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in Marine Resource Use:
A Case Study of the
Primeiras e Segundas Archipelago
in Mozambique**

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Social and Ecological Linkages in Marine Resource Use: A Case Study of the Primeiras e Segundas Archipelago in Mozambique

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Abstract

Implementing successful marine protected areas (MPAs) requires an understanding of local marine ecosystems, fisheries and human communities. A rapid assessment conducted in October 2006 was used to identify resource use patterns in the Primeiras and Segundas (P&S) archipelago in Mozambique, by examining data on local marine fisheries, demographic and economic context, as well as the current resource governance regime. Findings suggest that resources users employ low-selectivity fishing gear due to a combination of factors, including institutional weakness, resource dependence by coastal communities, and economic importance of target species, thus threatening the viability of local fisheries and ecological integrity of the area. This paper demonstrates that the inclusion of social and demographic data in rapid assessment promotes a nuanced understanding of the state of the marine system, the predominant threats to system health, and the social drivers that underlie resource use patterns. Information on these dynamics can be used to inform MPA design, promoting more effective governance and voluntary compliance of resource users with management regulations, and, ultimately, increasing positive returns from the MPA to local communities through improved system productivity.

Introduction

To varying degrees marine protected areas (MPAs) are managed in order to conserve biodiversity, maintain ecosystem services, promote recovery of fisheries, and protect marine resources that are necessary for livelihoods and sustenance of human communities (Johannes, 1998; Sanchirico *et al.*, 2002; Gell and Roberts, 2003; Christie *et al.*, 2003; Halpern, 2003; Hansen and Jones, 2008). To achieve these goals management plans should be grounded on information about the biological and ecological characteristics of the systems affected by MPAs (Fox *et al.* 2012). In addition, implementing successful management measures requires an understanding of the underlying social dynamics and incentive structures that drive resource use patterns (Salm *et al.*, 2000; Mascia *et al.*, 2003; Mascia *et al.* 2010). These biological, ecological, and social data, however, are rarely available in sufficient detail or at large enough spatial extent to adequately inform

management design, implementation, and monitoring (Johannes, 1998; Gaston, 2003; Smith, 2005; Hansen and Jones, 2008). Data limitations are as much the product of the high complexity and dynamism of marine systems as they are of the prohibitive costs in time, labor, and capital associated with fine scale data collection for large areas (Johannes, 1998; Gaston, 2003; Hockings, 2003).

The scientific and conservation communities have developed several strategies to inform protected area management in the face of these data constraints (Hockings, 2003). One response is to adapt lessons learned from rigorous quantitative research in a few areas, and apply them to similar areas of conservation interest (Johannes, 1998). A second strategy is to conduct rapid assessments of ecosystems and coastal communities in an effort to gather enough coarse-grained data to develop reasonably informed management strategies. Rapid assessment techniques range from the detailed study of a few surrogate species as indicators of larger system dynamics (Gladstone, 2002; Smith, 2005), to detailed taxonomy of a few survey sites to characterize ecosystem components, to employing local ecological knowledge to fill data gaps (Scholz *et al.*, 2003).

The traditional approaches to rapid assessment gather data primarily on the biophysical components of systems (Sayer *et al.*, 2000; Scholz *et al.*, 2003), viewing human and social factors as exogenous threats to the system (Sayer *et al.*, 2000). A more comprehensive approach to rapid assessments would examine the natural and social worlds as a coupled system, having reciprocal feedback processes that affect the state of each component (Christie *et al.*, 2003; Mascia *et al.*, 2003). Just as marine resource use is heavily influenced by the social and economic context of coastal communities (White *et al.*, 2002), so too can system health affect the viability of the communities that depend on natural resources for livelihoods and economic growth. The traditional rapid assessment frameworks that artificially delineate the natural and social components of systems miss those interactions and incompletely capture system dynamics.

This paper examines the utility of incorporating social variables into rapid ecological assessment and MPA planning. Data for this research was drawn from a rapid assessment that evaluated both social and biological characteristics of a proposed MPA in Mozambique. The inclusion of social data into that assessment provides access to nuanced system dynamics and allows us to highlight several linkages between the social conditions, resource use patterns and the ecological conditions of the region.

