

Diagnostic of community marine reserve models and methodologies for application in the Mesoamerican Reef Region



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Guatemala, August 2006

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Photograph on front cover by Valentina Giannini
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Community Management of Marine Resources: Models and Methodologies

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1 Introduction

1.1 Objective of the study

Communities that benefit from the use of resources have to take responsibility and manage the resource they are utilizing. Small-scale artisanal and subsistence fishers benefit from conservation efforts: due to habitat protection and spill-over effect their landings should increase (PISCO, 2002).

The objective of this research is twofold: 1) to document and evaluate different types of community marine reserve models and methodologies developed and practiced in other regions of the world, and 2) to analyze the information on key conditions for their success and determine what models or combination of models can be applied to the Mesoamerican Reef (MAR) social, economic and environmental conditions.

The MAR Fund focuses on the Mesoamerican Reef Ecoregion (MAR). MAR Fund defines the ecoregion as the area extending almost 1,000 km from the northern tip of Mexico's Yucatán Peninsula to the Bay Islands/Cochinos Cays complex off the northern coast of Honduras. The coastal/marine portion of the ecoregion ranges from about 40 km off the northern coast of the Mexican state of Quintana Roo to about 240 km from the Gulf of Honduras, and 50 km off the north coast of Honduras at the mouth of the Aguán River. The MAR also includes the Caribbean watersheds of those four countries, clearly establishing a ridge-to-reef approach to conservation in the ecoregion (<http://www.marfund.org/themesoamericanreef.html>).

1.2 Background information

Overfishing threatens the conservation and sustainable use of marine resources, and measures should be taken to avoid it. Management of marine resources is needed to avoid overfishing. If fishing gets to the point of overfishing, and a closure is required, the local fishing populations are left without jobs, the price of the fished species goes up, and the combination of the two leads to poaching (Castilla, 2001). There are different management options to tackle the issue of overfishing, including: establishing Marine Protected Areas (MPAs), seasonal closures, and gear restrictions, among others. Some degree of management redundancy, i.e. the enforcement of diverse overlapping tools, is a good option to foster integration of actions taken by authorities and fishers (Castilla, 2001).

Among all options, MPAs are a widely used solution. They can include zones with various degrees of protection, from no-take zones to buffer areas with little limitations. It seems that the simplest forms of MPAs, i.e. those exclusively made of no-take zones, give the best results (Himes, 2003). Their contribution to the conservation of marine resources has been proven (Russ et al., 2004). Two recent meta-analyses performed by Halpern (Halpern and Warner, 2002; Halpern, 2003) indicate MPAs are effective at protecting marine species. Halpern and Warner (2002) analyzed 112 separate studies, and Halpern (2003) analyzed 89 separate studies comparing no-take zones to unprotected areas; they concluded that within the no-take zones there are higher values of density, biomass, individual size, and diversity of the species.

A careful selection of the location is essential, as well as a clear statement of the objectives and cooperation of the community towards the implementation. Therefore we can argue that all forms of MPAs should not be managed in isolation, but, since they are affected by different factors, they should be planned within a larger scheme involving ecological, social and economical linkages (Cicin-Sain and Belfiore, 2006).

Establishing networks of MPAs seems the choice to be sought, because habitats in the sea are linked, for example by ocean currents and through mobility of migratory species. If MPAs are strategically planned as a system, the conservation effect will be greater than the sum of individual sites (Agardy, 2005). However, monitoring and evaluation of the effects within and outside the reserve are needed to understand the processes that affect the reserve (Lubchenco et al. 2003).

For MPAs to be successful, the decision making process should involve the participation of the wider public and local communities. Important goals can be met in sustainable use of fisheries from "participatory management in which local community stakeholders share resource management responsibilities with regional or national institutional bodies" (McCay and Finlayson 1995 in Warner, 1997). Involving people is not a straightforward and simple task: a careful study has to be carried out to assess who are the stakeholders, defined as whoever has some interest in the use of the resource, or whoever can be affected by its use (Renard, 2001).

The importance of the participation of local communities in conservation is now widely recognized as decisive for the success of any protected area (Badalamenti et al., 2000; Friedlander et al., 2003; Hilborn et al., 2004). Stakeholders and user groups have to be identified from the beginning, and they should all take part in the decision-making process, as well as in the management (Renard et al., 2001). Participation has to occur at various scales of management and decision making: the local level of individual resource users, the

community level, local government, state and national levels (Cicin-Sain and Belfiore, 2006; Colmenares et al., 2002). The degree and timing of participation by different sectors of society can determine the extent to which a MPA will be successful (Warner, 1997).

Participation occurs within the wider context of cultural history, societal structure, government-community relationships, and financial support (Himes, 2001). Fishers, administrators, conservationists, researchers should actively take part in the process: from the first analysis, to the definition of the goals, the design, the management, and the monitoring (Renard, 2001).

People's involvement is becoming substantial and they will become responsible for their fishing areas, gaining a stronger sense of ownership (Drew, 2005). A bottom-up approach, which includes the stakeholders, seems therefore necessary in order to be successful (Brown et al. 2001). Knowledge of the availability of the resource enables local communities (especially members of the community that do not practice commercial fishing) to plan to avoid overexploitation (Basurto, 2005).

However, a participatory process needs a preliminary educational phase. The involvement of different subjects, each with their own knowledge, should lead to information sharing, a very important process that should be facilitated and become part of the decision making process to establish regimes of conservation (Colmenares and Escobar, 2002). The application of Traditional and Local Ecological Knowledge (TEK/LEK) is very important: "the use of TEK in a conservation program is not about a one-time extraction of information. Instead, its use presents the opportunity for long-term collaboration and development of information" (Drew, 2005). Recognizing and relating to TEK/LEK is part of the advancement of shared knowledge. Scientists can have access to information which is generated through long-time observation and is site specific (Drew, 2005).

1.3 Potential in the Mesoamerican Reef region

Even though artisanal fisheries have contributed to overfishing (Pauly, 2005) they are not the only cause. In spite of this, fishers should understand that it is in their power to do something about it: they should be part of the solution (Bourillon, Carrasco, personal communication 2006). Fishers have to manage their resource in a sustainable way.

The positive results of community participation in the conservation of natural resources gives support to the idea that communities have to be actively involved in the management of natural resources. This can be done through the design and implementation by the communities of management plans: Community Management of Marine Resources (CMMR). These plans should be designed -using the tools described in section

4- to avoid overfishing and to conserve the marine environment. Some indications on the possibility for a community to be responsible for the management of an area will have to come from the analysis of the legal framework of each of the four countries of the MAR region (refer to the report commissioned by MAR Fund: "Community Management of Marine Resources in the Mesoamerican Reef Fund. Legal frameworks and legal status of the marine protected areas of Mexico, Belize and Honduras").

As a confirmation of this possibility, in the MAR Region some fishers have expressed the desire to manage their resources. For this to take place fishers need to understand the implications of accepting this responsibility (Gale, Garcia, Teni, personal communications, 2006). A way to achieve this is by recognizing the relevance of their knowledge. Because they spend a lot of time in the ecosystem, fishers have good knowledge and understanding of natural processes. Scientific knowledge and traditional knowledge are complementary (Warner, 1997). Fishers know about the life cycles of the fishes, e.g. where the spawning grounds are or when the reproduction takes place (fishers personal communications, 2006).

In talking to fishers, researchers, and conservationists I learned that fishers are very aware that the resources they depend on for their livelihoods have significantly decreased. They have started to realize that they must change some of their fishing techniques in favor of the use of more sustainable ones. They have also started to advocate for special measures to be put in place to address the matter of overfishing.

