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Identifying management preferences, institutional organisational rules, and their capacity to improve fisheries management in Pemba, Mozambique

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The potential to improve the management of fisheries in Pemba, Mozambique, were explored by evaluating stakeholder's preferences for management and the key institutional design elements of the fisheries organisations or community councils of fisheries (CCPs). We interviewed fishers, community leaders and government fisheries officers regarding (1) their perceptions about different fisheries restrictions, (2) their socio-economic conditions, and (3) the institutional design and rules of the CCP arrangements. Fishers had low levels of education (<4 years) and biweekly expenditures of around US\$100, and they were permanent residents of their villages, being part of large households (9–12 members). Apart from effort restrictions, respondents' perceptions were similar and strongly supported a range of fisheries regulations, particularly gear and minimum size restrictions. The suggested minimum size of captured fish was 20.6 cm (SD 3.0), whereas the suggested size of closed areas was 8.4 km² (SD 2.0). Fishers associated with community or conservation groups generally had more positive views of spatial closures and other less-preferred management restrictions. A number of the essential design principles for fisheries rules were in place with the exception of graduated sanctions. There is a need for strengthening groups, forums, leadership training in finance, and means to implement transparency and graduated sanctions.

Keywords: attitudes, community-based organisations, fisheries co-management, marine protected areas, social ecological, socio-economics

Introduction

Successful management of common-pool resources relies heavily on the perceptions and implementation of shared values and trust among resource users and managers (Ostrom 1990, Pretty 2003). Yet, in many cases, stakeholders hold divergent views of both the costs and benefits of natural resource management (Evans 2009). These varying perceptions about management can lead to conflicts and non-compliance that can ultimately hamper adoption and implementation. For example, when adjacent communities, resource users and managers differ greatly in their socio-economics and perceptions of costs and benefits, there is likely to be conflicts that will make management at scales beyond the very local difficult to implement (McClanahan et al. 2008, 2012). Consequently, surveying and evaluating the various resource management options during the early stages of implementation is expected to improve the chances of finding restrictions that are agreeable among the most key stakeholders.

Standard restrictions used in fisheries management primarily include variations on restrictions of area usage, time of usage, size of capture, gender and species captured, gear use, and fishing effort (Walters and Martell 2004). Stakeholders are expected to support these fisheries restrictions, depending on a variety of cultural, historical and socio-economic factors. Previous evaluations in East Africa have shown that education, livelihoods, and history of management, poverty, a sense of equity, and interactions with

managers, are critical (McClanahan et al. 2005, 2008, 2012). Additionally, people's preference for specific management strategies are likely to be influenced by factors such as their perceptions whether and how proposed restrictions benefit specific stakeholders (including both costs to self and issues of perceived equity); whether the institutions have specific 'design principles' that increase credibility among users that follow the rules; and the perceived legitimacy of the leaders and the rule development and implementation process (Ostrom 1990, Wade 1994, Kuperan and Sutinen 1998, Sutinen and Kuperan 1999, Pomeroy et al. 2001, Cinner et al. 2012).

Therefore, attempts to implement natural resource management should benefit from understanding how people perceive fisheries restrictions and subsequent management plans. In particular, it is important to identify those restrictions that are likely to lead to conflicts, the socio-economic factors associated with both negative and positive perceptions, and the level of agreement about these perceptions. Eventually, once perceptions and weaknesses in rule creation and implementation are identified, forums and a resolution of these factors can be addressed through collaborative management arrangements (co-management), which share management responsibilities between local stakeholders and groups such as governments and civil society. This is expected to eventually achieve higher compliance with restrictions and increase the chances of achieving

sustainable resource use (Jentoft et al. 1998, Pomeroy et al. 2011).

