework for planning, establishment and management of MPAs exists and is functioning. Further elaboration on how these instruments have been used in real situations is provided in the coming sections.
Process for Establishing Marine Protected Areas

Each instrument provides reasons for establishment of a particular MPA within its mandate. Reasons are either aimed at conservation of marine biodiversity, maintenance of productivity of coastal and marine ecosystems or, contributing to the socio-economic welfare of coastal communities. The focus of each legal instrument is different but includes a combination of elements of each of the three main purposes of MPAs. For example, the main focus of the Fisheries Act in relation to MPAs is to develop regulations controlling licensing of fishing efforts, fishing seasons, and prohibiting fishing in designated core areas. This implies that fisheries rather than biodiversity as a whole if the priority for the Act.

According to the MPRA, the process to establish MPAs involves four key steps:

i) Identification of representative marine areas and selection of the potential MPA. The process to establish a MPA can be initiated by a local government authority (including village council), research organization any other government agency, civil society organization, private sector or even an individual. For MIMP, it was researchers from Tanzania (particularly the Institute of Marine of Sciences (IMS), University of Dar es Salaam) and outside (from Sweden and the United Kingdom) and representatives of international NGOs such as WWF who in 1990 developed the idea originally proposed by Ray (1968). The process that finally culminated in the selection of the MBREMP, involved three other sites: Jange/Sudi Bay and Kilwa Archipelago in Lindi, Mbegani Bay and Mwamba Kuni in Bagamoyo. This process was led by experts from IMS with technical support from IUCN, who collected data on both biophysical and socio-economic parameters from literature reviews, interviews and field studies in the proposed sites. Criteria such as scientific, economic, social and ecological importance, feasibility in terms of attitude/interest in MPAs, naturalness and national and international significance were used to prioritize the three sites.

In both MIMP and MBREMP, during the first stage, local authorities and coastal communities were consulted and they strongly supported the idea because of serious destruction of critical ecosystems/habitats and associated biodiversity, including fish, caused by illegal methods of fishing such as dynamite and beach seines. In both parks, local communities formed groups which were doing patrols to combat illegal fishing in their respective areas. In Mtwara and Lindi regions communities went further and formed an NGO, namely the Southern Zone Confederation of Marine Environment (SOZOCOMAE) with support from the Rural Integrated Project Support (RIPS), a Finnish International NGO by then, based in Mtwara. The main objective of the SOZOCOMAE was to control the illegal fishing being undertaken in the area. During the process of establishing MBREMP, different stakeholders, including government leaders and SOZOCOMAE members, convened a meeting which resulted in a strong resolution, the “Mtwara resolution” sup-
porting the idea of establishing MBREMP.

ii) Negotiation of a MPA agreement (within government). The Minister consults with local government authorities in the vicinity of the proposed area to be declared an MPA, which, according to the Act, may also involve adjudication of rights and compensation for loss of property rights, though this was not applied when MIMP and MBREMP were established. This was due to the fact that residents within those gazetted areas were not displaced, retained their own property and were allowed to carry out their normal activities, provided they comply with the new Act, GMP and associated regulations.

iii) Parliament resolution. For the marine parks, their establishments have to secure Parliament approval, which give the Minister powers to declare the proposed area a Marine Park. Such a Parliament resolution is not required for the establishment of a Marine Reserve.

iv) Declaration of the MPA. The Minister declares a Marine Park or Marine Reserve (pursuant to Section 8 of the Act 29/1994), with Notice of the Declaration of an MPA published in the Government Gazette, thereafter becoming law.

**Involvement of Stakeholders**

The consultative process aims at creating sense of ownership, winning support and commitment of local communities and other key stakeholders living within and adjacent to the identified area proposed for the MPA. Local resource users are treated as key stakeholders and partners in conservation through their involvement at different levels of management such as planning, decision making, implementation of conservation activities, benefit sharing and monitoring and evaluation as well as sharing responsibilities. Similarly, the five Acts described above provide for involvement of different stakeholders in the planning, establishment and management of MPAs. For example, under the MPRA, the Board of Trustees of Marine Parks and Reserves was established and is responsible for policies and oversight on the use of the MPRU Conservation and Development Trust Fund (CDTF) as well as playing an advisory role to the MPRU. This Board, which operates at a national level, has representation from different groups such as private sector, local communities, government and environment. At the Marine Park level, each park has an Advisory Committee (AC) appointed by the Permanent Secretary. These committees are supposed to advise the Board of Trustees on the management of the MPA and provide oversight on the operation of the MPA. The committees are supposed to consult with the wardens on day to day operations, technical functions and other matters regarding the park. The AC reports various issues that need immediate attention of the Board i.e. local communities’ projects which need financial support from the CDTF. It also suggests and recommends names to the Board for appointment of a Warden in-Charge.

Local communities, district authorities, relevant government departments, research institutions and private sector are represented in these committees. All members representing
different groups and/or institutions have equal status, though no veto power in making decisions.

Furthermore, the Act stipulates that the village councils in the vicinity of the MPA should participate fully in all aspects of the development or any amendment of regulations, zoning or GMP as well as advising the park management on all matters relevant to management and conservation of park.

**Preparation and Implementation of General Management Plans and Zoning**

General Management Plans (GMPs) aims at providing a strategic framework for long-term conservation of marine and coastal biodiversity and sustainable management of human activities. The MPRA provides for formulation of the GMP in the established MPA and the Act requires that the GMP be developed within six months of gazettment of the MPA. However, MIMP, MBREMP, TACMP and DMRs developed their GMPs a few years after their establishment.

The GMPs of most of the MPAs operating under the auspices of the MPRU follow a similar structure containing description of resources and resource use, management goals and objectives, guiding principles and the appropriate management strategies and zoning schemes. Marine reserves however some have no GMPs and are simply no-take area. Other sections in the GMP include management structure and operational framework and monitoring and evaluation of the plan.

As required by the MPRA, the development of GMPs for MPAs operating under the auspice of MPRU (MIMP, MBREMP, TACMP and DMRs) should be participatory, involving the parks’ and/or reserves’ numerous stakeholders. For example, for MBREMP, the process was slightly different from those at MIMP and TACMP, involving two main steps – the environmental planning process at village levels and a stakeholder consultation process which were conducted concurrently, as underscored below:

i) A village-based environmental planning process to develop Village Environmental Management Plans (VEMPs). As a result of this process, ten villages developed VEMPs comprising natural resource profiles, zoning, by-laws, management systems/modus operandi, main aims, action plans monitoring and evaluation systems.

ii) A series of consultative workshops for stakeholders. Three major stakeholder workshops were held in Mtwara to solicit the input of all the stakeholders affected by the adoption of the GMP.

In Tanzania, as mentioned above, the zoning plan is part of the GMP. Zoning is particularly useful for multiple-use MPAs such as MIMP, MBREMP and TACMP. The zoning schemes in these parks divide the multiple-use area into user zones that have different levels of protection depending on their respective conservation and economic importance. There are
three types of zones in these parks namely: core zone, specified-use zone and general-use zone. The zoning scheme for MBREMP was developed based on inputs from the VEMPs, consultative meetings and the results from the scientific assessments.

**Funding of MPAs**

In Tanzania, like other parts of the world, major costs related to MPA establishment include consultative meetings to agree on the establishment, infrastructure and equipment once the park has been declared and later development of a management plan, while ongoing costs for day-to-day management include administration, salaries, maintenance, monitoring and enforcement. According to survey of 27 MPAs situated in the Indo-Pacific region including MIMP, the greatest expense for MPAs is wages, followed closely by operational costs such as fuel and maintenance (IUCN, 2004). Analysis of spending by theme, showed that enforcement received over half of available funds, followed by research and monitoring (Gravestock, 2003). According to Hurd, (2004), the breakdown of costs in MPAs in Tanzania is as follows: personnel and consultants (30-45%); community development (0-15%); workshops, training and travel (10-15%); office running costs (10-15%); field running costs (5-30%) and capital costs (15-30%). The costs of enforcement in the Tanzanian MPAs seems to be lower compared to other MPAs in the region ranging from 5-30% which is contrary to what suggested by Gravestock, (2003). This is due to participatory philosophy being used to manage resources in the MPAs, through the philosophy people are involved at different management levels which in turn, increases sense of ownership and compliance among community members and resource users residing within or surrounding the MPAs.