Methods

Study Area

The Primeiras e Segundas (P&S) archipelago consists of two island groups, each with five islands, along the northern coast of Mozambique, spanning the provinces of Zambézia and Nampula (Figure 1). The proposed MPA includes a marine area of approximately 8,226 Km², with a 10 Km marine buffer and a 30 Km terrestrial buffer in the districts of Angoche, Moma and Pebane. Land cover in the study area is characterized by a mix of coastal dry forests and complexes of mangroves. The vegetation in the area is interrupted by agricultural development (including small subsistence farms and larger industrial coconut

and cashew plantations), dispersed coastal villages, and by timber extraction. Swidden techniques are used to clear land for both agricultural expansion as well as for opening areas for timber extraction (Alves and Sousa, 2007; Nhancale and Mbeve, 2007). Uncontrolled fires resulting from these activities further contribute to forest fragmentation, and accelerate natural erosive forces and flooding.

The marine portion of the study area consists of a series of coral reefs and seagrass beds extending along the coast. The reefs are thought to be some of the most well-preserved and diverse in Mozambique (Pereira and Videira, 2007). Additionally, the seagrass beds are thought to support dugongs (*Dugong dugon*; de Abreu *et al.*, 2007). The islands and coastal beaches in the study area serve as important nesting grounds for several species of sea turtles in the Indian Ocean, including green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and olive ridley turtles (*Lepidochelys olivacea*) (Costa and Sítio, 2007). Seagrass beds together with the coastal mangrove forests also provide crucial habitat and nursery grounds for the region's important shrimp populations.

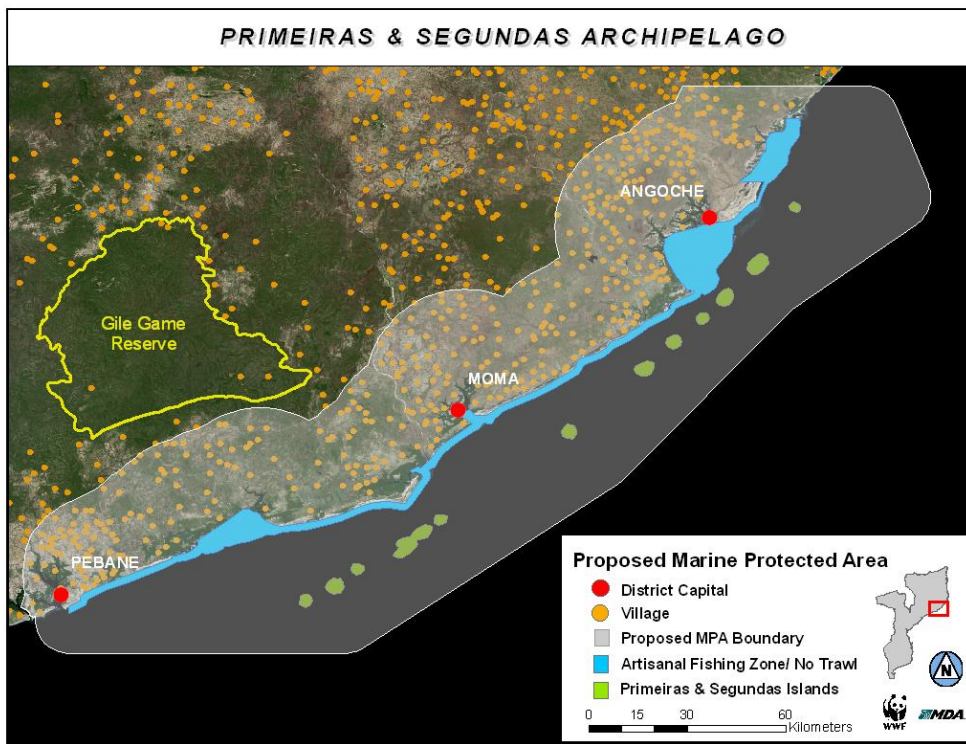


Figure 1: Proposed MPA in the Primeiras e Segundas Archipelago in Mozambique

Rapid Assessment

The research reported herein analyzed data collected during a rapid assessment of the P & S archipelago in Mozambique conducted in October 2006 to examine the social, biological, and political characteristics of the area in preparation for the establishment of a proposed MPA. This analysis explored several components of the P & S system, including coastal forests, coral reefs, seagrass beds, fisheries, sea turtles, mangroves, and socioeconomics