To evaluate the potential for co-management of the fisheries, we examined the preferences and perceived benefits of the standard fisheries restrictions in Pemba, Mozambique, and determined the level of heterogeneity in opinions concerning proposed management systems. The stated preferences for specific management strategies and the potential underlying causes of this heterogeneity in perceptions were explored, along with the capacity of people and their organisations to implement the management preferences. Additionally, we explored the current state of the rules in use as evaluated by the leaders and members of the community-based fisheries organisations. These two directions of research were used to determine what stakeholders might like to see in their management systems and what institutional elements might be strengthened to achieve these goals.

Material and methods

Study sites

This study took place during January and February 2012 in Pemba Bay, Mozambique (Figure 1). Pemba has three main community councils of fisheries (CCPs) or fisher organisations. The largest CCP is Ruela and contains seven villages, whereas the others are sparsely populated and include Bandar CCP with only one village, and Jimpia CCP, which includes four small villages, namely Jimpia, Meshaja, Mikindani and Mwembe. Of these, we conducted research in five villages: two in Ruela CCP — Ruela and Paquite, and two in Jimpia CCP — Jimpia and Mikindani, and Bandar (Figure 1). Given the small size and closeness of some of the villages, the questionnaires were pooled and analysed as a single Pemba location. This region is undergoing an evaluation effort to increase fisheries co-management and this study is part of that ongoing process.¹

Sampling and surveys

There were three types of questionnaires that were administered, targeting different groups but all geared towards understanding management and conservation. These included (1) a community leader survey, which gave a general understanding of the community context; (2) a community-based organisation survey that were administered to each of the CCP leaders to evaluate how resources are managed within the fishers groupings and organisations; and (3) the main survey, which focused on fisheries restriction preferences by both managers and resource users themselves. The latter survey was directed at fisheries officers (hereafter referred to as 'managers') and fishers (resource users).

The community and CCP leader surveys were conducted with the official leaders in these positions, therefore random or probability-based sampling was not feasible or desirable. Interviews for the resource user surveys were undertaken

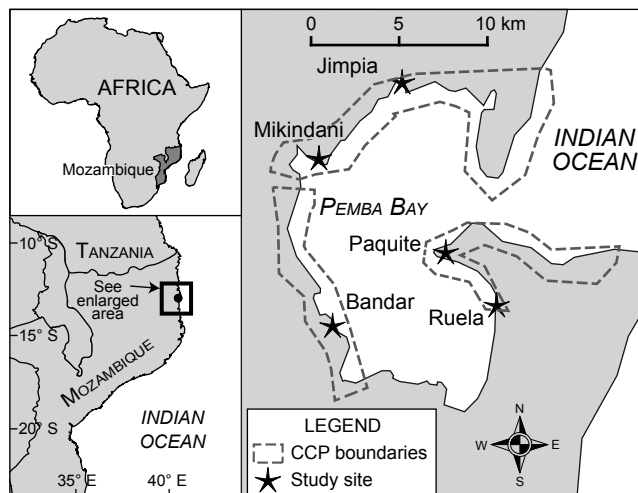


Figure 1: Map of the study sites and the sampled villages in the Pemba region and their location along the Mozambican coastline

either at the landing sites or at fishers' homes. In order to sample proportionally in an unbiased way, the number of resource users at the sites was determined from discussions with leaders and direct observation, and the fishers were classified according to the main gear types they use. The fishers were then numbered one to n in each dominant gear-use category (e.g. traps, linefishing, gillnets, etc.) and these numbers were randomly selected to identify the person for interviewing, but such that their proportion to the gear used at the landing site was constant. The lists of fishers were obtained from the landing sites and from various fisher groups at the site. Fishers were listed with their main gear and, in case of multigear fishers, listed by their primary gear. The percentage sampled depended on available time and number of resource users, but no less than 10% of the total and from each resource-use category were sampled and a total of 60 people were interviewed, 57 fishers and three fisheries managers. Managers were considerably fewer than the resource users and therefore all three available managers were interviewed.