MPAs traditionally rely on several sources of funding, including generated revenues, central government subventions, donor’s funding and trust funds, but all are subject to unpredictable fluctuations and are therefore unsustainable (Depond and Green 2006). Funding for management of MPAs in Tanzania comes from three main sources: central government subventions, donor funding and revenue-generating activities such as entry and user fees, licensing and taxation. The MPRA stipulates the establishment of Marine Parks and Reserves Conservation and Development Trust Fund, which serves as a repository for all funds from the government, donors, user and entry fees, tourism levies, and voluntary subscription, donations and bequests. The Government subventions funds mainly cover personnel salaries and basic recurrent costs (e.g. consumables, utilities, etc.), but are often insufficient to cover the overall day-to-day operational costs associated with managing the MPA.

In 2002, in both MIMP and MBREMP, donors (Worldwide Funds for Nature (WWF) and Norwegian Development Agency (NORAD) for MIMP and; Global Environment Facility (GEF) and Fonds Français pour l’Environnement Mondial (FFEM) for MBREMP) provided between 75-95% of total funds used for the operations of these parks (Hurd, 2004). However, donor
funding for these two MPAs ceased when those project phases ended, the main objective of these projects was establishment of those Parks to ensure that their systems are functional. However, not all systems were accomplished. For example, the GEF project for MBREMP aimed to develop a sustainable financial strategy which could support conservation project in a long term, however, the strategy was never developed (Machumu, 2012). Generally, lack of funds after phasing out of the donor-supported projects has proved to be a limiting factor for effective management of the MIMP and MBREMP. Inadequate funding often prevents management regimes from fulfilling MPAs missions (Thur, 2010).

**Enforcement and Compliance**

Enforcement is a vital component of the marine parks and reserves management, which in most cases determines whether an MPA will succeed or not. More specifically, the type of enforcement and outreach programs that are put in place are the main determining factors for successful MPA management. Enforcement involving the local communities can be effective in stopping destructive activities through social pressure. In addition, regulations and by-laws developed by local communities have the chance of being respected within the community more than those developed by central authorities. In MBREMP, ten villages have developed village environmental management plans (VEMPs), which amongst others included by-laws and zoning scheme for their respective reef areas.

According to MIMP (2006), over 137 combined random sea-and land-based patrols were conducted in 2005 by park staff and village enforcement units. This resulted into impounding of eight drag nets, one gill net, four boats and the 30 fishers involved who were taken to court, majority of them were acquitted and few were given minimal punishment which couldn’t commensurate with the gravity of offences committed.

Patrols in the CFMAs of Rufiji and Mafia have always included community representatives, more recently forming the Beach Management Units (BMUs), as well as enforcement officers from District councils, MPRU and Monitoring, Control and Surveillance (MCS) Unit of the Division of Fisheries. Each CFMA has been provided with patrol boat by WWF to service its area of operations. Yet despite all these efforts, the use of illegal fishing methods, including dynamite and beach seines has been reduced substantially but not eliminated completely.

**Summary**

It is evident from the above discussions that the legal and institutional framework for establishment and management of MPAs at different levels i.e. at the national and site levels has largely served its intended purposes. However, a number of concerns remain, as highlighted below.

- Overlapping mandate and roles. Recognition of the MPRA as the supreme act in re-
lation to establishment and management and importance of MPAs is only acknowledged by some of the other relevant acts. The Fisheries Act 2003 for example, does not explicitly provide for MPAs, although the provisions in section 17(h) and section 57(m) provide for the Minister to adopt measures “prohibiting fishing in designated areas” and “providing for the protection of critical habitats”, respectively, which could be inferred to imply promotion of the establishment of MPAs.

- Although private sector is represented in both Board of Trustees as well as the Advisory Committee, the MPRU Act does not provide for the private sector to establish MPAs. In contrast, the Forest Act 2002 empowers the Director of Forestry to enter into concession agreements with the private sector to manage forest reserves.

**Are MPAs Achieving their Objectives?**

In previous sections, the reasons as to why marine parks and reserves are established in Tanzania were provided. The key questions are for example, within the MIMP (in existence for almost twenty years), whether it has achieved its intended objectives, what are the tangible and measurable impacts to the environment or the communities living within the park? In this section, using a set of indicators, attempt is made to provide answers to these questions.

Many indicators can be used to judge the success of an MPA, as highlighted in a number of publications (such as Pollnac et al., 2001; Ward et al., 2001; Pomeroy et al, 2007). Normally the indicators are developed with a wide range of knowledge about MPAs in mind, so that they can be flexible and adaptable to the specific conditions and situation of a particular MPA (Pomeroy et al., 2005). There is a little information on the trend of resources which causes some difficulties to assess whether the MPAs in Tanzania are achieving their objectives. This is due to the fact that some MPAs are missing necessary baseline information or sufficiently long datasets as well as sufficient monitoring programs. The limited amount and quality of reliable data on some of the indicators does not allow for all indicators to be treated equally. However, for the purpose of this review, the following indicators are used to illustrate the performance of some of the MPAs in Tanzania.

i) Fishery and non-fishery resources inside and outside MPAs;
ii) Establishment and maintenance of features necessary for a functioning MPA;
iii) Compliance by users to the regulations and rules associated with the MPA;
iv) The level of support and/or participation in the management by primary stakeholders; and
v) Maintenance and enhancement of the social and cultural well-being of local communities

Local communities had been the major beneficiaries of the MPA’s resources since they use those resources for their livelihoods. Despite MPA communities being aware of the benefits accrued from well-managed marine resources, they tend to focus only on the benefits to their livelihoods, neglecting many important benefits accrued to nature (Angulo-Valde’s
Marine Protected Areas (MPAs) in relation to Fisheries Management

Marine Protected Areas on mainland Tanzania: what is their future?

As far as benefit sharing is concerned, the MPRA states that 10% of the net revenue borne from the park’s resource use should be allocated for the park communities (URT, 1994). However, the majority of stakeholders are not satisfied with tangible benefits, particularly the revenue accrued from conservation activities.

In addition, many community members had perception that the park would come up with a more vibrant plan that could create an enabling and conducive environment for communities by supporting activities, which are not a threat to the MPA resources (environment friendly activities). MIMP and MBREMP engaged in exhaustive support for alternative income generating activities (AIGAs). Though, this could only be possible if the park’s management helped its communities to access soft loans from financial institutions or solicit funds through fund-raising events or other means to implement such tasks (Machumu, 2012).

Increased Fishery and non-fishery resources inside and outside MPAs

Research is increasingly showing the fishery benefits of ‘no-take’ zones in MPAs and of MPAs totally closed to fishing in tropical coastal ecosystems (Roberts and Hawkins, 2000; Ward et al. 2001).

In Tanzania, some studies have proved that MPAs benefits some fisheries. Kamukuru et al. (2004) based upon research conducted on density and size of the blackspot snapper, *Lutjanus fulviflamma*, within and outside MIMP, it was found that the species was over four times more numerous, its biomass six to ten times higher and individual sizes on an average 37% larger within the Park than outside.

According to McClanahan et al., 2005, the Tanga collaborative fisheries management system has been successful in increasing fish stocks, reducing erect algae, and maintaining ecological diversity and stability of the coral reefs even after the bleaching event of 1998.

In MBREMP, fish catch, income from fishing and fishing effort data collected in 2006 and 2010 were compared to evaluate their trends (Machumu, 2012). The results of that study showed that fish catch and their income have been increased in the MBREMP and the increased contribution from fishery has also been one factor to improve income of park’s residents above the country’s income per capita, which could be attributed to the success of MPA management actions (Machumu, 2012; Machumu and Yakupitiyage, 2013). Machumu and Yakupitiyage, (2013) also noted that; although the conservation measures can play a key role in fishery management, there are other factors besides management regimes which could have also contributed to the increased fish catch. For example, the location of MBREMP at the area where South Equatorial Currents (SEC) meets the East African coast, forming a unique node of accumulation of marine organisms through the constant supply of propagules (Obura et al., 2008; Machumu, 2012); together with the presence of coastal habitats such as estuaries and mangroves that provide critical nursery habitat for organisms including fish, potentially combine to boost local fisheries production.
Other examples as summarized in Francis et al. (2004) include the following:

i) The MPAs of Chumbe (Zanzibar) and Kisite (Kenya) have larger size and higher diversities of finfish compared to the unprotected reefs off Dar es Salaam and Tanga. The protected sites have around 3.5 times more fish biomass than the unprotected reefs (McClanahan, et al., 1999).

ii) The recovery of the triggerfish *Balistapus undulatus*, a predator on sea urchins, in the five fully protected areas of Malindi, Watamu, Mombasa, Kisite, (all in Kenya) and Chumbe (Zanzibar) has been extensively studied (McClanahan, 2000). *B. undulatus* dominance partly recovered on a time scale of 5-10 years, though as much as 30 years or more may be required for full recovery.

iii) A study of 22 sites along the coastline of Kenya and Tanzania found that the abundance and species richness of commercially important triggerfish, surgeonfish and parrotfish were higher in protected areas compared to fished areas (McClanahan and Arthur, 2000).

iv) On the southern side of the Mombasa Marine Park, the total wet weight of catches per trap, the mean size of the trapped fish, and the number of fish species caught per trap declined as a function of the distance from the park edge for rabbitfish, emperors and surgeonfish (McClanahan and Mangi, 2000).