(de Abreu *et al.*, 2008a). Fieldwork and data collection for the rapid assessment was conducted over a four week period spanning October and November, 2006. Data collection included site-specific inventories of the flora and fauna of the region's mangrove and coastal forests, coral reefs, and seagrass beds (de Abreu *et al.*, 2008b; Pereira and Videira, 2007; Alves *et al.*, 2008), semi-structured interviews with key informants from the artisanal fishing sector to identify distribution and bycatch rates of sea turtles (Costa and Siteo, 2008), household surveys in coastal communities (Nhancale and Mbeve, 2007), and collection/review of fishery reports from governmental agencies, non-governmental organizations, and grey literature (Santos, 2007). An interdisciplinary analysis was conducted of the socioeconomic and fishery data in order to investigate the current state of marine fisheries and explore the social factors that affect system health.

The social data were collected using a demographic survey administered to a systematic and random sample of households in the study area. The coastal portions of the Angoche, Moma and Pebane districts that fall within the proposed MPA extending up to 30 km inland were divided into 66 enumeration areas (villages), and ten households were randomly selected and surveyed in each area. The survey tool was designed to collect data on the social, economic, and demographic characteristics of households within the study area including: household size and structure, mortality/morbidity, mode of resource use, extent of resource dependence, and economic participation. Data were coded, processed, and analyzed in the SPSS 1.5 statistical software package (SPSS Inc., Chicago, IL.)

The survey had a target sample of $n=660$. However, due to logistical constraints associated with working in remote and isolated portions of the countryside, and due to differences in subsistence and economic activities across villages within the study area, there was a highly variable response rate across sections of the survey instrument. Responses on questions regarding marine resources were particularly low, with response rate generally ranging between 0 and 36.1%, or between $n=0$ and $n=241$ responses. This low response rate inhibited rigorous statistical analysis of the survey responses. Instead, the data provide avenues for qualitative exploration of the social and economic context of coastal communities, and the relationships that local fishers have with marine resources. To compensate for the low response rate for questions dealing specifically with marine resources, ancillary data were incorporated from, government reports, and national surveys. Where such data were incorporated, their sources are directly cited.

The data pertaining to fisheries in the study area include monthly and annual estimates of total catch and catch per unit effort (CPUE), species composition of industrial and artisanal catches, and information on fishing methods for each sector. Data were collected from technical reports of the Mozambican Fisheries Institutes, including the National Institute for Development of Small-Scale Fisheries (IDPPE) and the National Institute of Fisheries Research (IIP), and from several grey literature sources. All references provided here refer to the original documents.

Differences in scale between the fisheries and social data sets precluded rigorous statistical analysis of the linkages between fishery and social variables. The fishery data are aggregated at the district, provincial and national scales, whereas the social survey is structured to represent the population of the study area spanning three districts and two provinces. Due to this spatial variation it was not possible to disaggregate fishery data for

only the proposed study area. These constraints likewise precluded aggregation of the social data to correspond in scale to the fishery data.

Due to these constraints a mixed-method approach was employed to examine the data gathered through the rapid assessment process. That approach consisted of in-depth review of available quantitative data on fishery catch trends, processing and analysis of the response data from the household survey, and identification of resource use patterns and methods. Linkages among the various components of the system were qualitatively explored, identifying some of the social and biophysical drivers of resource use and overall system health in the P&S archipelago.

Results

Socioeconomic Context

The estimated population of the study area is 749,000, and includes coastal populations in the districts of Angoche, Moma, and Pebane. The family or household is the primary social unit. Household structure and composition appear to be similar across districts. Average household size is 5.16 members, and the average age of the household head is 39.49 years. Average education levels (# of school years completed) for household heads is 4.55 years. The population of the area is thought to have increased dramatically in the period following Mozambican independence, as inland communities migrated to the coast to escape the violence associated with the civil war that spanned the years 1976-1992. Persistent drought in the interior has likewise forced people to migrate to urban and coastal centers in search of alternative livelihoods (World Factbook, 2008). This migration continues to the present day, evidenced by population growth in the area of nearly 45,000 people between the 1997 and 2007 national census (INE, 2007a, b; INE, 1997 a, b). Population growth continues to place intense pressure on the coastal marine resources.

