

Comparing the perceptions of fishermen towards MPAs and the status of their adjacent coral reefs between coastal communities in the Philippines

Tomas Chaigneau

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Summary

1. The establishment and management of MPAs in the Philippines is viewed as a simple and cost effective way to protect critical habitat and biodiversity and to sustain or enhance adjacent artisanal fisheries by preventing spawning stock collapse and providing recruitment to fished areas.
2. Although over 700 MPAs are in place in the Philippines, the majority of them have been rated as “ineffective”. This lack of effectiveness often arises because of limited acceptance and support by adjacent communities. It is thought that if such communities cannot perceive fishery benefits in the immediate area of the reserve, such as those caused by ‘fishery spillover’, they are far less likely to support reserves as a fisheries management tool.
3. Despite their importance in implementing and maintaining MPAs, there has been little study on the effects of MPAs on the adjacent communities. This study therefore, aims to determine if the presence of well managed MPAs are having any positive effects on the adjacent fishing community.
4. The perceptions of fishermen towards the status of the fish stocks, the adjacent coral reefs and their attitudes towards marine reserves are compared between two communities with an adjacent well managed MPA, two communities with an adjacent MPA rated as inefficient, and two other communities without any conservation management strategy in place.
5. As expected, the fishermen from villages with well managed MPAs were more positive about the future status of the fish stocks and towards the use of these reserves as a conservation management strategy than other fishermen. However, surprisingly, fishermen from poorly managed MPAs were also positive about implementing a well managed reserve and were more positive about the current status of the fish stocks.
6. The results suggest that poorly managed MPAs may act as a “stepping stone” in ensuring the future support of fishermen towards well managed MPAs.
7. This study emphasizes the importance of acquiring strong support from local stakeholders in the maintenance and establishment of reserves. By furthering our knowledge of their perceptions towards MPAs, the information gathered will be essential in constructing a network of well managed MPAs.

Key Words: fisheries management, area management, artisanal fishing, MPA effectiveness, overfishing

Introduction

Coral reefs worldwide are in serious decline, mainly due to over fishing, pollution, disease and climate change (Bellwood *et al* 2004). It is thought that the total world catch from marine stocks has peaked and is now decreasing (Hilborn *et al* 2003). Although most of the world's fisheries continue to produce substantial yields, a number have collapsed, many are overfished and many more stocks appear to be heading toward depletion (Hilborn *et al* 2003). In addition, the continued expansion of commercial and artisanal fisheries has prompted fears for a worldwide crisis in fisheries (Allison and Ellis 2001). The repercussions of such a crisis would be devastating for many developing countries as over 80% of the population make all or part of their living from fish production or capture (Allison and Ellis 2001). Furthermore, in poor coastal communities, people depend directly on reef species for most of their protein needs (Gjertsen 2005). A large decline in fisheries would hence threaten their livelihoods.

This study considers the case of coral reef management in the Philippines. These reef fisheries provide livelihoods for more than a million small scale fishers (White, Vogt and Arin 2000). The coastline is fringed with 25,000 km² of coral reefs containing over 2,500 fish species and 500 different hard coral species. These reefs provide crucial ecological services such as the maintenance of biodiversity and shoreline protection (Coral Cay Conservation 2006). Despite being some of the most biologically diverse reefs in the world, 97% of these reefs are at risk from sedimentation, pollution and fishing pressure (Spalding, Ravilious and Green 2001). Furthermore, Roberts *et al* (2002) have ranked the Philippines as having the highest threats to reefs in a centre of endemism and hence is of huge conservation importance.

At the same time that this environmental degradation is taking place in the Philippines, a large percentage of the population lacks the resources to meet its basic needs (Gjertsen 2005). In 2006 almost 33% of the population lived below the Philippines' poverty threshold (National Statistical Coordination Board, 2006). Most live in rural, coastal areas and depend on subsistence farming or fishing for a livelihood (International Fund For Agricultural Development 2007). Unfortunately,

because of the highly seasonal nature of agriculture, its vulnerability to price fluctuations and low prices offered for raw products; agriculture cannot by itself make a substantial difference in levels of unemployment, underemployment and poverty. Furthermore, overfishing in the Philippines has already reduced fish stocks in many areas to well below their maximum sustainable yields (Cinner and McClanahan 2006). With the population expected to double by 2035, it has also been suggested that the present levels of fishing can no longer be sustained (Courtney *et al* 1999). Given that reef fish are the primary source of protein for most Filipinos and that the coral reefs provide livelihoods for coastal communities through fishing, aquaculture and tourism it is imperative to ensure that small scale artisanal fisheries do not collapse.