It seems that establishing CMMR in the MAR region is a viable option for the sustainable use and conservation of the marine resources. With reference to this objective I will analyze case studies, identify lessons learned from them, and make recommendations for the establishment of CMMR in the MAR region.

2 Method

In this report I will analyze six case studies of communities that are successfully managing their resources, describing how they have been able to establish areas to be managed by them. I will write about the contribution given by conservation organizations to the communities, which enabled them to manage their fisheries. I will describe which are the tools, programs, and projects that have been used to establish plans of community management. I will also review two manuals that have useful information for the design of a management plan. These eight sources have been chosen because of their relevance in indicating possible solutions to the issue of managing marine natural resources.

Information has been collected directly from the organizations that have aided the local communities in the process of establishing managing plans. I have looked at their web sites, read the materials published by them, and contacted directly the people in charge of the projects to interview them and gain insight of the projects.

Moreover, conservationists, researchers, fishers, intermediaries have participated in the research by sharing with me information and experiences. The people I have contacted were identified as key informants through peer recommendations. Field observations have given support and strength to my findings.

3 Case studies

3.1 Tortugas Reserve, Florida, USA

3.1.1 Description and analysis

In 1990, recognizing the threats to the marine environment, the US Congress voted to create the Florida Keys National Marine Sanctuary (FKNMS) to overcome degradation caused by overdevelopment, polluted water from sewage, boat damage to seagrasses, coral diseases, and coral reef destruction by ships. Within the boundaries of the FKNMS, an area was designated as Tortugas Reserve. The process to design its management plan began in 1997. The Tortugas 2000 Working Group was formed to define its boundaries and its regulation: it included government agencies, fishers, conservationists, and other people with interests in the area of the planned reserve. The participants were selected to represent all the organized groups with some interest in the region, only the shrimp trawlers refused to participate. The scope of work for the group was to identify and develop criteria to evaluate the possible alternatives for the design of the reserve. The process was long: five meetings were held over a one-year period. The Government paid and organized the meetings, but no funding was given to the participants.

The meetings were led by a professional facilitator to ensure impartiality. The facilitator promoted everybody's participation, and helped the group reach an agreement, by suggesting processes and procedures.

In the first meeting, held in April 1998, the benefits of reserves were identified. The goals of the reserve were stated as:

- Conserve biodiversity and habitats
- Promote fisheries sustainability

- Protect spawning areas
- Protect full life cycles
- Be of sufficient size
- Allow compatible activities
- Minimize socioeconomic impacts
- Facilitate monitoring
- Ensure enforcement/compliance

As part of this first activity an *Ecological Forum* was held to share knowledge and identify gaps in understanding of the region's ecology. It was held by a panel of scientist and citizens who presented research and local knowledge on currents, water quality, geology, seagrasses, lobsters, fish, seabirds and turtles.

In the second (June 1998), third (February 1999), and fourth (April 1999) meetings, each member of the *Working Group* provided input on the ideal reserve, criteria for the ranking of the issues were established, and boundary alternatives were drafted. As part of the second meeting a *Socioeconomic Forum* was organized to share knowledge and identify gaps regarding human use of the region. The analysis of the different options was done with the aid of Geographical Information System (GIS) software to make it easier to compare the different options, and understand the implications and benefits of each one.

The fifth meeting, in May 1999, was held to adopt the proposed reserve. A consensus agreement was reached on one of the design alternatives recommended by the Working Group. It embodied a reasonable compromise between conservationists and fishers, based on biodiversity and socioeconomic impacts. Everybody agreed on the fact that to achieve benefits the Tortugas Reserve must be a no-take zone.

As a result, 196 square nautical miles (67,226 ha) are now protected, representing a variety of habitats.

3.1.2 Problems encountered and solutions

The *Working group* was integrated by people with conflicting ideas about the use of the FKNMS. Potentially this could have led to an unfruitful process. However, having selected the participants carefully made it possible for the group to work: all the interests were represented. Another key aspect of success was defining the objectives at the beginning of the process. Everybody therefore was giving their contribution to achieve the stated goals.

In the end, the agreement reached satisfied both the conservationists and the fishers.

3.1.3 Lessons learned

1. The first step for the definition of the Tortugas Reserve was the selection of the people who should participate in the working group. Participation was sought and encouraged from the beginning. Developing trust among participants that had to make decisions was essential to involve them in design and management of the reserve. Through this process, consensus was achieved. It is very important that stakeholders are able to participate from the beginning.
2. Information and education played an important role: knowledge was shared and made available to everybody as a basis with which to give strength to the decision-making process. The best available natural and social scientific knowledge, as well as local and traditional knowledge should be utilized in participatory processes to design the MPA.
3. During the process for the establishment of the FKNMS, socio-economic structure and ecological processes were analyzed. The scale of the researches was broad, encompassing the whole wide region or ecosystem. This led to the identification of criteria, which were used to draw boundaries on maps. Identifying the broad scale processes is useful to define criteria for the design of the MPA: the scale of the analysis should be broad, and not limited to the area object of the study.

3.1.4 References for this section

<http://www.wwfus.org/wildplaces/sfla/results.cfm> (last accessed July 26th 2006)

<http://www.floridakeys.noaa.gov/> (last accessed August 9th 2006)

Powerpoint presentation made available by Buffy Turner (WWF)

Joanne Delaney and Fiona Wilmot (NOAA), personal communications 2006

3.2 Comunidad y Biodiversidad, Golfo de California, Mexico

3.2.1 Description and analysis

Comunidad y Biodiversidad (COBI), a Mexican Non-governmental Organization (NGO), was founded in March 1999 to promote Environmental Management in the Gulf of California through the involvement of the local communities. The interdisciplinary workforce of COBI has developed a methodology to achieve the objective of establishing Community Marine Reserves, also known as no-take zones, or areas where

no extraction is allowed. COBI places a big emphasis on educating the fishers on the usefulness of no-take zones.

COBI works with communities that have asked for their support. Since COBI thinks developing and strengthening community organization is essential for environmental management, their first intervention is to support fishers to formally and legally organize themselves in cooperatives.

In the first phase the fishers are invited to participate in a data collecting project, which can last up to three years, so that they will gain knowledge on the state of their resource. Data about size, sex, and juvenile to adult ratios are collected. This makes them aware about the processes that are taking place in their environment, and enables them to define the issues to be addressed to achieve a sustainable use of their resource. A Socio-economic monitoring study to determine the costs and the revenues from the fishing activities is also carried out. The knowledge gained by the fishers will enable them to be part of the reserve design and management processes.

After this first data-collecting phase a capacity building workshop is held to illustrate the reasons for the importance of Marine Reserves, the role of each species in the ecosystem, economic and ecologic values, methods for monitoring, map-making tools, and statistical analysis tools. This enables fishers to understand the effects their decisions have on the environment, and thus guide them in the decision making process for the management plan.

The second phase requires the use of decision-making software (Delphos) for a multiple criteria analysis, using both qualitative and quantitative data. Criteria and rankings of the issues -identified in the first phase- are defined in workshops, with the participation of all actors, including fishers, conservationists, and researchers. According to the defined ranking of the issues conservation and management priorities are defined. The result of the process provides an indication of which areas are to be selected as Marine Reserves. The whole process is highly participatory and the decisions are transparent. The implementation phase will follow. Since COBI works in partnership with communities the result of the process is the protection of areas, not whole regions.

COBI also aids the fisher communities to lessen the impact on fishing in two ways: exploring other forms of income, and using regulations to protect their resource against the exploitation of commercial big fleets.