Rather than depending solely on specialization in one sector, livelihoods in the study area are comprised of a mosaic of economic and subsistence activities relying almost exclusively on coastal forest resources, small-scale fishing, and household agricultural production. Few alternative livelihood options exist outside of these practices however, making coastal communities particularly sensitive to fluctuations in fisheries productivity, agricultural yield, environmental conditions, and regulations that limit access to the resources.

Fishing, agriculture, and forest product extraction in the area are practiced both for subsistence and income-generating purposes. Certain forest products are also used for medicinal/traditional healing, as well as for their cultural significance. Agriculture is the most widely practiced economic activity and source of sustenance, practiced by over 90% of coastal households. Corn and cassava are the regions staple food and cash crops, and coconut, cashew, peanuts, manioc, corn, and rice are abundantly grown and sold to generate income. Fishing is practiced by approximately 36% of households in the area, and serves as a means for augmenting protein and caloric budgets, as well as household income. Of families that engage in fishing practices, 90.6% of these do so for both consumptive and income generating purposes, while the remaining households fish solely for subsistence.

Regarding formal salaried employment, approximately 18% of households in the P&S archipelago have a salaried wage earner, with unemployment highest in Angoche (95%), and lower in Moma and Pebane (75.9% and 71.3% respectively). Wage earners are employed in a variety of positions including civil servants, teachers, and miners. There is a large disparity in income distribution among these wage earners. The average monthly income is 5187.00 meticaís (approximately \$217 USD)¹; however the median income is 1225.00 meticaís (\$51 USD). This means that at least half of the salaried households generate less than \$2 USD/day. The poorest 25% of the salaried households report monthly earnings of only around 500 meticaís (approximately \$21 USD), or nearly \$0.70 USD/day. With 82% of households reporting no salaried family members, and half of the salaried households earning approximately \$51 USD/month, it appears that formal employment does not play a large role in the livelihood strategies of the majority of households in the study area. This highlights the value of marine and agricultural resources in the predominantly subsistence-based coastal communities.

Marine resource use

Fishing in the P&S archipelago is divided into three sectors: artisanal, semi-industrial and industrial. Artisanal fishing is practiced on foot from shore or in small boats such as canoes and dhows, typically less than 10 meters in length. A variety of fishing methods are employed, including gillnets, surface drift nets, and hand lines. However, beach seines are the most commonly employed, and are estimated to provide over half the employment opportunities (Baloi *et al.*, 1998; Wilson and Zitha, 2007). Catches from this method include a variety of species and fish sizes, but are dominated by small pelagics, such as anchovy (*Thryssa* spp.; Wilson and Zitha, 2007). Of the 92 fisher families interviewed, 70% own a fishing vessel, usually a “Moma-type” dugout canoe. None of the interviewed families owned a motorized boat.

The shallow, sandy bank areas of the proposed MPA represent the northern portion of Mozambique’s Sofala Bank, and are important trawl fishing grounds for the semi-industrial and industrial fishing sectors, comprised predominantly of a limited number of companies of mixed national and foreign capital. Their fleets consist of larger, motorized vessels, and are equipped with means of preserving the catch on board. The main target species for the semi-industrial and industrial fishers are the Indian prawn (*Fenneropenaeus indicus*) and brown shrimp (*Metapenaeus monoceros*) (Palha de Sousa *et al.*, 2004).

In general, fishing methods in the region are characterized by a low level of selectivity. A study of the artisanal beach seine fishery in Angoche and Moma reported 233 species of demersal fish, 113 species of pelagic fish and 22 species of crustaceans (IFAD, 2000). Almost no portion of artisanal catches is discarded, the exception being parts of the catch that are inedible. Low selectivity of beach seine gear is compounded by the common use of mosquito nets as lining. Use of mosquito nets results in a large percentage of larvae and juvenile fish in catches (Baloi *et al.*, 1998). These small fish are easier to preserve by sun-

¹ According to the US Treasury, at time of research exchange rates for US Dollar and Mozambican Metical were 1:23.8600. <http://www.fms.treas.gov/intn.html#rates>

drying, salting and smoking, the main preservation methods available in the region. At the same time, large fish of high commercial value are often prohibitively expensive for general consumption by local communities. Thus, a market exists specifically for small catch, such as *Stolephorus* anchovy and the tsivakihini paste shrimp *Acetes erythraeus* (Wilson and Zitha, 2007).