Some of these results are supported by fishers, who are claiming for example in Mafia that their catches have improved considerably because of the MIMP (Bryceson et al 2005; Tobey and Torill, 2006). Likewise, in Mtwara fishers declare that fishes and their sizes have been increased due conservation efforts of MBREMP (Machumu, 2012).

Examples of benefits accrued from MPAs on non-fishery resources are highlighted below:

With the exception of mangroves from a few areas around Dar es Salaam, there has been relatively little decline in mangrove coverage in the period from 1991/92 and 2002 (Wang et al. 2003). In MBREMP, the local community perceived that mangrove harvesting have been decreased considerably, whereas compliance of regulations has been increased (Machumu and Yakupitiyage, 2013).

i) This, to some extent may be attributed to the existence of MPAs, Mangrove Forest Reserves and the effective implementation of the National Mangrove Management Plan.

ii) The turtle nest protection on the Mafia Island has been successful with 140% increase in the number of nests and a significant decline in egg poaching (Muir and Abdallah, 2002).

*Establishment and maintenance of features necessary for a functioning MPA*

Characteristically, an MPA has a range of activities and operations that are essential for its operations. Features such as marker buoys, management plans, management committees, and office facilities are necessary for MPAs to achieve their management goals.
Marine Protected Areas (MPAs) in relation to Fisheries Management

Marine Protected Areas on mainland Tanzania: what is their future?

The MPAs in Tanzania are no longer considered “paper parks” as most of the management actions necessary for their management are in place. All three marine parks (MIMP, MBREMP and TACMP) have management team and committees in place. They have wardens, necessary staff and Advisory Committees in place to oversee and guide implementation of their activities. MIMP has in total 18 staff, while MBREMP and TACMP have 17 and 14 staff members respectively. Some of the reserves have honorary wardens/rangers as officers’ in-charge on the site. All the three parks and one reserve (i.e. the Dar es Salaam Marine Reserves (DMRs)) have GMPs, with the ones for MBREMP and DMRs approved by the minister responsible for marine parks and reserves in September 2005.

In relation to enforcement, all the Marine Parks (MIMP, MBREMP and TACMP) and DMRs have the essential equipment such as patrol boats and VHF radios needed for the purpose.

In September 2001, the Government published Notice 232, providing fees schedules for entry and user fees in marine parks and reserves. An entry and user fees system has been in all parks and reserves. In 2005/2006, over US$ 115,000 was collected as entry and user fees from the parks and reserves (MPRU, 2006). In 2009, the government provided subsidiary legislation through Government Notice No 92 providing for new entry and user fees in both parks and reserves. With increasing revenue and tourism activities in these parks and reserves, this amount increased to more than three-fold amounting to US$ 440 000 by 2013/2014 (MPRU Progress Report, 2014).

The level of support and/or participation in the management by primary stakeholders

Local communities in MIMP, MBREMP and TACMP as well as some of the other MPAs in mainland Tanzania have been involved in different roles in their establishment and management, as described in the previous sections. This participation is mandated through the relevant Acts, with MPAs following an approach focused on participatory and community-based management, thereby seeking to empower local communities to conserve and manage their resources and encourage ownership.

Communities within these MPAs were involved in their establishment, participated in the development of the GMP as well as the zoning schemes and are actively involved in the enforcement and monitoring activities. They are represented in both the Board of Trustees as well as in the respective Advisory Committees. Other stakeholders, such as the private sector and Non-Governmental Organizations (NGOs), are also actively involved in the management of MPAs in mainland Tanzania, similarly represented in the key organs, namely the Board of Trustees and Advisory Committees.

Leon et al., (2004) and Tobey and Torill, (2006) in a study conducted in five MPAs in Mainland Tanzania and Zanzibar namely; Mafia Island, Tanga, Menai Bay, Misali Island and
Jozani-Chwaka found from the people they interviewed that MPAs have strengthened the roles and effectiveness of village leaders and village Environment Management Committees in the management of their respective MPAs.

In the Tanga donor-funded programme described earlier, one of the important and noticeable achievements has been on increasing the involvement of women in village groups and decision-making processes. The programme raised awareness and deliberately supported women (and men) to ensure a more equitable representation, and raised the confidence among women to participate in meetings (Verheij et al. 2004).

Furthermore, stakeholders have been involved in the monitoring of ecosystems and resources use as well as in enforcement of MPAs regulations. Some hotels in MIMP have agreements with MIMP management to monitor seine net fishing through guests who go on the water. In the Tanga programme, after training, resource users were involved in monitoring of mangrove and coral reef ecosystems, fish catches, and seaweed production (Verheij et al. 2004; Wells, et al. 2007). Both studies also found that in all five MPAs, microfinance and savings schemes have been initiated and are helping to build the culture of saving. In MIMP, for example, Savings and Credit Societies (SACCOS) were formed in 9 of 11 villages of the Park by then.

**Compliance by users to the regulations and rules associated with the MPA**

In all MPAs in the country there has been a decline in the number of detected offences related to park regulations, such as the use of destructive fishing methods and gears and the frequency of MPA border incursions (Pers. observ). This is because the majority of stakeholders comply willingly with regulations due to their involvement in all the phases of MPAs development, including regulations. This provides empirical evidence that adopting manageability criteria during the planning of MPAs should lead to increase in voluntary compliance (Read et al., 2011). In addition, voluntary compliance can be optimized by gaining both public support and social acceptability of an MPA. This concurs with Thomassin et al. (2010) who defined social acceptability of the MPA as a “measure of support towards a set of regulations, management tools or an organization by an individual or a group of individuals”. Some examples related to compliance are presented below:

i) Due to enforcement efforts, dynamite fishing and the use destructive practices such as beach seine particularly in MIMP and MBREMP have been significantly reduced (Pers. observ).

ii) According to Dulvy et al. (1995) in the 1990’s coral mining ranked third as an income-generating activity, in terms of people involved on Mafia Island, however, the situation is different now. Recent surveys shows only 1% of the people surveyed reported coral mining as an economic activity (MIMP, 2014). Mining of live corals in the MIMP has been reduced, though lime from live corals is the only building
material available on small islands. Coral mining is only allowed for household use (Tobey and Torill, 2006). Live coral mining was commonly taking place in the MBREMP’s buffer zones, particularly Msangamkuu and Mikindani, with previous estimates at 4,800 tonnes of live corals and 3,000 tonnes of fuel wood being used in the industry (Guard, 2004). Coral mining in those areas had been reduced significantly, however currently the activity is resurfacing in those areas (Pers. Communication).

Local Community Empowerment as a Strategy to reduce Pressure on Resources

The contribution of MPAs to empowerment of coastal communities is one of their key objectives. Despite the efforts made by MPA management to develop alternative or supplementary income generating activities as a parallel activity to development of the MPAs, it has been the most difficult to quantify. This is attributed to the inadequate availability of quantitative baseline data on the impacts of MPAs on empowerment of villagers living within and adjacent to the parks.

From 2002 onwards, the MIMP has provided bursaries for about 800 students, with underprivileged parents, for study in secondary schools and colleges within and outside the Mafia Island (MIMP 2014). Kitomondo and Kirongwe Secondary schools are among the schools attended by most of these students (MIMP 2006). However, requests for support far exceed the resources the MIMP could provide for.

The MBREMP has been implementing AIGAs as a way of empowering local community members and easing or reducing the pressure on natural resources without creating hardships for the communities that have become dependent on them. AIGAs included enabling offshore fishing, beekeeping, gardening, rearing of improved local chickens and cashew-nut processing.