Community and CCP leader surveys

We also explored aspects of the social and institutional capacity to implement co-management by asking community leaders the following: (1) whether they had received training in (i) conflict resolution, (ii) financial management/accounting, (iii) proposal writing, (iv) environmental education/monitoring, (v) roles and responsibilities, (vi) health/sanitation, or (vii) other key issues such as agriculture; (2) the level of access to key socio-economic development and community-level infrastructure based on the presence/absence and distance to 31 infrastructure items (Pollnac 1998). Leaders' reports of training were grouped into six broad categories: conflict resolution, financial management/accounting, proposal writing, environmental education, laws and regulations/roles and responsibilities, and health/sanitation. We also included an 'other' category in two cases where leaders had noted that they had received training in agricultural issues.

¹ The substance of this article is derived from the report on the study made to the project funders and available at <http://www.globalfishalliance.org/pdfs/2012/WCS%20Pemba%20Report.pdf>

We also asked CCP leaders about (1) the rules in use, specifically the types of management restrictions that were in place either as formal or informal, and (2) the institutional design characteristics of existing management systems. Institutional design principles are conditions that can increase the likelihood of sustaining collective action over time, and were derived from the study of well-documented cases of long-enduring common pool resource regimes (Ostrom 1990). The institutional design principles and their local conditions can, but not necessarily will, provide credible commitments that resource users will maintain and invest in their institutions over time. The so-called design principles as defined by Ostrom (1990) include (a) clearly defined boundaries, such as geographic or institutional membership rights; (b) the development and enforcement of rules that limit resource use; (c) congruence between rules and local conditions (i.e. scale and appropriateness); (d) resource users have rights to make, enforce, and change the rules; (e) individuals affected by the rules can participate in changing the rules; (f) monitoring of the resources; (g) the presence of accountability mechanisms for those monitoring the rules; (h) sanctions that increase with repeat offences and in congruence to the severity of such offences (graduated sanctions); (i) the presence of arenas for discussion and agreement such as conflict resolution; and (j) the degree to which they are nested within other institutions. Several key design principles were investigated by interviewing CCP chairmen, community leaders, and key informants (Table 1).

Management preferences surveys

Resource users and managers were asked to rate their level of agreement with various fisheries restriction options on a five-point Likert scale (McClanahan et al. 2008). Interviewees were asked about their level of agreement with six restrictions: spatial closures, seasonal closures, restrictions on gear, limits on the minimum size of landed fish, restrictions of fishing effort, and limits on the species caught. Questions were asked as 'do you believe that *spatial closures* are a good way to sustain fisheries' and the same questions were asked again for each of the restrictions. Levels of agreement with these restrictions included agree completely, agree somewhat, neutral, disagree somewhat, and disagree completely (don't know was recorded separately and then dropped from the analyses). These answers were scaled from +2 to -2 with zero as the neutral score.

To evaluate the stakeholders and scales of the benefits, respondents were asked about the extent to which they, their community, and the government benefited from restrictions by marking an 'X' on a 10 cm scale that ranged from low to high benefits. Following these two sets of management preferences questions, specific questions were asked about specific restrictions, including what is the appropriate area for marine protected area management, closure size, and minimum length of fish for these restrictions. Units of measurements were discussed if this was confusing to the interviewee and a ruler was also used to show the sizes of fish that might be suggested. The preference study was followed by a series of questions focused on the respondent's socio-economic status including their age, education, duration of stay in the community, household size, biweekly

Table 1: Description of the indicators examined at each study site

Indicator	Description
Operational rules-in-use	Whether there were formal or informally recognised rules being practised to limit fishing activities. Recorded separately for restrictions on area, time, gear and species
Clearly defined boundaries	Whether boundaries are easily recognised (based on a three-point scale where 1 = difficult to recognise; 3 = very easy to recognise and were never confused)
Clearly defined membership	Whether there is ever confusion about who belongs to the social group that makes up the institution (Y/N)
Rights to organise	Resource users have a <i>de facto</i> or <i>de jure</i> minimal level of autonomy from higher level authorities to design and change rules, and do so through formal or informal mechanisms (Y/N)
Graduated sanctions	Whether sanctions increase with numerous offences or the severity of the offence (Y/N). This was recorded separately for each operational rule
Conflict resolution mechanisms	Whether mechanisms exist to resolve conflicts between resource users, and the degree to which a mechanism is effective at resolution (0 = no mechanism exists; 1 = mechanism exists but completely ineffective; 5 = mechanisms always effective)