With limited resources available to combat the dual problem of poverty and environmental degradation, knowing when and how to increase the prospects of achieving “win-win” situations between the environment and human welfare is invaluable (Gjertsen 2005). As a result, developing effective management strategies for coral reefs has become one of the most important challenges confronting conservation scientists (Cinner *et al* 2006). These strategies are aimed at preventing overexploitation and have often focused on opening new reef or aggregation fisheries, closed areas such as Marine Protected Areas (MPAs) or elimination of redundant or destructive gear (McClanahan and Mangi 2001). It is MPAs however, that have received the most attention and are viewed as being a simple and cost effective way to increase stocks in diverse and complicated tropical fisheries (Roberts and Polunin 1991, 1993).

These MPAs are ‘no take’ marine reserves in which all forms of extraction and disturbance by humans are permanently banned. Their primary aim is to protect critical habitat and biodiversity, to sustain or enhance fisheries by preventing spawning stock collapse and provide recruitment to fished areas (Gell and Roberts 2003 and Halpern 2003). The enhancement of fished areas is thought to occur either through transport of larvae from spawning stocks within the MPA (Gerber *et al*) or by a net emigration of adult fish to adjacent fished areas termed “spillover” (Abesamis, Alcala and Russ 2006 and Alcala *et al* 2005).

Unfortunately, it is proving very difficult to acquire evidence demonstrating the export of larvae (Russ and Alcala 1996). However, over the last two decades a number of studies have demonstrated that the abundance and size of fish within MPAs have increased (McClanahan and Mangi 2000, Mosqueira *et al* 2000, Roberts *et al* 2001, Halpern and Warner 2002 and Denny, Willis and Babcock 2004). Other studies have also documented an export of biomass outside the reserve (Russ and Alcala 1996, McClanahan and Mangi 2000, Roberts *et al* 2001, Russ, Alcala and Maypa 2003 and Tupper 2007). Fishery benefits such as these have been shown to occur within two to 5 years and continue to develop over time (Gell and Roberts 2003).

Evidence of the benefits of MPAs as a management strategy is continually increasing and has fuelled hopes of improving dwindling fish stocks and increasing fish catches in impoverished areas (Gjertsen 2005).

Over 700 MPAs are already in place within the Philippines (Alino, Palomar and Arceo 2000). These range in size from less than a hectare to hundreds of thousands of hectares, and also vary considerably in terms of design, implementation and enforcement (Gjertsen 2005). Although some of these have been implemented and managed effectively, as well as demonstrating benefits to the adjacent fisheries (Russ and Alcala 1996, Gell and Roberts 2003 and Abesamis *et al* 2006), almost 90% have been rated as ineffective (Beger *et al* 2005). The “effectiveness” has been decided on the basis of the level of management and enforcement; impact on catch and level of illegal activity. Therefore, most MPAs are little more than official declarations and represent “paper parks” that are designated but in reality do not achieve their goals often due to high levels of encroachment and relaxation of rules and regulations.

This lack of effectiveness of the majority of MPAs often arises due to limited acceptance and support by adjacent communities (Bunce *et al* 2000, Beger *et al* 2004). This can be attributed to a number of reasons; a lack of political will, insufficient funding and training and a reduction of alternative fishing grounds or opportunities for fishermen (Gjertsen 2005). Russ and Alcala (1996), even argue that if such communities cannot perceive fishery benefits in the immediate area of the reserve, such as those caused by spillover, they are far less likely to support reserves as a fisheries management tool.

Although there is a growing amount of evidence demonstrating that MPAs enhance adjacent fisheries (Russ and Alcala 1996, McClanahan and Mangi 2000 and Tupper 2007), fishery spillover appears to be strongly species specific and depends on species size and mobility (Tupper 2007). Furthermore, recovery rates of species in the adjacent fisheries differ between species, locations and the size of the established MPAs (Russ and Alcala 1996, McClanahan and Kaunda-Arara 1996, McClanahan and Mangi 2000, 2001). This, together with the cost of implementation and reduction in the area of the fishing grounds help explain why so many coastal communities are apprehensive in accepting and/or providing support for the establishment of MPAs and hence why so many are rated as ineffective.