Contrary to artisanal fishing, a large portion of semi-industrial and industrial sector catches are discarded. Non-target species, or bycatch, may reach 80%, and is composed of demersal fish (62.3%), pelagics (17.6%), crab (14%), cephalopods (3.5%) and other crustaceans (2.6%) (Palha de Sousa *et al.*, 2005).

Data on the influence of each sector in overall marine resource extraction for the study area were not immediately available. However, national estimates suggest that artisanal fishing accounts for 87% of the total marine catch, with the semi-industrial and industrial comprising only 13% (Jaquet and Zeller, 2007).

Marine resource use in the area is characterized by a high degree of competition between the different fishing sectors. The large bycatch of the industrial sector removes significant amounts of biomass that would otherwise be available to artisanal fishers. Competition in the system also stems from targeting of the juvenile component of many species by artisanal fishers, and removal of the adult component of the same species by industrial trawling. For example, prawn represents a small, but economically important component of artisanal catches. The main species caught is the Indian prawn, *F. indicus*, also the main target species of the semi-industrial and industrial sectors. The majority of prawn caught by artisanal fishers are juveniles (Maquine *et al.*, 2003), and though connectivity between juvenile and adult populations is not well understood, concern exists that artisanal fishing may impact adult prawn populations for the industrial sector. The industrial sector in turn may be further degrading prawn stock viability by removing a large proportion of the adult reproductive component (spawning stock), diminishing the capacity of the stock to replenish itself. This is evidenced by decreasing yields in industrial catch. Industrial fishing effort has been steadily increasing since 1977, while CPUE has been declining (Palha de Sousa *et al.*, 2005). Recent cost-benefit analyses for the industrial sector have shown no increase in catches with greater effort (Palha de Sousa *et al.*, 2005). The same study verified an overall decrease in prawn size, which negatively impacts market value. Thus, there is evidence that current industrial fishing practices are unsustainable, and optimization of the fishery will likely require a significant reduction in fishing effort.

Temporal trends in catch for the artisanal sector are more complex. In general, CPUE data show a high degree of monthly and inter-annual variability. Baloi *et al.* (1998) report that catch from one pull in the same area, within a single month may vary from zero to more than 1000 kg. This is due in part to the biological characteristics of the main target species. Small pelagics, such as anchovy, are shoal-forming and therefore patchy in distribution. In addition, they are particularly sensitive to variations in environmental conditions, which greatly influence their abundance and annual recruitment (Devaraj and Vivekanandan, 1997). Thus, artisanal fishing in P&S is characterized by a high level of migration on part of fishers, in search of areas of high productivity. Although artisanal CPUE data are difficult to interpret, and likely do not serve as a reliable indicator of stock health in the region,

interviewed fishers report now having to travel further to reach productive fishing grounds. The majority (61%) also believe that fish size has decreased over the last five years.

Marine Resource Governance

The current governance of fishery resources in the P&S archipelago is a mixture of national/governmental authority, provincial and local management institutions, and informal traditional authority. The Mozambican Ministry of Fisheries is charged with legal enforcement of regulations for all fishing sectors. Monitoring and evaluation of fishery resources is the responsibility of a subunit the Ministry, the National Institute for Fisheries Research (IIP). Artisanal fishing is monitored by IIP, along with the National Institute for Development of Small-scale fishing through provincial delegations and legally established fisheries co-management committees and community fishery councils (Baloi *et al.*, 1998; Tembe, 2005; Wilson and Zitha, 2007).