COBI is also one of the promoters of the Mexican Marine Fishery Fellow Project. Research shows there is interest from local communities in receiving aid on responsible fisheries and resource management, and interest from University graduates to be trained in these fields. The

purpose of this project will be to train Fellows to provide technical assistance to small-scale fishers on fishery management and conservation, achieving both sustainability and economic wellbeing, and improving cooperatives and community organization.

3.2.2 Problems encountered and solutions

The first reaction of some of the fishers of the Gulf of California when confronted about no-take zones was of total refusal. Meetings were organized where scientists explained the reasons for no-take zones. However a big role was played by more experienced fishers, often the retired ones, and fishers of developing fisheries. Both of these groups have experience on areas that are not accessible due to technical limitations, such as the power of their boat engines or the lack of navigating charts. More importantly they are witnesses of the benefit that can be gained by setting areas aside. Thus they were able to help the scientists to explain the benefits of no-take zones. Moreover fishers generally know some areas are fragile, thus should not be exploited. This confirms that education exchange plays an important role.

In other instances, e.g. Bahía de Kino, results have not been as positive. COBI, together with the fishers, the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARP), the Comisión Nacional de Acuacultura y Pesca (CONAPESCA), the Centro Regional de Investigación Pesquera (CRIP), NGOs, and administrators of the manufacturing companies (which are usually the intermediaries), have tried to develop an informal treaty to regulate the "Jaiba verde" (*Callinectes bellicosus*) fishery among the involved parties. Lack of law enforcement by the authorities and market demand has not made it possible.

Intermediaries represent another problem. They provide boats (pangas), engines and traps (or nets) to fishers, in exchange for the exclusive right to buy all the landings. This gives them the power to set the price to their advantage. COBI is helping fishers organize themselves to be able to be legally recognized, and therefore to have access to funds to help them cover the costs of needed equipment (i.e. boats, engines, traps, refrigerators), and also to be able to access the market directly.

3.2.3 Community needs for the conservation of marine resources

Communities lack funds to invest in the improvement or start-up of their activity. They therefore become dependent on intermediaries who provide funding for these needs, and become indebted with them. The fishers have to fish everyday to pay back their debt, and are thus more subject to market demand than to environmental considerations for sustainable management.

The *Tragedy of the Commons* (Hardin, 1968) also plays an important part. Due to lack of enforcement, fishers tend to over-fish with the justification that somebody else will fish anyway, leaving them with no fishes and no money. Fishers would like to see the authorities assuming their role and enforcing the law.

COBI's proposal to solve these issues has been the establishment of the Fondo Pescador (Fisher Fund). The Fondo Pescador's objectives are to encourage community organization, to provide technical, financial, and legal assistance to its partners, to support the decision making process with scientific knowledge, to encourage exchange of experiences and information among the fishers, and to provide access to funding for certification of fisheries and ecotourism. The available tools are described below.

Trough the Fondo Pescador two types of certification are made available: fishery with the Marine Stewardship Council (MSC), and ecotourism with Greenglobe 21. These are economic and social incentives for conservation based on the experience that market pressure can aid environmental conservation. The MSC certifies the lobster fishery of nine cooperatives in the Biosphere Reserve of Vizcaíno, but there is not yet a market for certified lobsters. However this is a political advance for the fishers as they represent themselves as responsible fishers.

The firm Kuyimá receives this ecotourism certification by Greenglobe 21. They are located in the Biosphere Reserve of Vizcaíno. They offer excursions varying from whale watching to sight-seeing of cave paintings.

The interdisciplinary project "Pesquerías de pequeña escala en el Alto Golfo de California: construyendo puentes entre los procesos humanos y biofísicos" (PANGAS) was established to foster management and research to support local fisheries with an ecosystem-based approach. Its partners are: University of Arizona, Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), University of California, Santa Cruz, University of Arizona, Centro Intercultural de Estudios de Desiertos y Océanos (CEDO). PANGAS focus is on investigating how people and environment interact, and on how this affects the coastal and marine ecosystems.

In March 2003 COBI organized the forum "Pescador a pescador" (fisher to fisher) to enable fishers from other parts of Mexico, and from other countries, to exchange their experiences on success and failure of Marine Reserves and Marine Protected Areas as a tool for fishery management. Fishers were first given talks about the objective of establishing a Marine Reserve. Then they were guided through a process to define their problems and how the establishment of the Marine Reserve helped solve them.

Due to the success of this first meeting, a second one was organized in March 2006, to discuss the issue of the responsibility of fishers in sustainable fisheries.

3.2.4 Lessons learned

1. In COBI's experience Community Marine Reserves are a useful tool for fishery management and conservation. Although no-take zones alone cannot solve the problem of fisheries decline -because of other relevant issues, such as that of intermediaries- there is evidence in the published literature that they contribute to conservation.
2. COBI established partnerships with fishers who want to manage their fisheries. Thus the establishment of Community Marine Reserves followed a bottom-up approach, i.e. all the stakeholders were involved in the design and management. Communication and exchange of information were fundamental to facilitate the active participation of all.
3. Enforcement and control by authorities have been necessary and fishers want to be supported by them.
4. The access to funding mechanisms through the Fondo Pescador has been the tool used to enable fishers to fulfil their needs. In this way the fishers did not need the intermediaries' financial support, thus intermediaries have been avoided, the fishers were able to choose who to sell the fish to, and therefore get better prices for their catch.

3.2.5 References for this section

- Saenz-Arroyo, A., J. Torre, L. Bourillon, and M. Kleiberg. 2005. A community-based marine reserve network in North-western Mexico. 2005 in Proceedings of the Symposium and Workshop of the North American Marine Protected Areas Network. Loreto, Baja California Sur, México. March 1 - 3. North American Commission for Environmental Cooperation. 19 pp.
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- <http://www.cobi.org.mx/> (last accessed July 27th 2006)
- <http://pangas.arizona.edu/> (last accessed July 27th 2006)
- http://www.msc.org/html/content_1102.htm (last accessed August 10th 2006)

<http://www.kuyima.com/kuyima.html> (last accessed August 10th 2006)

<http://www.pescadorapescador.net/> (last accessed August 10th 2006)

Luis Bourillon, Cesar Moreno, and Andrea Saenz (COBI) personal communication 2006

Fishers and patrones of Bahía de Kino, Sonora, Mexico, personal communications 2006

3.3 Punta Allen, Quintana Roo, Mexico

3.3.1 Description and analysis

The Vigía Chico Cooperative was established in 1968 by 49 members. The community that grew around the cooperative founded a village known as Punta Allen in 1970. In the past 30 years the main activity of the community has been lobster fishing, and now the tourism sector is growing fast. The first tourism cooperative was founded in 1994, now there are four.

The fisher members of the Vigía Chico Cooperative have developed their own rules. They have divided Ascension Bay into private parcels, or campos. Each campo is registered to a fisher, who has the right of access to the *casitas* that s/he has put on them. Casitas are artificial habitats in which the lobster finds refuge, and are thus collected from them. Bylaws made by the cooperative members regulate the campo. Today there are 76 fishers and only 51 own campos (dueños). The others are helpers (chalanes).

The members of the Vigía Chico Cooperative do not fish in the waters of the deep reef (40 m), where the lobster reproduces. According to the cooperative regulations lobster tails smaller than 13.5 cm and females with eggs must be left in the sea. All the fishers bring the lobster tails in the Reception Center for storage, where the buyers collect them. In the Reception Center the lobster landings are measured (length and weight) and counted. The live lobsters are picked up by the buyers directly at the dock. If a fisher does not comply to the cooperative regulations s/he can be expelled from the cooperative. Open season is from July 1st to February 28th.