Providing that the methods applied for conservation do not result in a new economic loss on their behalf, Elliott *et al.* (2001) found that fishermen believed the conservation of species is a good idea. Given that their support is vital for the implementation and maintenance of an efficient MPA, it becomes apparent that coral reef managers have to balance sustainable use of marine resources with reef conservation and that the relations between human behaviour and reef ecosystem are hence critical (Bunce *et al.* 2000).

Even when MPAs are successful on a biological level, there has been little study on their effects on the communities that implement and manage them (Gjertsen 2005). However, as previously mentioned, strong support is required for the efficient implementation and maintenance of an MPA. This support, in turn, often arises due to fishermen perceiving the benefits of fishery spillover in the immediate area of the reserve.

This project aims to determine if the presence of well managed MPAs are having any positive effects on the adjacent fishing community. The past, current and future perceptions of fishermen towards the status of the fish stocks, the adjacent coral reefs and their attitudes towards marine reserves are compared between two communities with an adjacent well managed MPA, two communities with an adjacent MPA rated as inefficient, and two other communities without any conservation management strategy in place.

As MPAs are thought to sustain or enhance adjacent fisheries, and that these benefits continue to develop over time, I predict that:

- Fishermen from villages with well managed MPAs perceive larger catches, larger sizes of fish and more productive reefs than fishermen from villages without MPAs present or from villages with poorly managed, inefficient MPAs.
- The perceptions of fishermen from villages with well managed MPAs towards their adjacent coral reefs should become more positive over time when compared to fishermen from villages with no MPAs or poorly managed MPAs present.
- The attitudes of fishermen from villages with well managed MPAs towards these marine reserves and their effectiveness will be more positive than fishermen from villages with poorly managed MPAs or without any MPAs

This study aims to provide vital information necessary for the efficient maintenance and future establishment of MPAs in the Philippines and other developing countries by assessing and understanding the attitude and perceptions of local communities to marine conservation.

This will, in turn, emphasize the importance of acquiring strong support from local stakeholders in the maintenance and establishment of reserves, particularly in developing countries.

Methods

STUDY SITES

Studies were undertaken on Panaon island in the Province of Southern Leyte, part of the Eastern Visayas region of the Philippines. The fieldwork was carried out at six different coastal villages along the western coast of Panaon, spanning two different municipalities; San Francisco and Pintuyan (Fig.1.).

Son-nok II and Napantao are both villages that have had MPAs implemented by the Provincial Government in 1995 and 1996 respectively. These are both approximately

5 hectares in size and given that low levels of encroachment are reported and that coastal police are in place to sanction illegal fishermen, these have been rated as well managed MPAs. Furthermore, due to their high coral and fish species diversity, they are now generating income, as they charge a nominal fee for boats and divers that want to enter the MPA.

On the other hand Balong-Balong and Anislagon are both villages that have implemented their own MPAs without any help from the provincial government. These mimic more traditional management systems, that were implemented to meet utilitarian community goals such as providing food for the community, rather than to fulfil western ecological concepts of conservation. Key informants stated that they had high levels of encroachment and certain fishing gears such as hook and line are allowed at all times. Furthermore, the consensus is that these “MPAs” will be opened to the community in times of need. For the purpose of this study, these areas are termed poorly managed MPAs.

Finally, Marayag and Canlawis are villages that have no MPAs implemented in their vicinity.