Empowerment should be regarded as an incentive to communities for easing pressure on resources and to continue participating in the conservation activities, inter alia enforcement, monitoring and rehabilitation of degraded areas. Lack of empowerment increase frustration among community members, especially fishers, and this consequently undermines the legitimacy of the management system (Nielsen et al., 2004).

Challenges Encountered in Planning and Managing MPAs

This section describes a number of challenges that the MPRU as well as the individual parks and reserves may have encountered or are encountering in planning and managing MPAs in mainland Tanzania:

While most of the villages in MIMP and MBREMP are generally in support of these MPAs, two villages, Jibondo in MIMP and Nalingu in MBREMP, in recent years have expressed
their displeasure with these parks in different fora despite being involved in their planning and establishment from the very beginning.

The antagonism has been interpreted by some as due to either their expectations of the MPA providing immediate benefits not being met or particularly for Jibondo Island, realizing that its special characteristics were not taken into consideration during the designing of the zoning schemes, Jibondo Island depends largely on fishing and its related activities as being a coral rag area, basically with no farming taking place on the island. Jibondo Island is also very dry with a serious freshwater availability problem (Bryceson et al., 2006). For Nalingu, villagers are claiming that advantages and disadvantages of the park were not well explained to them, so they initially supported it without knowing what the park would entail (Gawler and Muhando, 2004).

Recognizing these limitations, MIMP has also supported the construction of water projects to address water problems on Jibondo Island, as well as supporting women fisher group and providing loans to villagers to enable them to undertake different activities. Despite these efforts and others, MIMP has not been able to win the support of people in Jibondo Island.

Resistance to these MPAs could be explained in terms of two factors:

- **Strategic position.** While Nalingu is on the border between Tanzania and Mozambique, Jibondo Island is the farthest island from the main Mafia Island, making them strategic transit routes for smuggled items. Some people in such places, for economic reasons, will oppose the presence of any government-related institution. Problems with Nalingu villages started after MBREMP brought patrol boats fearing the exposure of their elicit and illegal businesses, namely smuggling goods in and out of neighbouring Mozambique.
- **Strong dependence on coastal and marine resources.** With most of the Jibondo Island dominated by coral rag land with poor soil cover, its economic activities are almost entirely limited to fishing, seaweed culture, and boat building. This situation is further complicated by increasing population, overall decrease in the individual fish catches and accessibility to traditional fishing grounds, which a currently under the MIMP zoning plan.

AIGAs activities initiated with the intention of reducing dependence of local community members on marine resources, have not been successful as expected. Some of these activities were facing a number of constraints which are limiting the achievement of their intended purposes. Sustainability of the activities initiated is not ensured due to lack of markets and inadequate extension services. For example, oyster farming and seaweed farming initiated in Tanga and Mafia, respectively, failed due to unavailability of reliable markets for these products. Being new activities and with minimal capacity within the communities to implement these activities, the need for continued extension services is essential.
Due to small budgets allocated for income generating activities, most of these remain small-scale pilot projects with minimal chance of scale up to increase their impact on the well-being of the communities involved. In addition, AIGAs must have to be working properly before they are introduced, also this process should involve local communities from the beginning.

All policies and acts relevant to the management of natural resources are providing for local communities to be given more responsibilities in the management of their resources. These responsibilities require communities to have the minimum requisite human, institutional and financial capacities, which may be inadequate in some of the coastal communities. One of the challenges facing the government and proponents of devolving more responsibilities to the communities to manage their resources is that, even within the same district, communities vary in their history and receptivity to initiatives such as MPAs. These communities are very dynamic and one has to have good understanding of power relations within these communities as experience from Nalingu and Jibondo Island have shown, to be able to work with them effectively.

Private sector has an important role to play in economic activities taking place in MPAs. The activities include tourism, fisheries and others such as use of mangrove products and seaweed. Through these activities they are providing revenues (user and entry fees) and market outlet for products from the parks. The hotels located in MIMP are marketing themselves using the park as well as the pristine environment it has to offer as attractions for potential tourists. This clearly shows the private sector and the Park could complement each other well.

The existing business community, for instance, in MIMP could have done more to create a conducive environment for the operation of the parks. One way that could have been done is through providing employment to the people from the nearby villages. For example, the Chole Mjini Conservation and Development Company Ltd have built a number of community facilities in the Chole Island. These include construction of four classrooms and teacher’s house, kindergarten, hospital and a market. The hotel owned by the company also supports these projects through a voluntary guest levy of US$ 10 per guest per night. The hotel employs 25 people from Chole full time and 18 part-time. Some of these staff members were fishermen.

Financial sustainability is an issue of major concern to all the MPAs. Dependence on one or a few sources of revenue to run the parks and reserves proved to be unsustainable as most of the MPRU revenue is dependent on the tourism industry. If tourism is not well developed, especially at the beginning of the park’s operations, the revenue base that is expected to fund conservation activities automatically collapses. The MPRU management should undertake a thorough study to identify other potential sources of revenue (diversifying revenue base) in their areas instead of relying on one source.
Recommendations

The history of MPA development in Tanzania is rather short, about twenty years old, but evidence of their impact on the participating communities as well as to the environment are emerging. The impacts are reflected in increased fishery and non-fisheries resources within some of the MPAs, increased adherence to the regulations and rules associated with the MPAs and increased participation of communities in the decision-making processes of MPAs. The development of MPAs has faced a number of challenges, including opposition by some villages to the implementation of park mandates to their villages as well as continued usage of destructive fishing methods though at a much reduced levels, in some sites.

Based on the review, a number of recommendations are made:

i) Integration of private sector activities in the local economy. If the businesses were integrated or linked into the local economy, impacts of their activities would have been much greater, and they would ultimately increase the financial resources that go to the communities. In addition to employment of the local people, private sector presence inside MPAs could focus more on purchases from local sources as well as sharing some activities with local people. For example, the Msasani Slipway withdrew from providing transport services to and from Bongoyo Island (part of the Dar es Salaam Marine Reserve) as well as from providing restaurant services on the Island. These services are being handled by local communities.

ii) Despite the problems both MIMP and MBREMP are facing in Jibondo and Nalingu, respectively, it is important these villages continue to be engaged and involved in park activities. More attention should be paid in empowering the ‘poorest of the poor’, so that they can break their dependence on certain influential members of the villages. Some of the concrete benefits of MPAs on environment and the communities living within the parks and reserves may not be immediate. It may take several years for the benefits to become evident to resource users. Consequently, change in resource users’ perception on the existence of MPAs, may also take time. This calls for continued and persistent communication between managers and resource users, highlighting both direct and indirect benefits of MPAs. A study in three national parks (no-take areas) in Kenya found that resource users living adjacent to the Malindi National Park, which is the oldest park held more positive perceptions than those living adjacent to the newest park (McClanahan, et al., 2005). Tobey and Torell (2006) found similar results in Tanzania.

iii) Tanzanian MPAs, particularly the MIMP, have been at the forefront in linking conservation with social issues and poverty reduction. Experience in Tanzania shows that this approach is slowly winning the support of the communities for conservation activities. For example, paying bursaries for primary and secondary schools pupils in Mafia Island is a strategic decision, with long-term outlook, as in doing so the park is helping to build a literate society that is likely not to be too dependent on resources for their livelihoods. This approach should be maintained
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as it is in line with call by broader policy documents such as the National Environment Policy, National Poverty Eradication Strategy and the Poverty Reduction Strategy Paper, that conservation and poverty reduction activities should be linked.

iv) As Tanzania is planning to establish more community-based MPAs, questions raised by Lowry et al. (1999) related to power and class dynamics in communities, are also relevant and therefore should be looked at seriously. The understanding needed include: “how power is distributed among individuals, families and groups in communities, how management responsibility is most effectively organized, and what are the incentives needed to engage community stakeholders in collective efforts to manage resources.” Another important key issue raised by these authors that needs to be taken into consideration is “community ‘capacity’ to share in the management of resources.”

v) There is a need for sustained efforts aimed at strengthening coordination and links between the MPA management with other governmental organizations, international and local NGOs and local communities, including all other key stakeholders within and outside the vicinity of MPA jurisdiction. Strengthening of coordination should go hand in hand with definition of the roles of all key players in conservation in order to avoid overlapping responsibilities, duplication of activities and unnecessary conflicts between organizations with stakes in natural resources and the environment at large.