When lobster fishing is in seasonal closure, the fishers target finfish or are employed in the tourism sector. Finfish are fished through the year for personal consumption or are sold to restaurants.

It is believed that because of the fishing techniques employed by the cooperative, the fisheries in the Ascension Bay have limited impact on the resources, but further studies are required for a definitive assessment. However in other areas of Mexico, where the campos system

has failed, fishers have used other fishing techniques and the unregulated use of the resource has led to depletion.

The buyer is selected by the Vigía Chico Cooperative each year in a meeting that takes place one month before the opening of the season, based on the best price offer. During the season, if another buyer offers a better price, the original buyer is changed.

Support has been granted to the cooperative by several national and international NGOs and research institutions to develop their projects.

3.3.2 Problems encountered and solutions

The Vigía Chico Cooperative had some problems due to frauds committed by cooperative officers. The members who were found guilty of breaking the rules were voted out and therefore lost their campos. New fishers were able to join the cooperative and have campos assigned.

Hurricanes, such as Gilbert in 1988, have a negative effect on the lobster fishery, by destroying the casitas and changing the bottom conditions. New areas were taken into consideration but with little success. The availability of another sector, tourism, seems like a better option. Tourism also represents an alternative during closed seasons of the lobster fishery.

3.3.3 Lessons learned

1. Strong consensus on the rules set by the members of the cooperative was achieved. All the members have respected them making the project successful.
2. Good market prices have been essential for the success of the project, but also an alternative sector of employment to sustain the economy during closed fishing seasons.
3. Fishers' respect of the division of the sea floor in campos was the core of the project. Rights of access regulated by officials of the cooperative are the way to achieve this.

3.3.4 References for this section

Solares-Leal I., O. Alvarez-Gil. 2003. Socioeconomic assessment of Punta Allen: a tool for the management of a coastal community. Sian Ka'an Biosphere Reserve, Mexico. UNEP/ICRAN-CONANP/SKBR. 102 pp.

3.4 Comitato Internazionale per lo Sviluppo dei Popoli, Guatemala-Italia

3.4.1 Description and analysis

As a consequence of the results of a preliminary diagnostic analysis of the fisheries of the Gulf of Honduras (GOH), Comitato Internazionale per lo Sviluppo dei Popoli (CISP) developed a project to manage the fisheries in the region. The project was developed in three phases: organizational capacity building, technical capacity building, and creation of the "Centro de servicios para la pesca artesanal en el Golfo de Honduras" (CESPAGOH). The project was made possible by European Union and Japanese funds.

Each group of fishers was involved in an activity tailored to their knowledge needs to learn about the importance of organization. The appointment of new leaders was encouraged. The fishers also lack knowledge on natural resources management, economics, and environmental law. This knowledge is needed to increase their awareness and enable them to manage their natural resources, knowledge is not the only tool they lack; often the groups basic needs -such as a fully equipped office- have not been met.

The fishers in the Bahía de Amatique in 1996 were aided in the establishment of a gentlemen's agreement, known as "Pacto de Caballeros" (Gentlemen's agreement), after incidents had happened between the different groups, upon regulating the use of the bay. As a result the bay was divided into three sections. Each group, comprised of fishers that share the same fishing technique, is allowed only to fish in one section at a time. A rotation of the allowed areas takes place weekly on Sunday. The agreement has now become part of the Guatemalan Caribbean fishing law (Reglamento de la Ley General de Pesca y Acuicultura, Acuerdo Gubernativo No. 223-2005).

Based on the pre-existing voluntary agreement on access to fishing grounds (i.e. Pacto de Caballeros) a further step was taken to create a higher level structure to unite the fishers. CISP facilitated the foundation of the "Red de Pescadores artesanales del Caribe guatemalteco y Lago de Izabal" (Network of artisanal fishers of the Guatemalan Caribbean and Lake of Izabal), and provided advice for its legalization. The Network was established drawing on common needs of the fishers on the 2nd of February 2004. It is integrated by 16 communities, and coordinates their fishing efforts. Its objectives are to find solutions to shared problems, to conserve and exploit fisheries, and to encourage communication among fishing organization. The fishers of the Network have contacted other fishing communities (e.g. Punta Allen, Pacific coast of Guatemala, Honduras) to exchange information.

CISP organized two courses. One was on fishing techniques and was held in Cuba. The other on engine maintenance, was organized with the

support of Yamaha, the most common brand of engine used by these fishers. Only one member from each group participated, the groups were in charge of the selection of the group representative.

As a result of the consultations with the local fishers, the necessity of a centre for the processing of fish (centro de acopio) was identified. The principal objective for the foundation of the CESPAGOH was to increase quality of the fishing activity and promote the conservation effort. The fishers claim 15% losses of their landings, and processing the fish would avoid it. With the opportunity of directly selling the landings -given by the center- the intermediaries will be avoided and the price per unit of catch will increase, and thus the pressure on the resource will be reduced.

This center would also enable the fishers to have direct access to the market, avoiding intermediaries, who in this area act as a cartel and impose low prices. CISP promoted a feasibility economic study to validate this idea and to define the optimal location. A land that belongs to the "Cooperativa agrícola integral y de pesca Rio Dulce R.L." in Livingston was selected. The centre was designed taking into consideration the economic study, with the participation of the fishers, and according to the Guatemalan laws. A society to administer the center was formed.

3.4.2 Problems encountered and solutions

The consultation processes among the different groups were at times very slow; sometimes it is not easy to reach agreements. When the success of the operation was at stake CISP was forced to intervene and take the responsibility of deciding on some of the issues independently from the fishers.

3.4.3 Lessons learned

1. Formation of the "Pacto de Caballeros" is a successful strategy that should be taken as a model. Establishing territorial use rights (TURF) exclusive to a defined group of fishers, facilitates the respect of the rules, and avoids incidents. For the respect of such pacts it is essential that all fishers in one region subscribe to the "Pacto". In the cited example of Bahía de Amatique in Guatemala only the fishers members of the Network respected it, the others did not.
2. The fishers have demonstrated to have a good knowledge of their resource and some ideas on how to manage them. However CISP has organized workshops to increase their knowledge on administration and in management of the natural resources, which the fishers were lacking. Capacity building efforts should be directed to sustain

the fishers in these issues. Fishers also need to learn more about environmental laws.

3. The foundation of the Network was sustained by CISP to find shared solutions to common problems. The success of this example has the value of demonstrating the willingness of the fishers to cooperate with one another.

3.4.4 References for this section

Julian Arana, Blanca Rosa Garcia, Hugo Hidalgo, Julio Lee, Angelica Mendez, Justo Rodríguez, Melvin Teni, personal communication 2006

Material published by CISP: brochure of course on fishing techniques, brochure of course on engine maintenance, posters about the Gulf of Honduras and the Trinational Alliance for its conservation, poster of the first monitoring program in the Gulf of Honduras for manatees, poster on species of commercial fisheries in the Guatemalan Caribbean.

3.5 CoopeTárcoles, Costa Rica

3.5.1 Description and analysis

CoopeTárcoles was founded in 1986 in Tárcoles, Puntarenas, Costa Rica. Its members are fishers that want to achieve responsible fishing and comply with social and environmental responsibilities. In their statute they declare they want to "promote the search for forms of sustainable management of natural and cultural resources".