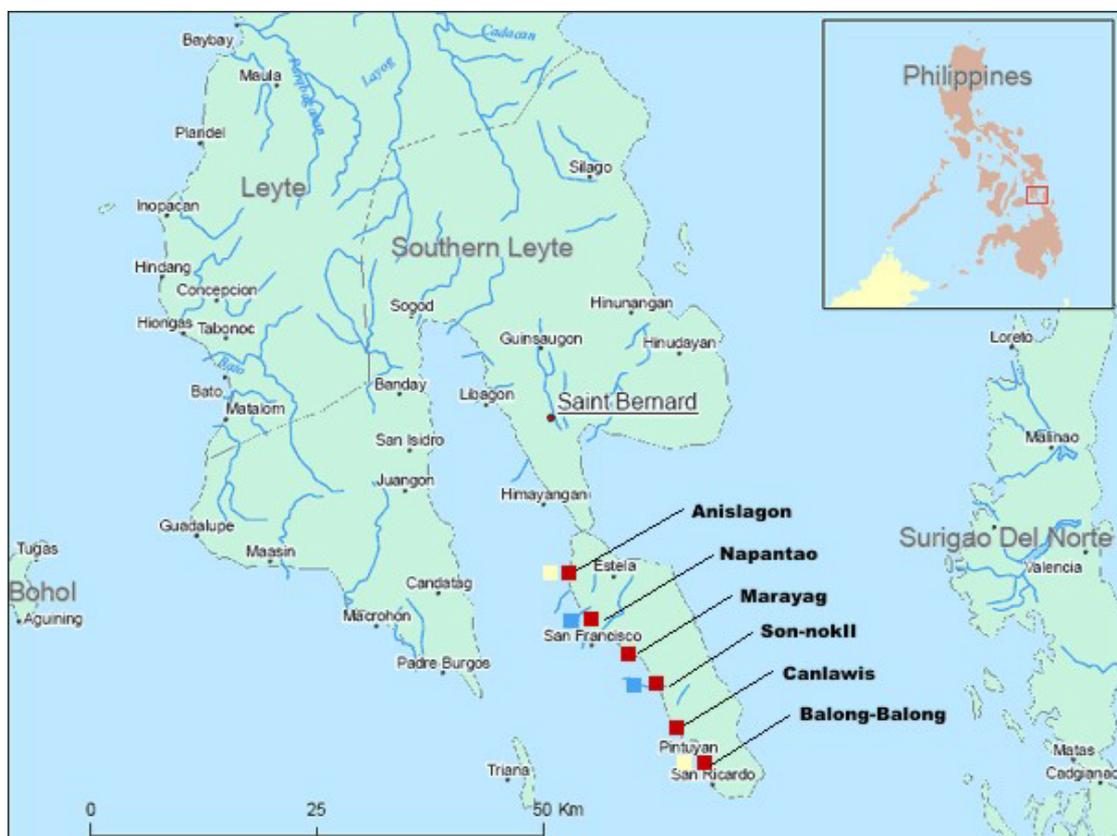


Fig. 1. The six different coastal villages studied (red squares), and adjacent well managed MPAs (blue squares) or poorly managed MPAs (white squares).

INTERVIEWS

A total of 30 fishermen of varying ages were interviewed at each of the six sites during June and July 2008. Interviews were undertaken in private and were carried out opportunistically. Most interviews occurred throughout the day as fishermen brought in their catch at landing sites, while they repaired fishing traps and nets during non fishing days or at their homes. The questionnaire was produced both in English and in Cebuano but due to their limited knowledge of English, most interviews were carried out with the help of an interpreter. The questions were designed to elicit the perceptions and attitudes of the fishermen towards the present, past and future status of their reefs and fish stocks and towards the use of MPAs as a coral reef management strategy.

Fishermen were asked to score the overall size of their catch, and the average size of individual fish as small, medium or large. Furthermore, they were asked to score the condition of their reefs as either non productive, moderate productivity, good productivity or high productivity. They were asked to score the fish catch, fish size and reef condition not only at present but also 10 years ago, 5 years ago and in the future. This would provide information demonstrating how these perceptions have changed over time and how these differ between sites. The fishermen were also asked whether they thought there would be enough fish for future generations, whether they thought MPAs were effective in managing fish stocks and if they would like to keep/implement a no fishing sanctuary opposite their coastal village.

The technical and ethical recommendations of Bunce *et al.* (2000) were followed as detailed advice on conducting respectful interviews and acknowledging customs and culture as provided.

DATA ANALYSIS

The data collected on the perceptions towards the status of the reefs and of the fish stocks was classed as “ordinal” and hence non parametric tests were used. A series of Kruskal Wallis tests were performed at each time period (10 years ago, 5 years ago, present a future) to compare the perceptions of fishermen in villages with well

managed MPAs, poorly managed MPAs and those without MPAs in their vicinity. If significant, post hoc tests were undertaken and a series of Mann Whitney U tests were used.

Wilcoxon Signed Ranks tests were also carried out to determine if there are any significant differences in the perceptions of fishermen between time periods and if these differ between fishermen from villages with well managed MPAs, villages with poorly managed MPAs or villages without any form of conservation management.

The data obtained from the remaining questions was classed as categorical answers were scored as “yes” or “no”. A series of Chi-squared tests of association were therefore performed. This would determine if the perceptions of fishermen towards the effectiveness of MPAs, the sustainability of fisheries and whether they would like to keep/implement an MPA adjacent to their village differs between fishermen in close contact with a well managed MPA, a poorly managed MPA or without a conservation strategy in their vicinity.