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Marine Protected Areas (MPAs) in relation to Fisheries Management
Introduction
This final chapter aims to present some thoughts on the relevance of the concept of “resilience” in relation to understanding the social and ecological impacts of Marine Protected Areas (MPAs), drawing upon research conducted in Tanzania.

During the last few years up until 2006, together with several of my students and colleagues, we have attempted to apply the concept of resilience towards analysing ecological and social processes in several studies related to MPAs. We have also carried out research on broader aspects of resilience vis-à-vis integrated coastal zone management, coastal aquaculture, and coastal fisheries. This research has been carried out in Mozambique, Bangladesh, Sri Lanka, Vietnam, Malaysia and Norway. In this chapter the focus is solely on studies of MPA cases in Tanzania.

In some of these studies, we attempted to complement resilience analytical approaches with other concepts, including vulnerability and sustainable livelihoods. We also endeavoured to contextualise the studies historically and politically.

The concept of social-ecological resilience
The concept of ecological resilience was originally proposed by Holling (1973) in his critique of conventional ecology, which assumed ecosystems to be normally stable, with a
“balance of nature” that is equilibrium-centred and in a steady state. In this conventional ecology, changes are considered to proceed in a linear fashion. This conception of ecology furthermore underpins cause-and-effect views of predictive science, which when applied to natural resource science, assume that resources are manageable and yields are predictable (e.g. carrying capacity, maximum sustainable yield, natural vegetation climax, island biogeography, etc.) and that perturbations can be controlled.

Holling (1973) challenged the “stable equilibrium” view, and proposed that ecosystems are constantly changing, complex, non-linear, multi-equilibrium, self-organising systems, which are permeated by uncertainty, episodic events, discontinuities and thresholds, with variability over space and time, also characterised by cross-scale interactions, path-dependency, and scaling of environmental processes. Thus, stability is a transient and temporary phenomenon, whereas change, complexity and uncertainty are recurrent.

Holling (1986) proposed a four-stage ecosystem renewal cycle consisting of exploitation-conservation-release-reorganisation stages. This is referred to as the “adaptive cycle” in the growing literature around the concept of resilience (Holling 1995; Berkes & Folke 1998; Holling & Gunderson 2002; Berkes et al. 2003; Folke, 2006).

Fig. 1. The four behavioural phases in the adaptive cycle (based on Holling and Gunderson (2002), reproduced from www.resalliance.org accessed 12.05.2005).

Holling and his colleagues had mainly natural science backgrounds, but they recognised the importance of the dynamic linkages and interactions between ecological and social processes, especially as applied to natural resource management, and they encouraged interdisciplinary thinking.
Berkes and Folke (1998) and Folke et al. (2002) proposed new ways to link ecological and social resilience, and identified and expanded upon four critical factors that interact across temporal and spatial scales, required to address natural resource dynamics during periods of change and reorganization:

- learning to live with change and uncertainty;
- nurturing diversity for resilience;
- combining different types of knowledge for learning;
- creating opportunity for self-organization towards social and ecological sustainability.

Berkes et al. (2003) defined resilience applied to integrated social-ecological systems of people and the natural environment as having three defining characteristics:

- the amount of change the system can undergo and still retain the same controls on function and structure;
- the degree to which the system is capable of self-organization;
- the ability to build and increase the capacity for learning and adaptation.

While this concept of resilience has a strong and convincing basis in ecological theory, it is still weakly grounded in social science theory, and is often propounded in apolitical and ahistorical ways – I shall return to this problem later in this chapter.

From the WIO region, McClanahan et al., (2002) provided an insightful review of studies on the ecological resilience of coral reefs, and proposed a conceptual model. They emphasised the importance of species diversity and connectivity, warned of the impacts of human activities that could cause ecological shifts, and called for major efforts at all levels to conserve coral reef resilience.

Within coral reefs and mangroves, as in other marine ecosystems, there are wide diversities of functional groups and individual species (Nyström, 2006). The existence of a range of different species that perform similar functions confers greater resilience because, in the event of an environmental shock resulting in the loss of a species, an ecosystem that contains higher biological diversity is more likely to recover and reorganise itself successfully because at least some species that perform particular key ecosystem functions are likely to survive: therefore, it has greater resilience than a species-poor ecosystem. In the resilience literature, similarity and complementarity between species within functional groups is sometimes rather misleadingly referred to as “redundancy” (Low et al., 2002), which is a word that connotes them being unnecessary or useless (e.g. Oxford Dictionary (2006): “no longer needed or useful; superfluous”). However, these so-called “redundant” species are actually considerably diverse and varied, even if they have somewhat similar basic ecosystem functions, and they are certainly useful and non-superfluous. I suggest therefore that a more appropriate term than “redundancy” would be “complementarity”, to reflect the
importance of the diversity of species within functional groups, and the fact that being similar certainly does not mean being unnecessary or superfluous.

Marine organisms that are harvested by resource users, also have differing degrees of resilience to utilisation. Some r-selected species (with short life-histories, many offspring, opportunistic habits, etc.) may be almost impossible to exhaust, even by strong fishing efforts: several fast-growing pelagic fish species with high fecundity may fit this description. A terrestrial equivalent is a weed plant that is difficult to eradicate by removal of individuals. Whereas K-selected species (fish with long life-histories, few offspring, specialised habits, etc.) may be more vulnerable to over-exploitation: some benthic coral-reef dwelling fish species are typified by this description. Slow-growing, late maturing large-sized coral reef fishes sometimes form spawning aggregations that render them potentially vulnerable to over-exploitation (Robinson et al. 2004). Life cycles of protogynous hermaphrodite fishes also expose them to be vulnerable to being over-exploited as large males, and thereby to becoming non-viable as a breeding populations. Depletion of certain relatively uncommon K-selected species that play a key role in an ecosystem may lead to unexpected impact through trophic cascades: perhaps allowing an r-selected species to suddenly proliferate and thus cause unforeseen ecosystem changes that might also affect the overall resilience of a marine biotope. Therefore, it is problematic to generalise about the effects of “overfishing” on both r-selected and K-selected fish species, without distinguishing between them, and between stages of their life cycles.

Sometimes a resilient condition might be considered to be a negative situation by resource users, for example a polluted sea, such as the Baltic, may be ecologically resilient in a state of eutrophication that is difficult to cleanse (Troell et al., 2005). The term “resilient” is not a normative one (either “good” or “bad”), but an analytical one.

Selected concepts that may complement resilience analysis
Scoones (1995 & 1998), Forsyth et al. (1998), Adger (2000); Anderies et al. (2004), Janssen & Ostrom (2006), and other social scientists have engaged in critical dialogue about various social and ecological theories vis-à-vis natural resource management, which both challenge and enrich resilience ideas. Amongst other views, they proposed that different perspectives on a particular environmental issue can coexist, upheld by different actors representing different social and political values or positions, and these actors use and value environmental resources in different ways. For example, actors may define differently what is meant by “degradation”, how it can have multiple meanings and be used for varied purposes depending on the context from which it is situated (Scoones, 1998)

Wisner et al. (2005) contributed a novel re-conceptualisation of “vulnerability”, which can also be used to enrich understandings of “resilience”. Whereas resilience stems from ecological science and exhibits shortcomings in addressing social issues, the concept of vulnera-
Vulnerability evolved from social sciences (particularly political economy) to challenge widely held myths about natural disasters. Vulnerability provides a way to understand the dynamics of the social dimensions that render societies more vulnerable to natural hazards and risks. Therefore, when vulnerability is analysed in parallel with resilience, the understanding of societal processes can be strengthened.

Holling (1978) proposed “adaptive management” as an unorthodox approach towards putting resilience ideas into practice, in which learning is information-intensive and requires active collaboration with those people most likely to be affected by policies being implemented. Adaptive management addresses the unpredictable interactions within and between peoples and ecosystems as they evolve together. It takes the view that resource management policies can be treated as “experiments” from which one can learn through continual collaboration between resource-users, managers and scientists. Organisations and institutions can learn as individuals do, and hence adaptive management is based upon social and institutional learning. Adaptive management differs from conventional resource management by emphasising the importance of feedbacks from the environment in shaping policy as an ongoing process. Agardy et al. (2003) raise several important and critical questions about MPAs in relation to adaptive management, warning that hasty and empirically unsubstantiated approaches may create potentially dangerous targets for conservation science.