Cooperativa Autogestionaria de Servicios Profesionales para la Solidaridad Social (Coope SoliDar) is formed by an interdisciplinary group of people with a focus on development and conservation of local communities. Their objectives include facilitating decision making processes, management planning of protected areas, environmental education, and publication of readings on environmental issues.

Together Coope SoLiDaR and CoopeTárcoles developed a code of conduct for the fishing members of CoopeTárcoles. It is an adaptation of a document published by FAO, the "Code of Conduct for Responsible Fisheries". Together they have also organized other activities to increase the awareness of the fishers on this issue.

CoopeSolidar facilitated the process of combining scientific with local knowledge. The result was published in a leaflet, where the most common species fished in the area are described.

Together they also worked on a brochure to provide information about the recently approved fishing law in Costa Rica (Ley de Pesca y Acuicultura #8436, 10 de febrero 2005) that regulates fisheries and

aquaculture. In the brochure the law is described taking into consideration the wider framework of national governing bodies, and international treaties. The law is analyzed with the goal of helping the fishers understand the benefits they will gain from its enforcement. Definitions of the recurring themes in environmental management, such as the concept of sustainability, are also explained.

3.5.2 Problems encountered and solutions

Fishers of the cooperative are very aware of limits in the use of natural resources, but not all of them act responsibly: they do not respect the indications for responsible fishing. However values and respect are key issues that can facilitate the process that will increase fishers' awareness of problems, such as overfishing.

Sometimes lack of information inhibits a proper use of the resource. The alliance between CoopeTárcoles and Coope SoliDar promoted acquisition on knowledge and information sharing.

3.5.3 Lessons learned

1. Organization is the most important element. Fishers that share problems have solved them by working together in an organized form. If the fishers are not already organized, the process to achieve this should be facilitated.
2. Information on environment and on laws has been necessary to help the fishers understand the importance of complying with the laws. Information should be made available to fishers and the understanding of it by them should be evaluated.

3.5.4 References for this section

<http://www.coopesolidar.org/> (last accessed July 27th 2006)

Material published by CoopeTárcoles and Coope SoliDar: brochure "Codigo de conducta para la pesca responsable"; brochure "Lo que pescamos en Tárcoles", brochure "La ley de pesca y acuicultura".

Vivienne Solis (Coope Solidar), personal communication 2006

3.6 Locally-Managed Marine Areas Network, Southeast Pacific

3.6.1 Description and analysis

The Locally-managed Marine Areas (LMMA) Network was established in October 2000 to collect and connect different examples of conservation projects related to community management marine areas around the world. Community members, conservationists and researchers exchange their

experiences to evaluate the contribution given by Locally-managed Marine Areas to conservation. The LMMA Network is present in Fiji, Indonesia, Palau, Papua New Guinea, Philippines, Federated States of Micronesia, and Solomon Islands.

An LMMA is defined as "an area of nearshore waters actively being managed by local communities or resource-owning groups, or being collaboratively managed by resident communities with local government and/or partner organizations" (<http://www.lmmanetwork.org/>, 2006).

The partners of the LMMA are convinced that project design, management and monitoring are part of one iterative process called *Adaptive Management*, used to continually test assumptions, learn and adapt the plan. At the beginning, a clear common purpose for the community management of the marine area should be established. According to the set goals, a management and a monitoring plan are developed and implemented. The information and data collected in the continuous monitoring is used to learn more about the environment and to understand the effects of the management plan on the marine resources. According to the data collected the management plan of the LMMA will be adapted on a constant basis.

3.6.2 Problems encountered and solutions

The fishing communities involved in this project are very different one from the other, because they belong to different cultures, therefore the tools utilized and their role varies. Different management tools are available to manage an LMMA: a Marine Protected Area (with increasing degree of protection, up to a core no-take zone); species-specific harvest refugia; restrictions on gear, effort or behavior; restrictions on season.

In a personal communication with Manuel Mejia, director of the LMMA Network of the South Pacific, he stated that some of the fishing communities they work with have customary and traditional property rights over their fishing grounds, called *qoliqolis*. This happens mostly in Fiji and in the other Melanesian countries (Papua New Guinea, eastern Indonesia, and Solomon Islands). In the other Southeast Asian sites communities do not have traditional property rights, this makes management and especially enforcement of protected areas more challenging.

Some communities at first do not agree with the idea of managing their fishing areas, due to market pressure, because they fear they will lose money. This can be overcome by utilizing peer pressure. If a few key people, i.e. leaders, of the communities understand the importance of the LMMA, the rest will follow. Therefore strong leadership is essential for the success of the LMMA management plan.

Last but not least, communities often lack the most basic facilities and instruments. They would greatly benefit from having the availability of an on site office with equipment, such as computer, GPS, and navigation charts. These tools would enable them to organize their work, to have access to information, and to fish in a way which would be safer both for the fishers and for the environment.

3.6.3 Lessons learned

1. The successful examples of LMMA are those where the local community, the conservationists, and all the other stakeholders, such as researchers and donors, strongly supported the LMMA, clearly stating from the beginning the benefits from the implementation of the plan. Commitment of all the stakeholders is therefore essential for the success of the LMMA.
2. The process of establishing LMMA started as an initiative of the resource 'owners' and has been carried out with the participation and the consensus of the whole community, both genders were involved. The needs of the community were respected. The rules were clear, thus understood by everybody. The bottom-up approach, when establishing a LMMA, is the best option.
3. Authorities, when enforcing the rules, have given an essential contribution to the success of the management plan. They have also organized educational activities to explain the rules to the people, and how the community will benefit from them. Authority support should be sought, it is very important for the fishers to feel backed. The authorities should play an active role in informing the fishers on the laws.
4. The involvement of the local community has been sought in a variety of ways. Environmental education programs in schools were organized, traditional stories were revived. Legends have helped foster a sense of stewardship towards the environment. Formal environmental education programs in schools could be implemented by the communities, to revive their traditions and help in the conservation of the environment.
5. Both traditional and scientific knowledge have been proven useful for management and conservation purposes. Therefore they should not be seen as opposed knowledge, but should be integrated in the process of acquiring knowledge.
6. Local people have been trained in monitoring, data analysis, and interpretation by researchers and conservationists. Knowledge of the processes increased their awareness, and enhanced their stewardship. Workshops for the communities to teach them monitoring techniques and data analysis should be organized by researchers and conservationists.

7. Communities have learned from one another about the benefits of LMMA. Interchange of experiences should be promoted.
8. Permanently closed areas, also known as no-take zones, have been the most effective tool for the conservation of the marine resources. They have two advantages, both very important. The first is that they seem to be the most useful tool for conservation. The second is that for the fishers it is better to have simple rules: it is easier to understand them, thus to comply with them. Information should be made available to the fishers on the effectiveness of no-take zones.

3.6.4 References for this section

Parks, John E. and Nick Salafsky, editors. 2001. *Fish For the Future? A Collaborative Test of Locally-Managed Marine Areas as a Biodiversity Conservation and Fisheries Management Tool in the Indo-Pacific Region: Report on the Initiation of a Learning Portfolio*. The World Resources Institute. Washington DC, USA. 82 pages.

The Locally-Managed Marine Area (LMMA) Network. 2005. Improving the practice of marine conservation, 2005 Annual Report: A Focus on Lesson Learned. 46 pp.