Results

PERCEPTIONS TOWARDS THE PAST, PRESENT AND FUTURE STATUS OF THE FISH STOCKS AND THE PRODUCTIVITY OF THE REEFS

The perceptions of fishermen towards the present size of the catch and the present size of individual fish differed significantly between fishermen from villages with well managed MPAs, from villages with poorly managed MPAs and from villages with no such closed area management (Table 1). Although fishermen from villages with no MPAs scored higher catches and larger fish sizes than fishermen from villages with well managed MPAs, it was only fishermen from villages with poorly managed MPAs that significantly scored both, higher catches and larger fish sizes than fishermen from well managed MPAs (Mann Whitney U, $Z = -3.55$, $N_1 = 60$, $N_2 = 60$, $P < 0.001$ and $Z = -2.73$, $N_1 = 60$, $N_2 = 60$, $P < 0.005$ respectively).

No such significant differences were found between the perceptions of fishermen towards the catch and fish size in the future or in the past, both 5 and 10 years ago.

However it may be important to note that fishermen near well managed MPAs consistently scored worse catch and fish sizes in the past, and perceived larger catch and fish sizes for the future, than fishermen from villages with no MPAs or inefficient MPAs (Table 1).

A series of Wilcoxon signed ranks test demonstrated that fishermen in villages with well managed MPAs, no MPAs and those with poorly managed MPAs all, on average, scored significantly lower sizes of catch and of individual fish at present than either 5 or 10 years ago (Tables 2 and 3). Interestingly, fishermen from villages with poorly managed MPAs scored significantly lower sizes of catch and of individual fish in the future than at present (Tables 2 and 3), this was not the case for fishermen from villages with well managed MPAs or with no MPAs present. It is interesting to note that fishermen from villages with no MPAs were more pessimistic about future catch and fish sizes than fishermen from villages with well managed MPAs.

The perceptions of fishermen towards the present conditions of the reef differed significantly between villages with well managed MPAs, from villages with poorly managed MPAs and from villages with no such closed area management (Table 1). Further post hoc tests showed that both fishermen from villages with well managed MPAs and fishermen from villages with poorly managed MPAs perceived the reef to presently be in significantly better condition than fishermen from villages without MPAs (Mann Whitney U, $Z=-2.54$, $N_1=60$, $N_2=60$, $P<0.05$ and $Z=-2.32$, $N_1=60$, $N_2=60$, $P<0.05$ respectively). Fishermen from villages with well managed MPAs, poorly managed MPAs and without MPAs did not perceive there to be any significant changes in the reef condition from past to present (either 10 or 5 years ago-Table 4). However, fishermen in each case, believed that their reefs will be significantly more productive in the future than at present (Table 4).

When fishermen were asked whether they believed there will be enough fish for future generations, fishermen from the three different types of coastal villages produced very similar answers. Both, fishermen from villages with well managed MPAs and from villages with poorly managed MPAs produced identical answers with 84% of fishermen being positive there will be enough fish in the future. This figure drops to 77% when Fishermen from villages without MPAs were interviewed.

Table 1. A comparison of the perceptions of fishermen in villages with well managed MPAs, poorly managed MPAs and those without MPAs in their vicinity towards the size of the catch, of individual fish and the condition of the reef for four different time periods. Results of a series of Kruskal Wallis tests are presented.

	Size of Catch				Size of Individual Fish				Condition of Reef			
	10YA	5 YA	Present	Future	10YA	5 YA	Present	Future	10YA	5 YA	Present	Future
Mean Rank of well managed MPAs	85.25	85.87	75.79	94.14	84.28	81.48	80.43	90.02	95.13	89.37	98.10	91.23
Mean rank of poorly managed MPAs	97.48	90.00	105.00	91.29	94.03	101.13	103.25	93.36	83.74	92.43	95.90	98.12
Mean rank without MPAs	88.77	95.63	90.71	86.07	93.20	88.90	87.83	88.13	91.22	88.19	76.13	80.68
d.f.	2	2	2	2	2	2	2	2	2	2	2	2
Chi Square	3.11	1.30	12.79	1.10	1.82	5.08	7.72	0.44	1.59	0.25	8.01	3.76
P	NS	NS	<0.005	NS	NS	NS	<0.05	NS	NS	NS	<0.05	NS

Table 2. A comparison of the perceptions of fishermen in villages with well managed MPAs, poorly managed MPAs and those without MPAs in their vicinity towards the changes in the size of the catch between past, present and future time periods. Results of a series of Wilcoxon signed ranks test are presented. The differences in the perceptions are calculated between the latest time period minus the earlier time period.