The resilience literature defines “adaptive capacity” in social-ecological systems as the ability to adapt to changing circumstances whilst continuing to function effectively in terms of key social-ecological processes, or to recover from a crisis and develop new pathways. Similarly, adaptive capacity is related to the ability of institutions and social networks to adapt and continue to function successfully in the face of change and uncertainty, and to take innovative advantage of new opportunities that changes often create space for. Maintenance of resilience results in strengthened adaptive capacity: biological diversity (at genetic, species and ecosystem scales) generally enhances ecological adaptive capacity (Loreau et al., 2001), and socio-cultural diversity correspondingly augments a social system’s ability to learn, re-organise and renew after a shock to the system (Folke et al., 2002). Ecological and social memories are key factors in ensuring adaptive capacity (Berkes et al., 1998).

The concept of “sustainable livelihoods” (Scoones, 1998; Ellis, 2000; Allison & Ellis, 2001) can also be useful towards understanding the impacts of management interventions on coastal people’s lives, and these ideas may also be applied to MPA interventions alongside resilience analysis.

Power relations constitute a crucial political dimension of analysing social-ecological processes, whereby “winners” and “losers” emerge within class struggles at all levels, from the local to the global, in the context of neo-liberal policies, neo-colonialism and imperialist...
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Marine Protected Areas in developing countries

In developing countries, the implementation and effectiveness of MPAs have been influenced by the dominance of political economic processes (Shivji, 2002, 2006; Harvey, 2005), which are clearly relevant to the understanding of the influence of political economic processes on MPAs in an increasingly globalised world.

### Resilience concepts vis-à-vis conservation and MPAs

The word “resilience” is becoming increasingly fashionable in conservation literature. However, conventional ecologists and conservationists appear to interpret the concept of “resilience” as being equivalent to “persistence” or “resistance to change”, maintaining the “balance of nature” (Cuddington, 2001; Grimsditch & Salm, 2006). In so doing, they effectively co-opt the term “resilience”, and misinterpret its meaning, and they then proceed to advocate the managing of ecosystems against change, rather than acknowledging that ecosystems are constantly changing. These conservationists thereby assert “resilience” in ways that are diametrically opposite to what Holling (1973, 1986) was arguing in proposing the concept. The utilisation of resilience as an analytical concept requires cognisance of such a contradiction in terms.

Holling’s (1973, 1986) concept of ecosystems as complex, non-linear, multi-equilibrium, self-organising systems permeated by change, uncertainty, episodic events, discontinuities and thresholds, contrasts starkly with the assumptions of many conventional conservationists who generally consider ecological change to be a threat, and prescribe management interventions designed to prevent change, to maximise equilibrium and stability, often to the extent of displacing local communities from their traditional fishing grounds or severely restricting their utilisation of coastal resources (Hansen et al., 2003). In this way, some such conservationists effectively deny that people are a part of the “system”, and yet they ignore the fact that the conservationists’ own interventions in stopping fishing or access to resources may actually constitute a “change”. In preventing people from fishing, these conservationists are thereby essentially (and ironically) changing the system rather than conserving it.

Conventional conservationists also often conceive humans to be a threat to “pristine” nature, such as in MPA designated areas, and they tend to portray local communities as agents of destruction, sometimes implying that poverty drives people to destroy nature to an even greater extent (Neumann, 2004). Nothing in nature is actually pristine; everything is historically and continually affected by human-induced and other processes of change.

In fact, local communities have been and should continue to be an integral part of local social-ecological systems (Agrawal & Gibson, 1999), as custodians of the environment. MPAs that set out to exclude them are both unjust and conceptually misguided because human activities can and often do augment ecological processes. For example, on land, grazing by herbivores increases the productivity and biodiversity of vegetation in contrast to ungrazed vegetation (Rook & Tallowin, 2003). Similarly, harvesting (to a sustainable extent)
of fishes, reefs, mangroves or algae enhances productivity rates and biodiversity, also causing mild perturbations which can positively open up ecological opportunities for a wider variety of organisms.

Rather than looking upon local communities as “indiscriminately” exploiting natural ecosystems and resources, they should be acknowledged and rightfully included as key planners, decision-makers, actors and implementers of all management interventions and institutions. Secure land and sea tenure and resource access rights are among the most important prerequisites. This approach should be based upon their intrinsic rights and responsibilities, and as such, has important social and political implications (Peter, 1998). It should be understood that local communities demonstrate their capacity and responsible attitudes towards sustainable resource use, partly because they are aware of their own direct dependence on these resources and also through an intrinsic traditional knowledge system that enables their long-term utilisation and management of coastal resources (examples have also been given by Sharma in Chapter 6 of this book).

By contrast, wealthy people generally consume more resources, waste more, and cause greater disruptions of natural processes than poor people do. Thus, to blame local communities is misdirected – a glance at the impacts of high-end beach tourists’ consumption patterns and ecological impact, vis-à-vis those of neighbouring villagers along a tropical shoreline, is a prime example.

**Political and historical dimensions**

When engaging with social aspects, there is a tendency within much of the resilience literature to be apolitical and ahistorical, as mentioned above. Therefore, it is essential to raise questions of power relations which address whose interests are being served by what decisions, who proposes and who decides, who monitors, and who controls. (Lebel et al., 2006) ask: resilience from what and for whom? Some forms of change are desired by some people, while other forms of change by other people – whose rights and interests count most? In each situation, it is important to ask who are the “winners” and who are the “losers”.

Engagement of resilience theories with literature on critical analysis of “participatory management” and “governance” is vital. The promises and problems of genuine and sham types of “participation” (Pretty 1997) of institutions and governance (Jentoft 2000, 2004), as well as “good or bad types of governance” (Shivji, 2004) are crucial questions that are situated in the context of ongoing political struggles of peoples for their fundamental rights, between classes and against neoliberal imperialist domination (Peter 1998; Shivji 2006; Harvey 2005).

An understanding of how a circumstance of social resilience may be good for some people and simultaneously bad for others is essential. An oppressive dictatorial regime may be “resilient” against the struggles of people for democratic change, and in these cases some actors
would understandably consider that this type of resilience should be struggled against, overthrown and replaced, perhaps necessitating a revolution. The discussion of “transformation” in resilience literature (Walker et al., 2004) is clearly politically inadequate in these contexts.

**Investigating the Benefits and Disadvantages of MPAs in Developing Countries through Social-Ecological Resilience Analysis**

The overall literature on MPAs is expansive and has increased rapidly during the last few years (Willis et al. 2003), but studies that link social-ecological resilience in relation to MPAs appear to be relatively few to date.

It has been widely recognised that command-and-control or top-down approaches to marine conservation and fisheries management have not worked (Berkes et al. 2001). In response, the concept of “co-management” has been increasingly been adopted by government agencies, NGOs and researchers seeking to formalize the involvement of resource users in MPAs. Within “co-management” approaches to MPAs, accession of some power to resource users, local institutions and/or local communities may be done enthusiastically in a sense of solidarity towards empowerment, or grudgingly in recognition of the fact that they often constitute cheaper and more effective guardians of resources. It is thus not surprising that most proponents of MPAs currently propose participatory and co-management approaches, but the degree to which they are genuinely willing to share power varies considerably. This section seeks to illustrate how the actualisation of co-management is complicated by the fact that there are differences in wealth and power amongst the various actors (or so-called “stakeholders”) of co-managed MPAs.

The most common initiation of an MPA begins with a conservationist organisation or institution taking the first steps. In most cases, areas to be designated as MPAs are chosen on the basis of their natural beauty and high biodiversity characteristics. MPAs in developing countries are established in areas of coral reefs or mangrove forests, areas which also serve as important resources by and for coastal communities. These coral reefs and mangroves are usually owned as communal property with traditional institutions regulating access and use; institutions which are often unrecognised by government authorities and conservation proponents. Neo-liberal policies advocating privatisation of such commons (as in the case of privately-run MPAs) create serious problems for local communities. In some inherently protectionist cases, conflicts of interest may lead to antagonisms, non-compliance and even litigation (Jones, 2002). To the contrary, those MPAs initiated with more inclusive approaches may possibly lend towards more peaceful and compatible developments alongside sustainable conservation.