expenditures, perceived disparity in the benefits of management (benefit to government — benefit to self), and participation in community and fisheries organisations. These are factors known to influence perceptions towards management restrictions (McClanahan et al. 2008, 2012). A logistic stepwise multiple regression analysis was used to test for associations between the respondents' socio-economic and perception characteristics and their management preferences using JMP statistical software (Sall et al. 2001). The logistic stepwise regression does not require normally distributed data but results can be influenced by co-linearity (Whittingham et al. 2006). Socio-economic and disparity variables were tested and found to have weak co-linearity ($r < 0.50$) with the exception of the respondent's age and length of stay in their village ($r = 0.70$), which were kept in the model due to different responses with these two variables. The number of questionnaires analysed by the stepwise procedure was less than the 57 undertaken because a few were not filled in correctly or did not answer the specific question needed to evaluate the relationships.

Results

Description of respondents

In all, 60 surveys were completed of which 57 were fishers and three managers. Interviewed fishers generally specialised in the use of one gear with multigear use found only in Ruela. Eight types of fishing gear were recorded but were dominated by the main three gears: handline, gillnet and beach-seine (Table 2). Socio-economic surveys found

that fishers were long-term residents of their villages and most were permanent and had stayed in their villages for around 30 years (Table 3). Fishers typically had less than four years of education and their household sizes were large and ranged from 9 to 12 people per household. A little less than one half of the respondents were members of community organisation and one fifth were part of fishing or conservation groups. Fisheries officers had also lived in the location for many years and were of similar age to fishers but had considerably more years in education, a higher biweekly expenditure, and smaller household sizes than fishers (Table 3). Fisheries officers expended around US\$200 per month compared to US\$50–130 per month for fishers and were not part of social or conservation groups. The mean perceived disparity in benefits of management restrictions for fishers was similar to that of managers.

Fisheries restriction and benefits assessments

Reducing the numbers of fishers was perceived to be the least beneficial restriction for improving the sustainability of the fishery (Figure 2). There was generally strong agreement with all of the other types of management restrictions. Gear restrictions, minimum sizes, and species selection were all rated highly, and closures were more variable in the responses. The mean proposed size of a closed area was

Table 2: Description of the fishing gear used in the main study sites. CCP = community council of fisheries

Fishing gear	Landing site			Grand total
	Bandar CCP	Jimpia CCP	Ruela CCP	
Handline	2	4	16	22
Gillnet	3	4	14	21
Beach-seine	5	2	4	11
Shark net	0	1	4	5
Longline	0	0	3	3
Harpoon	0	0	2	2
Speargun	0	0	1	1
Trap	0	0	1	1
Grand total	10	11	45	66

Table 3: Means and standard errors of the mean of respondents' characteristics, namely: duration of stay in the village, age of respondent, level of education, biweekly expenditure and household size. There were about 27 Metaxais per US\$ in 2012. ANOVA comparisons for fisheries officers and fishers are significant for the level of education, biweekly expenditures and household size ($F > 12.0$, $p < 0.001$)

Variable	Respondent	
	Fisheries officers ($n = 3$)	Fishers ($n = 57$)
Duration of stay (years)	28.0 ± 4.5	33.2 ± 1.1
Age of respondent (years)	38.0 ± 6.2	37.0 ± 0.7
Level of education (years)	14.7 ± 1.3	3.3 ± 0.1
Expenditure (Metaxais)	5 567 ± 4 727	2 638 ± 110
Household size	4.0 ± 2.4	10.4 ± 0.4
Perceived mean disparity	0.55 ± 0.4	0.60 ± 0.1
No. of all community organisations	0.0	0.4 ± 0.1
Fishing or conservation groups	0.0	0.2 ± 0.02

given as 8.4 km² (SD 2.0) and the suggested minimum size of a captured fish as 20.6 cm (SD 3.0). There was generally strong agreement that most restrictions benefitted the individual, community and government, with most perceived benefits accruing to the government (Figure 3).