Size of Catch	Well Managed MPAs			No MPAs			Inefficient MPAs		
	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present
Number of positive differences	2	2	16	3	1	12	2	8	13
Number of negative differences	52	45	15	46	42	24	51	35	29
Number of Ties	6	13	29	11	17	24	7	17	18
Z	-6.33	-5.98	-0.96	-5.86	-5.89	-1.761	-6.32	-3.99	-2.08
P	<0.001	<0.001	NS	<0.001	<0.001	NS	<0.001	<0.001	<0.05

Table 3. A comparison of the perceptions of fishermen in villages with well managed MPAs, poorly managed MPAs and those without MPAs in their vicinity towards the changes in the size of individual fish between past, present and future time periods. Results of a series of Wilcoxon signed ranks test are presented. The differences in the perceptions are calculated between the latest time period minus the earlier time period.

Size of Individual Fish	Well Managed MPAs			No MPAs			Inefficient MPAs		
	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present
Number of positive differences	2	5	10	4	6	10	5	9	7
Number of negative differences	45	36	11	46	34	21	41	40	24
Number of Ties	13	19	39	10	20	29	13	10	28
Z	-5.86	-4.80	-0.218	-5.75	-4.55	-0.75	-5.00	-3.91	-2.45
P	<0.001	<0.001	NS	<0.001	<0.001	NS	<0.001	<0.001	<0.05

Table 4. A comparison of the perceptions of fishermen in villages with well managed MPAs, poorly managed MPAs and those without MPAs in their vicinity towards the changes in the condition of the reefs between past, present and future time periods. Results of a series of Wilcoxon signed ranks test are presented. The differences in the perceptions are calculated between the latest time period minus the earlier time period.

Condition of Reef	Well Managed MPAs			No MPAs			Inefficient MPAs		
	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present	Present – 10 YA	Present – 5YA	Future – Present
Number of positive differences	22	21	27	21	13	28	30	25	34
Number of negative differences	24	13	10	23	19	12	20	18	13
Number of Ties	13	25	22	16	28	20	10	17	13
Z	-0.53	-1.90	-2.28	-1.03	-0.43	-2.70	-1.64	-1.55	-2.99
P	NS	NS	<0.05	NS	NS	<0.01	NS	NS	<0.005

A Chi squared test of association demonstrated there is no significant association between these positive or negative answers of fishermen from different villages.

PERCEPTIONS TOWARDS MPA'S AND THEIR EFFECTIVENESS

When asked whether they thought MPAs were effective at managing fish stocks, the majority of fishermen (89%) answered positively. However, whilst only 5% of fishermen from villages with well managed MPAs responded negatively, this increased to 10%, when fishermen from villages with inefficient MPAs were interviewed, and increased further to 18% when fishermen from villages without MPAs were interviewed. Despite these slight differences, a Chi squared test of association demonstrated there is no significant association between the positive or negative answers of fishermen and the different villages.

When fishermen were asked whether they would like to keep/implement a well managed MPA in their village, a chi square test showed a significant association between the answers of fishermen and the type of coastal village they are from (Chi Sq=8.16, d.f. =2, $P < 0.05$). Whilst 88% of answers were positive from fishermen in villages with well managed MPAs, this figure dropped to 78% when fishermen from villages with inefficient MPAs were interviewed, and dropped further to 67% when fishermen from villages with no MPAs were interviewed.

Discussion

PERCEPTIONS TOWARDS THE PAST, PRESENT AND FUTURE STATUS OF THE FISH STOCKS AND THE PRODUCTIVITY OF THE REEFS

An increasing number of studies have shown that fish populations inside reserves increase in size, live longer, grow larger and hence develop increased reproductive potential (McClanahan and Mangi 2000, Mosqueira *et al* 2000, Roberts *et al* 2001, Halpern and Warner 2002 and Denny, Willis and Babcock 2004). In turn, this is predicted to lead to a new export and increased settlement of fish outside the reserve boundaries (Gell and Roberts 2003).

However, no significant differences were found between the perceptions of fishermen from villages with different conservation management strategies towards past and future states of fish stocks (Table 2, 3). Furthermore, contrary to expectations, the present catch size and size of individual fish were perceived to be significantly higher by fishermen from villages with poorly managed MPAs than by fishermen adjacent to well managed MPAs or those without MPAs in their vicinity.