MPAs are also often established with an additional incentive being the promotion of tourism, and more recently, with so-called “eco-tourism” or “responsible tourism”, ostensibly also to earn foreign exchange for the host country (Honey, 1999; Gössling, 2002; Levine, 2006).
These types of shifts in incentives for MPAs in developing countries highlight how actors such as commercial tourism ventures and international NGOs have dissimilar vested interests and different sets of values vis-à-vis ecological and social characteristics of the area in question. It also demonstrates how actors will strive for different interpretations of what resilience means. The disparity of wealth between commercial tourism ventures and international NGOs on the one hand, and the poverty of rural coastal communities where most MPAs are situated on the other hand, is extreme. The majority of coastal communities where MPAs are designated, have low incomes that can render them especially vulnerable to restrictions on their rights to access resources, resulting in food insecurity and income loss.

Despite the challenges local people face when a MPA is established, one of the common and relatively resilient characteristics of fisherfolk and fishing communities in developing countries are their livelihood diversity strategies. These communities often fish alongside practicing agriculture, handicrafts, small-scale trade, service provision, etc. (Allison & Ellis, 2001). They may fish seasonally and migrate to different areas at various times of the year. These practices (and the traditional ecological knowledge and institutions associated with them) ensure enhanced resilience because in case of failure in one livelihood activity, people may switch to another activity until the conditions for the first activity have become favourable again. Such recognition of their livelihood resilience is not intended to advocate forcing fishers into non-viable “alternative livelihoods” that NGOs or Park authorities sometimes propose alongside the banning of fishing in MPAs.

Small-scale fisherfolk in marine and coastal areas of developing countries also generally use a variety of fishing gears, most of which are non-destructive of the habitat and do not result in “overfishing”. Therefore, it is highly questionable as to whether they need to be “managed” by external institutions (Misund et al., 2002). It is also dubious as to whether they should be restricted at all from carrying out small-scale fisheries with non-destructive types of gear within MPAs (Bryceson et al., 2006).

The resilience and sustainability of the aforementioned small-scale fisheries generally contrasts starkly with the case of large-scale industrial type inshore fisheries, which often damage the habitat (especially trawlers). Trawling is a global phenomenon which is often conducted along tropical coastlines of developing countries. The industrial fishing fleets are usually foreign-owned and capital-intensive, and they are linked to processing factories (some floating offshore) and international markets with seemingly insatiable demand. These fishing operations are not flexible in terms of livelihood alternatives and are unlikely to respond judiciously to falling catch rates. Industrial-scale fishing operations thus pose a much greater threat to fisheries sustainability, and potentially to MPAs. Increasing globalisation of the exploitation of and trade in fish resources accelerate these pressures, and the influence of small-scale fishing communities is in danger of being dwarfed, as is even the sovereignty of developing countries over their fisheries resources.
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In such a context, illegitimately conceived MPAs stand to dispossess, marginalise and pauperise small-scale fishing communities. This is particularly urgent in view of extremist proposals to dramatically increase MPA coverage globally in a wholesale manner (Sale et al., 2005). Therefore, in order to counteract the problems that often arise when small-scale fisheries intensify and become more commercialised requires a gradual democratic evolution of management institutions that recognise and respect people’s rights, have legitimacy among fisherfolk, and are able to respond to these types of changing ecological and social pressures and conditions. The responses may or may not include gear restrictions (for destructive methods), as well as the establishment of fisheries “no-take” seasons or areas, or MPAs.

Offshore pelagic industrial fishing operations generally cause less habitat damage (although they may cause changes in ecosystem dynamics between functional groups in adjoining coastal areas, including MPAs). These fleets are mobile and can move to other areas when stocks show signs of depletion. It should be noted, however, that an increase of capital and subsidy by rich nations can motivate them to maximise catches even when entire oceanic stocks show signs of decline or collapse (Berkes et al., 2006).

The realisation of the importance of moving from single-species fisheries management, to multi-species, and most recently to ecosystem-based fisheries management (FAO, 2003) are surely steps in the right direction. However, it seems to have been overlooked by many that the term “ecosystem management” does not explicitly include people. In view of the need to reflect the human dimension more clearly, I propose that a further step is necessary – towards “ecologically sustainable and socially just fisheries management”. I also argue for the need to critically examine the role of powerful actors, such as international NGOs, who often portray themselves as “stakeholders” in an apolitical and ahistorical sense, whereas they may not actually hold legitimate rights within MPAs. Therefore, I also propose to emphasise the term “right holders”, as suggested by Sharma in Chapter 6 of this book, be adopted instead of “stakeholders”. This would serve to clarify rights, responsibilities and roles of various actors, and also problems regarding differences in the wealth and power amongst the involved parties in MPAs could be clarified and addressed. There is a fundamental need to invoke democratic and transparent processes with regard to access to and control over resources, sharing of incomes and benefits, and influence over decision-making and policy formulation.

Some examples enhancing understanding of the social and ecological dimensions of MPAs through selected case studies of resilience in relation to Marine Protected Areas in Tanzania

The purpose of this section is to illustrate how resilience theory can enhance understanding of the social and ecological dimensions of Marine Protected Areas (MPAs) in developing countries based on a number of recent studies. When using resilience concepts to analyse cases of MPAs in developing countries, differences in ecological characteristics of resilience and vulnerability of various tropical marine
ecosystems becomes apparent. For example, the contrasts between coral reefs and mangrove forests are enormous. Coral reef ecosystems have adapted to relatively narrow ranges of change in physical and chemical conditions and are relatively vulnerable to changes in temperature (may cause bleaching by loss of symbiotic zooxanthellae), salinity (osmotic stress), eutrophication (overgrowth of filamentous algae), etc., whereas mangroves tolerate considerably wider ranges of change in these parameters, yet they, in turn, are highly vulnerable to oil pollution (which blocks the lenticels on their pneumatophores), and herbicides (which are applied in some agrochemicals) and insecticides (which are generally more lethal for mangrove-dwelling crustaceans than for the intended terrestrial insects considered agricultural pests). This was demonstrated when a patch of mangrove forest at the mouth of Dar es Salaam harbour was completely destroyed by a single oil-spill in 1983, where breathing lenticels of the pneumatophores were smothered with tar. This forest has never recovered and even the stumps have gradually disappeared. The shoreline behind where these mangroves used to be subsequently experienced increased erosion due to greater exposure to wave action.

In contrast, coral reefs and mangroves that experience little change are generally less resilient than those that are adapted to occasional mild perturbations, and these differences and characteristics should be considered. An example for coral reefs is demonstrated by Rostad (2005) who carried out a study on two coral reefs in Zanzibar. Rostad’s (2005) study was focused on ecological resilience in terms of the recruitment and survival of corals in Chumbe Island Coral Park and a nearby similar but unprotected coral reef at Bawe Island. Rostad’s (2005) results indicated that there was no significant difference in recruitment rates between the protected and unprotected reefs. Rostad (2005) found that recruit mortality was higher in the protected reef. Therefore, coral recruitment is not necessarily more successful in protected areas and this could be a result of the increased predation by fishes and greater competition for space in the protected area. These interesting findings suggest that Chumbe “Coral Park” should perhaps be referred to as a “Fish Park”, because the prevention of fishing obviously leads to a rise in fish numbers, but does not necessarily benefit the corals and may even have a slightly negative impact on their survival as recruits. This study indicates that establishment of MPAs does not necessarily affect the corals (the keystone species of the reefs) positively, and that a moderate amount of fishing by non-destructive gears appears unproblematic, and might actually be ecologically advantageous to corals.

An example of mangrove forests that respond positively to occasional mild perturbations is demonstrated in the findings of Wahira Othman’s thesis (2005) on the ‘social-ecological resilience of Pete and Maruhubi mangrove ecosystems in Zanzibar, Tanzania (also presented as a Chapter 9 in this book). Othman (2005) illustrates how mangroves in a highly populated area were actually more resilient than in a designated marine protected area, and surprisingly found that non-toxic organic pollution can actually increased mangrove productivity and species diversity.
Building upon Othman (2005)'s findings, a study by Yusuph (2006) assessed whether similar patterns occurred in mangrove forests in other areas adjacent to high population concentrations and found that they were not necessarily more threatened than rural and more remote ones. Three mangrove forests north of Dar es Salaam were examined, each of which were adjacent to a coastal village at increasing distance from the city. This study found that a clear pattern emerged whereby mangroves closest to the city (and in densely populated areas) had the highest number of stems per unit area, the least signs of overexploitation, and the highest biodiversity of crabs and gastropods. Another example similar to Yusuph's (2006) study is a mangrove forest at the mouth of the Msimbazi river located within the inner city of Dar es Salaam that appears healthy and is expanding in a similar manner to the Maruhubi forest of Zanzibar because it is nourished by sewage and largely untouched by local residents. The resilience of this mangrove forests is further illustrated when it was almost entirely eliminated during the blockage of the Msimbazi river mouth during 1980 in connection with the reconstruction of the Selander Bridge. In this situation, polluted water with very low dissolved oxygen was dammed up and covered the breathing roots of the mangroves and asphyxiated most of the trees. When the bridge was finally completed and the river-mouth was re-opened, the dead forest area was flushed regularly by tidal flows and mangroves gradually and naturally repopulated the area (initially Avicennia marina, the typical colonising species). Many of the trees subsequently grew to over 4m high, forming a dense forest and bird sanctuary within the city of Dar es Salaam.