<http://www.lmmanetwork.org/> (last accessed July 27th 2006)

Manuel Mejia (LMMA Network), personal communication 2006

3.7 Partnership for Interdisciplinary Studies on Coastal Oceans, West Coast, USA

3.7.1 Description and analysis

The Partnership for Interdisciplinary Studies on Coastal Oceans (PISCO) is an investigation consortium integrated by scientists from four US West Coast Universities: Oregon State University, Stanford University, University of California at Santa Barbara, and University of California at Santa Cruz. One of PISCO's major activities, besides research, is to provide accurate scientific information to policy makers, resource managers, and the public. In 2002 they published a manual on criteria for the design of Marine Reserves.

The focus of the manual published by PISCO is on MPAs, not on community management of marine resources, as the other case studies presented in this report. However some useful lessons can be learned from it, thus the choice of its inclusion in this report.

According to the publication, considerations for reserve design should meet both environmental requirements of the considered species and socio-economic needs of the local communities.

The biology, ecology and life stages of the species should be investigated in order to effectively protect them. The physical and chemical aspects (e.g. salinity or upwelling) should not be ignored, as they are essential to sustain life. A system of linked, moderate-sized reserve seems to be the best tool for the conservation of marine resources. Small reserves are not effective from a conservation standpoint, while big reserves do not leave much ground for fishers. The areas should be linked by larval dispersal or juvenile/adult migration to constitute a network.

From the socio-economic stand point, ecosystem services should not be ignored. Various groups of people should be involved in the process of definition of the reserve: community members, resource managers, government agencies, natural and social scientists, commercial and recreational fishers, and environmentalist. The personal knowledge of each is an added value. The necessities of the local community must be respected: the effect of the establishment of the Marine Reserve on their livelihood should be assessed.

However Marine Reserves alone cannot solve the problem of overfishing and habitat degradation, other types of management are also necessary: fishing quotas, seasons, and gear restriction.

3.7.2 References for this section

Partnership for Interdisciplinary Studies of Coastal Oceans. 2002. The Science of Marine Reserves. <http://www.piscoweb.org>. 22 pages.

<http://www.piscoweb.org/> (last accessed July 26th 2006)

3.8 MBRS Project, Central America

3.8.1 Description and analysis

The Mesoamerican Barrier Reef Project (MBRS) was established in 1997 with several goals; some of them are to promote the conservation of coastal and marine habitats, and to support the sustainable extraction of marine resources by fishing communities. As part of the MBRS Project activities, a training workshop on co-management techniques for marine resources was organized. The starting point was to recognize that fishers are already managing their resources, whether sustainably or not.

The focus of the workshop and manual published by MBRS Project is techniques for fisheries co-management. However because of the useful lessons that can be learned from it for community management of marine resources, it has been included in this study.

In the training workshop co-management case studies were analyzed and the usefulness of co-management was presented. The participants took part in formulating a hypothetical co-management plan.

According to the MBRS Manual, a co-management plan consists of three phases: a pre-implementation phase, an implementation phase, and a post-implementation phase. In the pre-implementation phase the problems are recognized and a plan to solve them is designed. Negotiation, consensus building, and development of an agreement are to be carried out. Fishers may seek the help of outside professionals to be guided in the design process. Conflict management techniques and facilitators are used to solve problems.

The implementation phase is focused on management and conservation. Both communities and institutions play an important role. Education, leadership, conflict management, and community organization are part of this phase.

In the last phase, post-implementation, an evaluation of the project is carried out, resulting in feedback and adjustment of the initial project.

3.8.2 Lessons learned

1. The fishers who participated in the workshop were generally satisfied about what they learned. They thought that learning about co-management, the need for it, and what can be achieved by it was useful. Workshops are a good tool for capacity building.
2. Fishers have appreciated the possibility of sharing their experience and learning from case studies presented by other fishers. The process of establishing contacts among fishers to exchange information and experience should be facilitated to enable the fishers to acquire knowledge of the tools to achieve marine resource conservation.
3. The fishers understood the need for organization. Workshops can be important to give them tools to achieve organization. Information can be presented on how to get organized and on which forms of organizations are possible. Moreover exchange of experiences between fishers can guide them in the process of achieving organization.

3.8.3 References for this section

Training course manual. Training in techniques for fisheries co-management in the MBRS region. 2003. 44 pp.

<http://www.mbrs.org.bz/> (last accessed July 28th 2006)

Alejandro Arrivillaga (MBRS/TNC), personal communication 2006

4 Principles from case studies

Based on the description and analysis of the case studies above, I will now identify social, economic, and environmental conditions and characteristics required for success in the establishment of Community Management of Marine Resources (CMMR) in the MAR Region. These lessons learned from the case studies ideally should be applied by the communities to manage their marine natural resources.

Below is a list of principles, which should be used as guiding criteria when designing and implementing Community Management of Marine Resources (CMMR).

4.1 Social analysis

1. Fishers want to be responsible for managing their resource.
2. Fishing organizations have the power to define and enforce rules for conservation and sustainable use of their fisheries.
3. Selecting the stakeholder groups should be the first goal of an organization that wishes to promote conservation and sustainable use of fisheries, as is the case of MAR Fund. The part who is promoting conservation should define eligibility criteria for participation.
4. Participation needs to be promoted and facilitated. Small-scale artisanal fishers should take active part in the process to establish conservation and sustainable use of fisheries from the first phases.
5. A commitment among the stakeholders who take part in the process of conservation and management, e.g. researchers and fishers, should be established from the beginning, defining what benefit each will gain.
6. Fishing communities should be organized into a legally registered structure to be able to obtain several benefits, such as to claim responsibility for the management of their fishing area, to have access to funding, and to have access to information.
7. Capacity building workshops are needed to educate fishers on marine ecology, organization of the fishing community, management of the natural marine resources, and technical skills for fishing.
8. Vertical and horizontal interchange of information, such as among fishers, conservationists, and researchers, should be encouraged by an organization that wishes to promote environmental conservation and fisheries management, such as MAR Fund.
9. Traditional and local environmental knowledge are to be taken in consideration.

10. Programs to teach traditional and local ecological knowledge, as well as scientific knowledge in schools have helped to foster the sense of stewardship in the community.
11. Territorial use rights in fisheries (TURFs) have enhanced the possibility of community management of fishing resources.
12. Establishing TURFs can be the first step towards the establishment of Community Marine Reserve.
13. The authorities should enforce national and international laws. They have to support the fishers and inform them about what is allowed and what is not allowed according to the law.
14. When designing a management plan, the needs of each fishing community have to be taken into account; the effect of the ruling on their livelihoods should be assessed in order to avoid their impoverishment.

4.2 Economic analysis

1. Economic alternatives are useful to diminish pressure on fisheries. If fishers have alternative incomes they might fish less.
2. Economic alternatives are relevant if the fishing season is not year-long.
3. Projects that would enable the communities to process the fish have to be encouraged, in order to add value to the activity. A processing center would enable the fishers to access the market directly, and thus obtain a better price for the landings.
4. If fishers have the possibility of earning a better price per unit of catch, they may fish less. Although this represents a good way to diminish pressure on fishing, it does not always have the same outcome: some fishers might be attracted by the possibility of bigger earnings and the catches would increase.
5. Intermediation in marketing practices should be avoided by enabling the fishers to access the market directly, i.e. through the establishment of a processing center.
6. Financial resources are needed for the implementation of a management plan. This should include every aspect, from the most basic office supplies, to the fishing equipment, and monitoring programs.

4.3 Ecologic analysis

1. The choice of fishing techniques should be guided by principles of reducing the damage to the environment, i.e. reducing by-catch.