It is possible that the fishing grounds of villages without MPAs or with poorly managed MPAs are benefitting through spillover and larval export from the nearby well managed MPAs. This is unlikely however, as export of biomass from marine reserves has mostly been shown to occur at very small distances (Russ *et al* 2003, 2004).

It is also possible that the benefits of spillover are outweighed by the costs of a decrease in size of the fishing grounds which reduced the total catch. Claudet *et al* (2006) state that “the observed benefits of MPAs don’t apply to all species at all times and responses to protection are also highly variable among fish taxa”. Another recent study, involving the mark and recapture of fish species demonstrates that four of the five species studied show little or no net movement out of MPAs (Tupper 2007). Furthermore, whilst MPAs were shown to increase the catch per fisher and per area in the adjacent fishing grounds, this was found to be insufficient to compensate for the lost area (McClanahan and Kaunda-Arara 1996 and McClanahan and Mangi 2000). A small or negligible “spillover” effect may therefore not compensate for the loss in the traditional fishing grounds and hence may not lead to larger overall catch and fish sizes in villages adjacent to well managed MPAs.

The well managed MPAs of Son-nokII and of Napantao have been in place for over 10 years, however they are both less than 0.1km² in size. Although Gell and Roberts (2003) suggests MPA work well across a size range spanning <1km² to >5000km², these small community based MPAs used in this study may be too small to ensure sufficient spillover to adjacent fisheries.

It is equally possible that fishery spillover from well managed MPAs is occurring but the benefits are not being perceived by the local fishermen due to a rise in fishing

effort. The Filipino population has been rising and is expected to continue to increase in the near future. As 60% of the population live on or near the coasts, increased pressure will be placed on the fish stocks (Coral Cay Conservation 2006). The consequent decreases in fish size and size of catch may have been worse if a well managed MPA had not been implemented. For example Roberts *et al* 2001 remark that when a previous 'no-take' reserve was re-opened to fishing in the Philippines, catches eventually collapsed suggesting it had previously supported fisheries.

There are, therefore a number of explanations as to why fishermen did not perceive any fishery benefits arising from a well managed MPA. However, post hoc tests confirmed that there were no significant differences in the perceptions of fishermen towards the past, present or future catch size and individual size of fish between fishermen from villages with well managed MPAs and those without MPAs. This suggests that the presence of a well managed MPA is not having any detrimental effect on the quality of the fishing grounds adjacent to it despite its reduced size. This in turn hints that the spillover from these well managed MPAs is indeed compensating for the reduction in size of the previous fishing grounds.

The fact that fishermen from villages with poorly managed MPAs have perceived greater catch and fish sizes than fishermen from the other two types of villages is a rather more surprising result. However, an increasing number of studies are showing that not only conventional MPAs but also traditionally managed areas instigated and maintained by the community can also be effective ways of improving reef ecosystem health (Cinner *et al* 2006, McClanahan *et al* 2006 and Cinner and Aswani 2007).

As the benefits from MPAs to adjacent fisheries are expected to increase over time (McClanahan and Arthur 2001 and Halpern and Warner 2002), the perceptions of fishermen from villages with well managed MPAs were predicted to become more positive over time when compared to fishermen from villages with no MPAs or poorly managed MPAs. However, this was not apparent, and in all cases, fishermen perceived the size of the catch and of individual fish to have decreased since 5 years ago and 10 years ago (Table 2 and 3). This, again, is most probably due to increased fishing effort due to an increasing populations and technological innovations and improving the fishing gear. However, the possibility of an increased fishing effort

outside these fishing grounds should not be ruled out as a significant proportion of the catch arises from fish migrating in from deeper shore areas where the trawlers operate (McClanahan and Mangi 2001).

Despite these perceived decreases in catch size and fish size over time, most fishermen believed there will be enough fish for future generations. However, fishermen from villages with poorly managed MPAs were significantly more pessimistic about the future catch and fish sizes than fishermen from villages with well managed MPAs. Fishermen from villages without any MPAs were also slightly more pessimistic about future stocks.

It seems, that although catch size and size of fish has apparently decreased since the implementation of well managed MPAs, fishermen from these villages are more optimistic about the future. This coincides with the McClanahan and Mangi (2001) argument that even if closed areas do not increase catches, they are likely to make the catch more diverse, sustainable and less vulnerable to collapse.