The primary management tools for fisheries in the study area are a closure period extending from 15 November to 1 March, and an industrial exclusion zone extending three nautical miles from the coast. The closure period applies to artisanal beach seining, and semi-industrial and industrial prawn trawling. The time of closure is considered to be the main spawning period for shimp and other fish in the region. Beach seines in Angoche and Moma were exempted from the closure in 1997, but pressure from the industrial sector resulted in their re-inclusion in 2005 (Wilson and Zitha, 2007). Non-compliance from the artisanal sector is very high, with the majority of fishers reporting a lack of alternatives for employment and subsistence during the closure period. Further, many fishers report a cultural and ancestral heritage of fishing without interruption, further confounding the implementation of the closure period. Wilson and Zitha (2007) also report that fishers rely on the income made from fishing during the closure to buy agricultural staples for the “hungry months” that correspond with low agricultural productivity.

Disregard of management regulations is not limited only to artisanal fishers, but extends also to the semi-industrial and industrial sectors. Infractions of industrial and semi-industrial trawling for shrimp inside the three nautical mile exclusion zone are common. The implications of these infractions can be indirect through interruption of fishing activities, or direct through damage of artisanal fishing gear (Wilson and Zitha, 2007). The industrial sector appears to maintain some compliance with the closure period, although since its inception in 1989, the industry has sought to compensate for lost revenue by extending trawling activities into the night during the open fishing season.

Other management measures for the artisanal sector include an annual licensing fee, currently 750 Meticaís (roughly \$32 USD), and specification of a minimum mesh size of 38 mm (Wilson and Zitha, 2007). As with the closure period, there is little compliance with these regulations among local fishers. Data suggest the overall rate of unlicensed fishers may be as great as 28%, with levels in Moma particularly high (68%). Similarly, non-compliance with the mesh size regulation appears to be wide-spread. A study done by IDPPE (2002) verified that out of 473 beach seines used in the District of Angoche, 67% used mosquito nets.

Although a legal framework for fisheries management exists, the current scenario in P&S reflects a lack of capacity for enforcement of these regulations, particularly on part of

governmental institutions. Locally, the co-management committees and community fishery councils work to manage fisheries with participation of the community, helping to secure compliance of regulations and resolve conflicts. The organizations are comprised of fishers, local research staff, maritime authority, as well as fish processors and traders (Wilson and Zitha, 2007). Our results indicate that there has been a decline in participation in these associations, with only 38.6% of those interviewed participating frequently in decision making processes. Views on the authority and credibility of such organizations may vary by region, and in some areas, fishers may resort primarily to traditional authorities for conflict resolution.

Discussion

Expanding the scope of the rapid assessment from traditional biophysical inventories to a more comprehensive systems approach provided a means of examining key relationships among the biological, social, and political aspects of the P&S system. This facilitated exploration of the current state of the P&S system, the predominant threats to the viability of key marine resources in the region, and some of the social drivers that underlie current resource use patterns, as well as highlighting potential avenues for improving the resource management and governance regimes in the area.

State of the system

The data from the rapid assessment indicate that marine resources in P&S are being overexploited. This is evidenced by declining CPUE trends for the industrial sector and increasing difficulty on part of artisanal fishers to locate productive fishing grounds. It is also evident that size distribution of fish and prawn species in the system is changing. Industrial catch records indicate an increasing proportion of smaller prawn. When considered in conjunction with lower CPUE, a decrease in size distribution of the targeted species is highly indicative of overexploitation, and resulting changes in population structure (Haedrich and Barnes, 1997). Although data were not available to examine shifts in size distribution for the artisanal fishery, many of the interviewed fishers report that such a decline has occurred.

Threats to the system

The predominant threats to the health of marine fisheries in the P&S archipelago appear to be the rates and methods of resource extraction. The combined pressure of both artisanal and industrial extraction, and to a large extent, the targeting of the same species, leads to a systematic decline in yields for both sectors. Despite efforts to relieve fishing pressure on the system through management actions such as the closure period, there has been an overall increase in industrial fishing since the end of the Mozambican war in the early 1990s. Likewise, expansion of the coastal population over the last several decades, has led to greater demand for fish and prawn for both subsistence and income. The high rate of extraction is accompanied by destructive methods of extraction. Both artisanal and industrial fishers employ low-selectivity fishing gear, removing significant biomass (both target and non-target) and a large percentage of juveniles and larvae. Further, both sectors have adapted to the fishery closure in disparate but damaging ways. The industrial sector

has intensified trawling during the open season to compensate for losses during the closure, whereas the artisanal sector largely ignores it. This combination across sectors of fishing that is of high intensity, and low selectivity serves as the primary threat to the already overtaxed system.