2. The objectives and the time needed to achieve the results of a community management plan should be clearly stated, and communicated in a comprehensible way. Since each process happens in a specific time frame, and over a definable space, the relevant temporal and spatial scales must be indicated.
3. Never underestimate the importance of local knowledge! An outsider -a researcher- can contribute knowledge, but rarely will have more information about the ecology of a specific site, than fishers who have a history of being there (Arana, Carrasco, Hidalgo, personal communications 2006).

5 Recommended methodology for the development of Community Management of Marine Resources (CMMR) in the MAR

MAR Fund's mission is to conserve the resources and natural processes in the MAR region for the benefit of present and future generations through the management of natural resources, technical and financial support for priority areas and issues such as water quality, sustainable tourism, sustainable fisheries and institutional strengthening. One of the ways MAR Fund is operating to achieve its mission, is through exploring the possibility of the establishment of a program for CMMR. The priority, as evident from the experience of the LMMA Network of the southeastern Pacific, is for local communities to establish plans for sustainable use and management of their fisheries.

In this section I will present what I regard as the recommended steps MAR Fund may take to reach the objective described above.

MAR Fund should initially encourage fishing communities to develop projects with a very high probability of success. The fishers will be more easily convinced on the usefulness of the management plan if they see the anticipated results in a short period of time. Also their experience can be used by MAR Fund as an example to obtain the participation of other fishers in the future.

5.1 Selection of communities

MAR Fund may select fishing communities according to the different criteria listed below. However, if fishers do not possess the listed requirements, they might acquire them with the participation in workshops, as described later on.

- **COMMUNITIES THAT ARE ORGANIZED.** The first requirement is for the fishers to possess some form of legally established organization. We have seen how when the community, through its organization, sets the rules, the fishers are more willing to comply with them.

- COMMUNITIES THAT WANT TO MANAGE AND BE RESPONSIBLE FOR MANAGEMENT OF MARINE RESOURCES. The fishing communities that show interest for managing their resource as well as protecting the environment should be preferred.
- COMMUNITIES WHERE VIGILANCE EXISTS. We have seen that fishers cannot be left alone; they need to be supported by authorities so other fishers do not take advantage of the situation.

5.2 Education and capacity building

If MAR Fund wishes to develop a program for CMMR, one of the first steps will be to develop specific education and training workshops to give fishers the further knowledge needed for fisheries management and natural resources conservation.

Fishers who are interested in more training should respond to MAR Fund's specific invitation and participate in workshops.

With this goal, MAR Fund's first step would be to define the focus and the objective of the education experience needed, because fishers have generally already taken part in several workshops and have traditional knowledge of marine ecology. The fishers should be motivated to participate in a series of workshops with a clear goal: the design, implementation, and monitoring of their management plan for sustainable fishery and conservation of marine resources. Capacity building and training activities must be part of the process of natural resources management (Renard, 2001).

Parallel to the workshops, fora should be held to give fishers the possibility to exchange their experiences. Successful case studies should be presented, such as COBI's projects, Punta Allen, CESPAGOH, CopeTárcoles, and others.

Recommendations on initial content of the workshops include:

1. Management workshop: methods for management plans, natural resource management
2. Ecology workshop: ecology of coral reefs; methods for ecologic data collection, analysis, and monitoring
3. Technical workshops: fishing techniques, engine maintenance
4. Monitoring techniques and theory of their importance
5. Social studies workshop: social structure, types of organization, conflict resolution; methods for social data collection, analysis, and monitoring.

6. Economic studies workshop: economic opportunities, alternative income possibilities, needs of the community; methods for economic data collection, analysis, and monitoring.

Contribution to the organization of the workshops and fora can be provided by some of the organizations whose work has been described in previous paragraphs. For example:

1. COBI could provide training about ecologic processes and the importance of management, explaining the usefulness of no-take zones. COBI could also teach how to use the software Delphos it has been developing, which is a tool for the decision making process to design the management plan.
2. CISP could provide training to strengthen community organization. They could also be involved in the organization of technical courses, such as the technical course for artisanal fishers held in Cuba in 2005. The participants to this course learned about possible fishing techniques in relation to each fishery; construction of different types of nets and traps; navigation and security at sea; emergency procedures; fishery administration; maximum yield and state of the fishing resource.
3. The people who led MBRS Project could share the experience of the training course held in 2003, which is illustrated in a manual. With the experience gained from it in participative decision-making, they could give indications on how to guide the process of CMMR. If the people who organized the workshop are not available to share their experience, the manual could be used as a guide to replicate the experience.
4. Thoughts should be given by the fishing organization whether to become part of the LMMA Network, to share experiences with the other members and learn from their experience. Different levels of memberships are available. The fishing organizations involved in the management of local areas could become full members, by complying with a set of criteria, such as practicing adaptive management and developing a community-based management and monitoring plan.

5.3 Data collection, monitoring, and analysis

To promote the process of the establishment of CMMR, MAR Fund could make funds available to fishing communities for data collection, monitoring and analysis. Being the owners of the data will give the fishers power and awareness of the problems.

The fishing communities should participate in the data collection, monitoring and analysis to understand the processes that are taking place in their environment. In this way fishers will be able to

identify the causes of their problems -environmental, social and economic- and will be able to propose solutions. New data should be collected in the field, but also published and previously collected data should be used for the preliminary analysis needed for the design of the management plan.

Data should be collected to describe ecologic processes and fish landings. However, these data sets are not the only important ones, it is essential to understand the social and economic structure of the communities. The socio-economic study should describe the community - e.g. demographic, services presents, sector of occupation- identifying issues such as how many members of the community rely only on fishing, specifically on what fishery, and what other income possibilities are present. The scope of this sector of research would be to understand the needs of the communities and its problems, to gain awareness and be able to propose solutions to better their livelihoods, and avoid negative impacts of the CMMR.

Data should be collected before the implementation of the management plan, to be able to evaluate the effectiveness of the plan, and eventually modify it if necessary. A before-after control-impact (BACI) analysis should be done (Halpern, 2003). Plots should be established and sampled for density, biomass, individual size, and diversity of the species before the establishment of the management plan, within and outside the boundaries of the managed area. The plots should be periodically checked after the implementation of the plan, and the data sets collected before confronted with the data sets collected after.

Different methodologies are available for monitoring. For the social and economic monitoring the Escuela Agrícola Panamericana Zamorano is adapting the "SocMon" methodology, elaborated by NOAA, to the region (Bunce et al., 2000). In the "Socioeconomic Manual for Coral Reef Management" the authors describe all the steps needed to guide the process of monitoring, from the selection of the working group to the definition of the parameters needed to describe the community. However the manual should be read more as a set of guidelines rather than strict rules to follow.

5.4 Identification of management minimum content for the establishment of Community Management of Marine Resources (CMMR).

5.4.1 Characterization of the fishing community

The fishing organization who is presenting the plan should describe the activity of its members, providing detailed information such as number of members and role of each, type of boat used and engine power, species fished, fishing techniques, and landings. The fishers should

also present a map to define the boundaries of the area they would manage.

Reference should be made to the legal framework of their country to justify the possibility of the implementation of the management plan.

If the community is not organized, a scheme of the proposed legal organization form chosen by the fishers should be presented, with the detail of the resources needed.

5.4.2 Social, Economic, and Ecologic Analysis

The fishing organization should present an analysis of the social, economic and ecologic conditions of their community and their fishing grounds. The focus should be on the definition of the needs and problems encountered. A before-after control-impact (BACI) type of analysis should be carried out to assess the initial conditions and effect of the management plan. (See also section on "5.3 Data collection, monitoring, and analysis").

An evaluation of possible economic alternatives to diminish the pressure on the marine resources they extract is recommended. Considerations should be made about the length of the fishing seasons and about how the market value of each species varies during the year.