Socio-economic factors associated with management restrictions

A number of socio-economic factors were significantly associated with the respondents support for the various restrictions, but overall these factors were weak in the whole model predictions (Table 4). The strongest model was for gear restrictions, where the two interrelated variables of duration of residency in the village and age of the respondent were significantly associated but in opposite direction with their support for this restriction. The older fishers were the more supportive but the longer they had stayed in their village, the less supportive they were of gear restrictions. Duration of stay of the respondent was also identified by the stepwise regression procedure but weak and non-significant for closed seasons, species selection, and minimum size of captured fish. Fisher participation in fishing or conservation groups was positively associated with their rating of restrictions of closed areas, closed seasons, and minimum size of captured fish. The perceived disparity in the benefits of restrictions was significant for ratings of closed areas and reducing numbers of fishers, but in the opposite direction. Higher perceived disparity resulted in less support for restrictions on fishing effort but still supporting closed areas. Rating of the closed area restriction was the most complex and influenced by age, expenditure, house size, group membership, and perceived benefits of disparity. Older fishers with more biweekly expenses were less supportive of closed areas but those that were part of community and conservation groups and with large households were more positive towards this restriction.

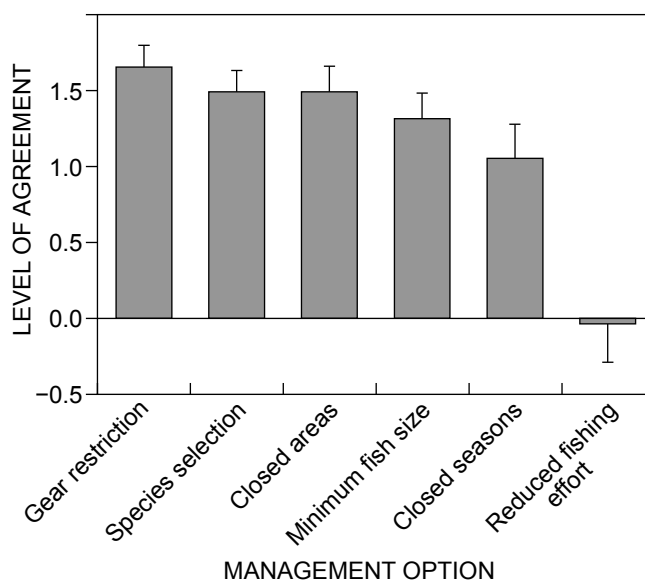


Figure 2: Rating of management restrictions in term of the agreement with statements that these restrictions will improve the state of the fisheries. Error bars denote SEM

Community leader survey

Community leaders reporting of the presence or absence and distance to infrastructural items such as hospitals, schools and roads reported only 5, 5 and 7 of the 31 infrastructural items in Mikindani, Jimpia and Bandar respectively (Appendix 1). In contrast, Ruela/Paquite had nearly one half of the items and the others were within 5 km of the village. All community leaders reported 6–7 years of training in leadership positions, but there was variation in the types of training received between communities (Table 5). Bandar leaders had received training for everything except proposal writing, whereas Mikindani and Jimpia leaders had received only environmental education and agricultural training.