Social drivers

The social drivers of resource use in the system include a mix of economic, cultural and political variables. In the P&S region, the growing coastal population depends directly on marine resources to augment protein and caloric budgets, particularly in seasons and years of low agricultural productivity. As the majority of households lack a formal wage earner, many families also depend on resource extraction for informal income generation. The dependence of coastal communities on fish for livelihoods and sustenance creates a strong pressure to maximize yield, regardless of future repercussions on the health of fish stocks. This, combined with limited enforcement has led to the widespread disregard of management measures, and use of low-selectivity fishing gear.

Other market incentives have perpetuated the use of mosquito nets, such as local preference for small fish, and limited preservation methods for larger catch. The industrial sector has likewise responded to market incentives with unsustainable fishing practices. For example, industrial ships have intensified prawn extraction during the open season to compensate for the economic losses incurred during the seasonal fishery closure. Overall, fishing practices from both sectors have a negative reciprocal effect where the stock available to each sector is increasingly depleted. This raises concerns over the continued viability of fisheries in the study area. While it is difficult to establish the full extent of the impact that low-selectivity fishing gear and over harvesting are having on the productivity of the fisheries, CPUE trends and survey respondents suggest that it is declining, owed at least in part to increased fishing.

Although there is a national governance framework, fishery management in the P&S archipelago remains largely ineffective. Data from the rapid assessment indicate that this results from several intersecting factors including institutional weakness, limited fiscal resources, and limited political will for enforcement/monitoring. In addition, there is the perception among the coastal communities that some policies, like the fishery closure period, are inconsistent with their subsistence, economic, and cultural needs. Further, there is little participation in fishery management by fishing communities. While there are legally established avenues for community participation, practically, community involvement in governance decisions and implementation is weak. The demographic survey data demonstrate that participation in community fishing councils is decreasing, and that a large number of artisanal fishers do not participate in designing or administering management strategies. While the majority of fishers reported knowing of administrative authorities, few reported actually interacting with them. Conversely, the survey data demonstrate that traditional authorities and power structures strongly influence both resource use practices and conflict resolution in coastal communities. The prevalence of traditional authority provides an avenue for incorporating local participation in resource management and stewardship.

Conclusion and Recommendations

This research demonstrates the value of incorporating social data into rapid assessments. The expanded framework employed in the rapid assessment of the P&S system allowed a means of uncovering the linkages between social, biological and political components of the system. A MPA that is informed by the social drivers of resource use would likely improve community support of and voluntary compliance with fishery management strategies in the area (Christie *et al.*, 2003, Mascia, 2001; Mascia *et al.*, 2003; Mascia *et al.*, 2010).

Resource use in the P&S system appears to be influenced more by economic conditions, cultural practices, and traditional power structures than it is by legal authority and national management strategies. This, combined with the limited fiscal resources and low political will for enforcement in the area, make voluntary compliance of artisanal fishers prerequisite for effective governance (Pollnac *et al.*, 2001).

The proposed MPA offers a unique opportunity to dramatically restructure governance and resource use patterns in the P&S system. A formally established protected area could provide an institutional mechanism that would increase enforcement of existing laws and regulations, like the three nautical mile exclusion zone and the seasonal closure. Also, the MPA could engage traditional authorities and build on existing management systems to increase community involvement in management design and implementation (Pollnac *et al.*, 2001, Jentoft *et al.*, 2007). Further, the exclusion of industrial trawlers from the area would yield immediate benefits to artisanal fishers by decreasing competition for scarce marine resources and mitigating conflicts among user groups. This would also relieve pressure on these resources and allow for biological recovery for overexploited species (Pipitone *et al.*, 2000; Fox *et al.*, 2012).

These potential benefits associated with an MPA- pressure relief, biological recovery, and participatory governance - could help to address many of the social drivers of both unsustainable resource use and poor governance that currently threaten ecosystem health in the P&S archipelago.

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