There are also other, indirect effects of closed areas on the surrounding environment and can result in increased coral and topographic complexity (McClanahan and Mangi 2001). It was therefore predicted that fishermen from villages with well managed MPAs perceive the reef productivity to be higher than fishermen from other areas. In this case, fishermen from both, villages with well managed MPAs and villages with poorly managed MPAs perceived the reefs to be in better condition than fishermen from villages without MPAs (Table 4). It is possible that although poorly managed MPAs suffer high levels of encroachment, the fishing intensity is less than in those areas without any form of conservation management. This result again, hints that traditionally managed areas instigated and maintained by the community can also be effective ways of improving reef ecosystem health .

PERCEPTIONS TOWARDS MPA'S AND THEIR EFFECTIVENESS

As predicted, the attitudes of fishermen in contact with well managed MPAs towards these reserves and their effectiveness are more positive than other fishermen.

Although most fishermen interviewed believed that MPAs managed fish stocks effectively, fishermen from villages with well managed MPAs were more positive towards the implementation or maintenance of these reserves than the other fishermen, with 88% of answers being positive.

This may be in part due to their higher optimism about the future of the fish stocks and hence the sustainability of the fisheries. The greater aesthetic value associated with MPAs, and the income generated from diver and boat tax within these reserves may also play an important part in generating this positive attitude.

Interestingly, fishermen from villages with poorly managed MPAs were also more positive towards the implementation or maintenance of these reserves than the other fishermen from villages with no MPAs, with 78% of answers being positive. This also hints that even poorly managed MPAs or more traditionally managed areas provide benefits to the adjacent communities. Whether or not they provide ecological or conservation benefits remains to be seen. However recent studies suggest that they can be effective ways of improving reef ecosystem health (Cinner *et al* 2006, McClanahan *et al* 2006 and Cinner and Aswani 2007).

Nevertheless, it should be mentioned that with only 33% of fishermen from villages without MPAs being negative towards the implementation of reserves in their area, it appears that most fishermen have positive attitudes towards the use of well managed MPAs as a fishery/conservation management strategy.

CONCLUSIONS

Contrary to the predictions made, fishermen from villages with well managed MPAs were not found to perceive significantly larger catches, larger sizes of fish and more productive reefs than fishermen from the other villages. Furthermore, their perceptions were not found to be come more positive over time when compared to the other fishermen.

No evidence was found suggesting that the MPAs boosted the adjacent fisheries in any way through fishery spillover. This is problematic, as this is often the main argument used to persuade communities to implement an MPA.

Surprisingly, the fishermen from villages with poorly managed MPAs, where gear restrictions are in place and the reserves are temporarily opened to encroachers, did perceive there to be significantly higher catch and fish sizes in their fishing grounds. Most were also positive towards the implementation of a well managed MPA in their fishing grounds. However, many are worried about the sustainability of their fisheries in the future. It is possible that, having already perceived some of the benefits that can arise with the instalment of a limited take MPA, many are willing to replace this with a well managed MPA to ensure the sustainability of their fish stocks.

The conservation benefits that arise through a poorly managed MPA may be less than those arising from a well managed one. However, the implementation of such a reserve may be a vital stepping stone, which will prove critical in ensuring the future support of fishermen towards well managed MPAs.

Nevertheless, it is encouraging to find that, as predicted, the fishermen from two villages which have had well managed MPAs for over 10 years (Son-nok II and Napantao), have positive attitudes towards the effectiveness of these reserves and are mostly keen to maintain them in the future. These fishermen were also significantly more positive about the future status of the fish stocks than fishermen from other villages.

LIMITATIONS AND FURTHER WORK

Although the six villages studied were very similar in terms of the size of the populations, the area they covered and their employment structure, unfortunately, very little data was collected on the fishing effort imposed on the reefs, the size of the fishing grounds or the ecological conditions imposed on the reefs. It is possible therefore, that differing perceptions of fishermen may not only be due to an absence or presence of an MPA but due to a number of other variables.

Furthermore, for the purpose of this study, only the perceptions of the fishermen were analysed. Given that it is the support of the whole community that is important in the efficient implementation and maintenance of MPAs, it could be interesting to see if

the perceptions of the rest of the community remain similar or if this differs between employment, age or gender.

It may also prove interesting to compare the results obtained from this study with data collected via a series of underwater surveys to see if the perceptions of fishermen between villages correspond to ecological data collected around their fishing grounds.

Nevertheless this study has emphasized the importance of acquiring strong support from local stakeholders in the maintenance and establishment of reserves and has suggested ways to increase this support. By furthering our knowledge fishermen's perceptions towards MPAs, the information gathered will be essential in constructing a network of well managed MPAs both within the Philippines and in other developing countries with endangered reefs.

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