Community-based organisation survey

Institutional design principles thought to contribute to the sustainability of commons governance were in place in the three CCPs examined but graduated sanctions were missing (Table 6, Appendix 2). There were considerable differences in the operational rules developed by the different CCPs and the level of compliance. The largest CCP, Ruela, had developed a number of rules focused on public health and safety, such as prohibiting selling fish from boats, a minimum age for fishing, and not going to the toilet in public areas, but no restrictions on resource use. Additionally, Ruela had the lowest levels of reported compliance and the CCP leader remarked that the enforcement capacity was limited, due, in part, to its large geographic size. In contrast, Jimpia and

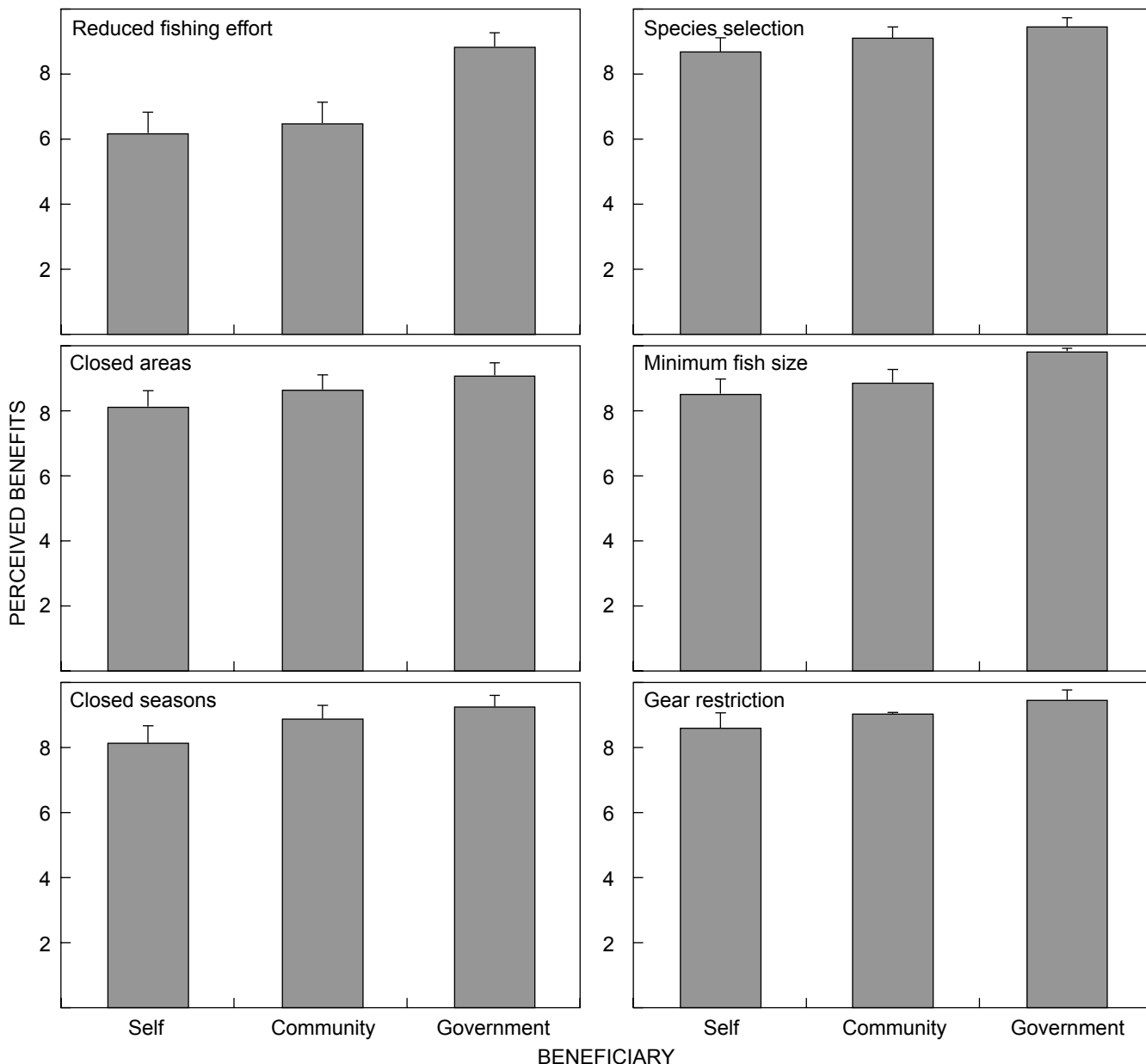


Figure 3: Rating of the benefits of the restrictions comparing benefits to the self, community and government in the three studied fisheries community organisations or CCPs. Error bars denote SEM