An example of how a resilience framework can illuminate the complexities of an MPA establishment is demonstrated in Aanby's (2006) resilience study of the social and ecological effects of the Mafia Island Marine Park (MIMP). Aanby (2006) confirmed that the livelihoods of fisherfolk in Mafia are combined with other sources of income and vary greatly seasonally, with their main fishing activities occurring during the calmer periods of the northern monsoon. Responses and perceptions of fisherfolk regarding catch trends were varied, some reported reduced catches while others felt that they had increased. Overall, most fishers felt that fish abundance had increased. Fisherfolk also indicated that they were satisfied with MIMP, while others were quite antagonistic. It seemed that everyone agreed on the principal goals of MIMP, but the implementation of the MIMP was perceived with mixed attitudes. The study also found that villages outside MIMP felt that those inside the park were benefiting unfairly, and attitudes towards MIMP seemed also to be strongly politicised in relation to the two main political parties (CCM being in power and CUF being the main opposition party). This study also highlights the important of recognizing the heterogeneity of local resource users, institutions and communities. It was evident that MIMP's relations with fisherfolk within and outside the park were mixed, and that they needed to understand the local villagers' predicaments through improved dialogue and consultation. Aanby (2006) suggested that a greater sense of legitimacy could be achieved by working together with the local
communities towards improvement of livelihoods and mutually beneficial cooperation in finding ways to conserve marine biodiversity, while practising resource utilisation sustainably and maintaining both social and ecological resilience.

Another example based on long-term personal observations, is a successful outcome of an MPA is the Dar es Salaam Marine Reserves System (DMRS) which covers the islands and reefs of Bongoyo, Pangavini, Mbudya, and Fungu Yasini. Earlier attempts to prevent dynamite fishing were futile for decades because urban-based and migrant fishers either ignored or evaded Fisheries authorities and the Marine Police (Bryceson 1978). However, when a group of young fishers from nearby village were recruited as wardens, and other villagers were allowed to earn income there by offering various services to tourists, such as food, drinks and hired snorkelling gear, they effectively ensured that dynamite fishing was halted (no incidents of dynamite fishing on these reefs have been reported since 2000). They occasionally patrolled the reefs in traditional fishing sailboats, and because ‘offenders’ also came from the same villages or migrant fishers’ camps, strong social pressure was placed on the offenders when they returned to their homes. The wardens turned a blind eye to non-destructive fishing methods, and maintained good relations with their fellow villagers. The corals and associated fish populations of these reefs recovered remarkably (personal observations and communication with Christopher Muhando). This case of recovery of the reefs underlines the central importance of the involvement of local communities, the issue of legitimacy, and the crucial question of people’s livelihoods in relation to the success or failure of MPAs.

The complex relationships among actors within MPAs designated for the promotion of tourism is illustrated in a study by Thorkildsen (2006) on an exclusively private “MPA” at Chumbe Island Coral Park that is managed by an expensive tourist hotel (Thorkildsen covers this in detail in Chapter 10 of this book). The “winners” and “losers” of this MPA were apparent, because the establishment of the tourist hotel and Chumbe Island Coral Park resulted in fishermen losing access to one of their main fishing grounds as well as the island itself, which led to increased resentment from fishers to the park’s establishment. Under these circumstances, the legitimacy of such a privately owned MPA was questionable because accountability was inadequately defined, economic leakages were difficult to control, and this clearly resulted in uneven distribution of benefits and costs.

Overall, it is evident that resilience theory can enhance the understanding of the social and ecological dimensions of Marine Protected Areas (MPAs) in developing countries. Resilience theory provides the theoretical tools to refute neo-Malthusian predictions that high human population density is associated with environmental degradation. A finding of resilience theory when applied to mangrove forests (Othman, 2005) in particular indicates that mangroves do not benefit from strict MPA conservation status. This was particularly the case where the processes in which they were instituted were not perceived to be le-
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gitimate by the residents who formerly had access to and control over the resources for common property use.

On a longer-term basis, a collaborative research effort (Bryceson et al., 2006) entitled “Fisheries Study in Tanzanian Coastal Waters: the effects of trial export of finfish from Mafia Island on ecological-social resilience and vulnerability” investigated the positive and negative ecological, economic, social, and political impacts of a trial change in fisheries policy to allow the export of finfish from Tanzanian coastal waters. The study adopted resilience and vulnerability as analytical frameworks, and it comprised of four parallel investigations: (i) a biological-ecological study, (ii) a participatory fish stock assessment, (iii) a socio-economic study, and (iv) a socio-cultural study. The study concluded with an intensive and inclusive process of analysing and synthesising findings in order to investigate their relevance towards a deeper understanding of the social-ecological resilience. We conducted a series of workshops in several villages in Mafia (both inside and outside the MIMP area) to share ideas, gain feedback and jointly improve the analysis with villagers and other relevant actors invited. Resilience analysis in this research project was strongly dependent upon close and continuous interaction between local communities, managers and researchers.

The initial study was completed in 2006 and subsequently led to an application for funds to conduct a follow-up study entitled “Coastal fisheries of Tanzania: the challenges of globalisation to resource management, livelihoods and governance” as a collaborative effort between the University of Dar es Salaam and the Norwegian University of Life Sciences (2007-2012).

**Fig. 5.** The main groups which need to continually interact towards the quest for resilient solutions for socially just fisheries development that is ecologically sound.
Conclusions

The results of the variety of case studies presented in this chapter suggest that MPAs can either contribute to or detract from social-ecological resilience; and that the outcome depends upon the power relations among the actors involved in planning, deciding, establishing, implementing and benefitting from any particular MPA. In most cases in developing countries, powerful and more wealthy actors promote MPAs in ways that protect the interests of foreign capital (such as high-end tourism ventures) and rich international NGOs, whose existence and fund-raising efforts are “justified” by major expansions in gazetting of tropical coastlines for MPAs that prevent or hinder small-scale fishing communities from developing their livelihoods.

Most MPAs seem to contribute to ecological resilience in terms of fish abundance and diversity, whereas it seems unconvincing that they contribute significantly to fish stocks outside their boundaries (see Kolding in this volume). They probably contribute to the overall resilience of coral reef and mangrove ecosystems in cases where the local communities consider the MPAs legitimate, but they can actually harm ecological resilience in cases where they lead to sharpened conflicts of interest.

Examples of better-functioning MPAs (as described for the participatory initiation of Mafia Island Marine Park and the Dar es Salaam Marine Reserves System) appeared to directly benefit local people in a number of ways, and to have more acceptance and legitimacy. They were also marked by tangible ecological improvements (e.g. the regrowth of coral reefs following the cessation of dynamite fishing of reefs).

Lessons are being learned and awareness is increasing about the pros and cons of MPAs. It is perhaps useful to heed the suggestion of McClanahan et al. (2005, 2006) and Kareiva (2006) based upon extensive research in Kenya, various parts of the western Indian Ocean, and Papua New Guinea, to move on from MPA-thinking to that of “Integrated Coastal Management” approaches. However, I suggest a further step beyond this approach to one of “Ecologically Sustainable and Socially Just Coastal Management”, which incorporates ideas of ecological resilience (in Holling’s original dynamic sense), while also fundamentally respecting human and fishers’ rights (as elucidated by Sharma in her chapter).

Changes in terminology do not constitute solutions in and of themselves, but they may be able to influence changes in thinking and management approaches. Words, terms, and theories will surely continue to be among the arenas for struggles by coastal peoples for their rights and for more genuinely ecologically viable and socio-politically just changes in the future. Struggles about the meaning of words such as “resilience” will surely continue.
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