Anecdotal evidence on the reduction of fisheries should be gathered with the help of old fishers, stressing the relationship between fishing techniques and increased catch per unit effort (CPUE) to fisheries decline. An interchange of information among the fishers of the community on this relationship should be facilitated, leading to an increase in awareness of the cause of the decrease of the resource (Bourillon, Carrasco, personal communication 2006).

5.4.3 Management tools

The tools proposed for management should be described, demonstrating their contribution to the objectives of the plan. The expected results should be clearly stated, as well as how much time is needed to achieve them.

A zoning of the area to be managed should be identified in maps, defining the different areas and the uses allowed in each one.

Having stated the importance of establishing networks of protected areas, a map with the larger regional context and the relationships of the area with existing MPAs, or other areas under management should be provided.

A variety of conservation tools and mechanisms can be applied. Below is a list with the most used tools. It is possible to use each one individually or a combination of two or more.

- NO-TAKE ZONES are the most rigorous: no extraction of any resource is allowed in a delimited area. In various articles published it is stated that they are the best tool for conservation (PISCO 2002; Halpern and Warner, 2002; Halpern, 2003; Lubchenco, 2003; Himes, 2003; Russ et al. 2004; Saenz et al. 2005). However it is not always possible to establish one. Fisheries might represent the only source of income for the community, who will not be able to support it without finding economic alternatives first. The expected results of a no-take zone are increase in biomass, size, density, and biodiversity within the zone.
- MPAs include zoning with various degrees of protection. They might include a no-take zone and can be of various sizes. With this tool it is easier to take into consideration the diverse needs of the stakeholders, deciding the use of each area according to a compatibility assessment. MPAs are established by national authorities and fishing communities could manage an MPA established in their fishing grounds. Protecting different habitats marine species will be protected, causing an increase in biomass, size, density, and biodiversity within the zone, while allowing extraction of resources.
- TURFs imply agreement by all fishers in one area to respect the division of the sea in parcels, establishing an exclusive correspondence between each fisher and his/her fishing ground. There are ways to define an exclusive use for a set time. However, this implies the restriction to the use of a common good and reference has to be made to each Country's laws. This could be the first step towards the establishment of CMMR.
- SEASONAL CLOSURES can be a useful tool if set in relation to the life cycles of fish. They are used to protect fishes during critical periods, such as in the reproductive season. A way to have fishers respect seasonal closures is by giving them the possibility of other sources of income during closures. Having an alternative to fishing would make respecting rules easier, thus the pressure on the resource would decrease.
- GEAR RESTRICTIONS set the size of nets and traps and size of mesh, and define the allowed catch. These measures avoid capture of non-target size or species of fish. Also, some techniques -such as bottom trawling- can be banned, because of the damage to the ecosystem. Techniques with the least impact should always be chosen.
- TOTAL ALLOWABLE CATCH is the definition of the maximum catch that each boat can take. This avoids capture of too many fish. However, this tool might provoke discarding the by-catch, which could be marketed, in favor of the target species.

- Establishing a MINIMUM and/or MAXIMUM FISH SIZE, a size under/over which fish cannot be extracted, is used to prevent extraction of juveniles, and/or of adults in the reproductive stage. This has various positive consequences, i.e. larger body size means higher reproductive rate (PISCO, 2002).

5.4.4 Managing body

The management plan must include a description of the administrative body of the organization, and provide information on each participant. The roles and responsibilities of each member also have to be defined. Examples will be provided in the capacity building workshops.

5.4.5 Information & education

The plan should also provide details of how the public will be educated about the rules and zoning of the management plan. Details should be given of the activities that will be organized to inform all stakeholders, including tourists.

5.4.6 Evaluation, monitoring, and adaptation

As part of the proposal, a monitoring plan should be defined. It should be used to evaluate the results of the management, to measure its effectiveness and propose changes to the plan when needed.

Data collection should not stop with the establishment of the CMMR plan. After establishing the CMMR plan, it is necessary to develop and implement a monitoring plan to have information about long term processes and be able to evaluate the effectiveness of the management. The same data collected for the analysis should be monitored constantly. According to the characteristics of each variable a specific time for the collection of a new set of values should be individuated.

The experience of the LMMA Network of the Southeast Pacific can provide examples of the adaptive management process (see: 2.6 "Locally-Managed Marine Areas Network, Southeast Pacific").

5.4.7 Budget

A budget should be presented. The cost for the workshops for capacity building and education, data collection, monitoring and analysis, and all the activities that make up the management plan should be detailed. The budget should also include the support provided by the community - in money and in labor- and any other source.

5.5 List of possible communities for a pilot project in the Mesoamerican Reef System

As a result of communications with practitioners in the MAR Region, I compiled a preliminary list of communities that can be contacted to establish potential pilot projects.

- BELIZE: Fishers of the Monkey River Village (Gale, personal communication 2006)
- GUATEMALA: Red de Pescadores artesanales del Caribe guatemalteco y Lago de Izabal (Angelica Mendez, personal communication 2006)
- HONDURAS: Fishers of the Laguna de los Micos in Jeanette Kawas National Park and Cayos Cochinos (Carrasco, personal communication 2006)

6 Conclusions

Establishing projects of Community Management of Marine Resources (CMMR) in the MAR region is viable. Fishers can contribute to solve the problem of overfishing by becoming involved in the management of their resource.

In this research I have described case studies, and have identified the possible tools that can be used by artisanal small-scale fishers to manage their activities, and avoid overfishing. Each community should be responsible for the management of the resource it depends on. Each community should choose the most appropriate tool to achieve environmental conservation, and thus avoid the exhaustion of the resource they depend on.

MAR Fund by making resources, both technical and financial, available to fishers can encourage and foster the process of establishing CMMR. MAR Fund by facilitating participation, by organizing training workshops, by enabling communities to access information, and by facilitating processes of information sharing among communities will support Community Management of Marine resources (CMMR) and therefore fulfill one of its goals.

7 Acknowledgements

The first acknowledgement has to be for the help and support I received from Maria José Gonzalez, who revised this work, and for the hospitality of MAR Fund.

For the information collected through informal interviews (June 5th - August 2nd 2006) I would like to thank all the people that showed interested and contributed with their thoughts and experience to my research: Julian Arana, Alejandro Arrivillaga, Lorena Boix, Luis

Bourillon, Juan Carlos Carrasco, Joanne Delaney, Omar Gale, Blanca Rosa Garcia, Hugo Hidalgo, Pedro Jimenez, Gregoria Lambey, Julio Lee, Manuel Mejia, Angelica Mendez, Cesar Moreno, Gloria Nuñez, Justo Rodríguez, Andrea Saenz, Cadudzzi Salas, Vivienne Solis, Melvin Teni, Buffy Turner, Fiona Wilmot, Participants of the workshop SocMon (Puerto Barrios, Guatemala, July 11-14, 2006), fishers and 'patrones' of Bahia de Kino contacted with the help of COBI (Sonora, Mexico).

I would also like to acknowledge the contribution derived from two previous researches: one done with my good friends Radhika Dave and Yukiko Ichishima under the supervision of Angela Cropper and Weslyne Ashton; the other done under the supervision of Mary Beth Decker.

Mary Beth Decker and Yves Paiz also revised the work and gave me feedback on it.

While I am grateful for the knowledge all these people have shared with me, I am the only responsible for the interpretation of it.

Funding for the research was given by MAR Fund, The F&ES Summer 2006 Globalization Internships Fund, and by the Carpenter/Sperry Summer Internship Fund.

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