Table 4: Socio-economic and perception factors influencing fishers' level of agreement for various management restrictions based on logistic stepwise multiple regression analysis. Variables included are those that remained after the stepwise screening procedure and those with * were statistically significant

Variable	χ^2	p-value	Direction of association
<i>Closed areas (n = 45; r² = 0.05)</i>			
Age of respondent	5.9	0.015*	Negative
Biweekly expenditure	6.85	0.009*	Negative
Household size	11.09	0.0009*	Positive
Perceived mean disparity	6.19	0.013*	Positive
Level of education	1.04	0.31	Negative
Fishing/conservation groups	5.13	0.024*	Positive
<i>Closed seasons (n = 53; r² = 0.07)</i>			
Duration of stay	1.19	0.27	Negative
Fishing/conservation groups	4.19	0.04*	Positive
<i>Reduced numbers of fishers (n = 41; r² = 0.09)</i>			
Perceived mean disparity	5.31	0.0211*	Negative
Level of education	2.85	0.091	Negative
Biweekly expenditure	1.59	0.21	Positive
<i>Species selection (n = 49; r² = 0.03)</i>			
Duration of stay	1.11	0.29	Negative
Level of education	1.19	0.27	Negative
<i>Minimum fish size (n = 55; r² = 0.07)</i>			
Duration of stay	1.42	0.23	Positive
Fishing/conservation groups	5.94	0.0148*	Positive
Household size	0.39	0.53	Negative
<i>Gear restriction (n = 53; r² = 0.12)</i>			
Duration of stay	4.04	0.045*	Negative
Age of respondent	4.16	0.04*	Positive
Community organisation	2.52	0.11	Positive

Bandar CCPs had restrictions specifically on resource use and reported better compliance and enforcement levels. Both small CCPs claimed to have developed a fisheries closures but the Jimpia CCP noted problems with legal recognition.

Discussion

Management is expected to have a better chance at meeting both social and ecological objectives when there are high levels of support for restrictions and rules and when their implementation is viewed as legitimately developed and implemented (Jentoft et al. 1998, Pomeroy et al. 2011). Our study found that Pemba fishers had generally positive perceptions towards fisheries restrictions, with the exception of those on fishing effort. Fishing effort was only weakly supported in the Ruela CCP where they also had established a minimum age for fishing. Restrictions such as gear and minimum length restrictions, species selection and closed areas had broad-scale appeal in this region and possibly more so than other regions of East Africa (McClanahan et al. 2005, 2008, 2012). Throughout East Africa, communities have heterogeneous perceptions about management restrictions and the study here suggests that an isolated community interacting with social awareness and education programmes can have the potential for positive views towards restrictions on resource use. Consequently, the high level of support suggests that there are considerable

Table 5: Training received by community leaders in the studied villages

Training type	Ruela/ Paquite	Mikindani	Jimpia	Bandar
Conflict resolution	x			x
Financial management/ accounting				x
Proposal writing				
Environmental education/monitoring	x	x	x	x
Roles and responsibilities/laws and regulations				x
Health/sanitation	x		x	x
Other		Agriculture	Agriculture	
Years as leader	7	6	7	7

opportunities to move forward on fisheries restrictions and to achieve rapid adoption. The differential sizes, available infrastructure and the distance to markets of the CCPs are likely factors that influence fisheries management developments in this region (Cinner et al. 2012).

Fisheries and conservation scientists' examinations of restrictions on fish lengths and closure areas are not much different from recommendations of the Pemba fishers (Hicks and McClanahan 2012). In the case of minimum fish lengths, the scientific recommendations for the dominant species found in the Pemba fish catch (Gell and Whittington 2002), such as rabbitfish *Siganus sutor*, pink-ear emperor *Lethrinus lentjan* (=mahsena), seagrass parrotfish *Leptoscarus vaigensis* and blacktip mojarra *Gerres oyena* are estimated for optimum yield at 32.7, 29.6, 22.7 and 19.4 cm where as the estimated size at first maturity are 29.1, 26.7, 21.2 and 18.5 cm respectively (www.fishbase.org). These values derived from growth models generally lay above the mean values for minimum lengths given by fishers of 20.6 cm (SD 3.0). Fisher suggestions were closer to the lengths at first maturity, which are more likely to be something that fishers can view and appreciate as important. Nevertheless, this correspondence offers an opportunity to mix, test and possibly reconcile fishers' recommendations with length-based scientific assessments. Minimum length restrictions that meet the criteria of both groups are likely to find broad-scale support.

Marine conservation scientists have suggested a minimum viable size for a closure of 3.1 km², with a range of 12.5–28.5 km² as more preferable (Halpern and Warner 2003, Shanks et al. 2003). Based on more than 4 000 marine protected areas, the median size of marine protected areas globally is 4.6 km² (Wood et al. 2008). Consequently, estimated closure size from the Pemba respondents of 8.4 km² (SD 2.0) was intermediate between the minimum and preferable sizes provided by conservation scientists, while above the global average. Consequently, it should be possible to create and maintain closures that are above some suggested minimum viable size in Pemba. These small closures may not be sufficient on their own to meet large national conservation needs but, if part of a larger network and some larger nationally protected areas,

Table 6: Institutional design principles of the studied community council of fisheries (CCPs)

Institution	Boundary ever confused?	Membership ever confused?	Resource users can make rules	Resource users can change rule	Graduated sanctions	Success of conflict resolution mechanisms ^a
Ruela CCP	N (but not easily recognisable)	N	Y (but no feedback from legal authorities, although forms were submitted)	Y	N (but there is a possibility that a fishing licence could be permanently cancelled)	2
Jimpia CCP	N	N	Y*	Y	N	2
Bandar CCP	N	N	Y	Y	N**	2

Y = yes, N = no

^a Scaled from 0–2: 2 = most or >75% of the conflicts get resolved

* At the opening ceremony of a protected area, a technical brigade from the Economic Activities Department did not consent to the opening, which created confusion that was resolved by the District Administration

** Depends on the decision of the Secretariat but is not institutionalised

more conservation and management goals can be met (Weeks et al. 2010).

Socio-economic factors and perceived disparity were factors, albeit not strong, in the rating of restrictions and these factors indicate directions for future social organisation and education. Specifically, it would appear that the older and more permanent fishers along with those involved in community organisations had more opinions and sometimes-positive perceptions of some of the restrictions. This suggests the need to strengthen the involvement of experienced fishers and community organisations in future management plans. Future work would focus on the factors that influence membership in community organisations and ways to increase participation, particularly among those fishers with the most local experience. Additionally, the sense of disparity in management benefits of certain restrictions can be addressed through research and education programmes that evaluate the types and scales of the various benefits of the management restrictions. Research questions could include 'What evidence is there that some types of management, such as closures, do or do not influence individuals as opposed to communities and governments?' These types of explorations of evidence and discussions among stakeholders are likely to clarify the potential costs and benefits of the various restrictions.

The prospects for high levels of adoptions and compliance and low conflict are indicated by our assessments of agreement with restrictions and benefits but the implementation may also greatly depend on the social organisation of the communities. On the positive side, the relative inaccessibility and long distances to commercial fish markets (with fish freezers, ice machines, etc.) for three of the four communities studied have been linked to a higher probability of co-management success (Cinner et al. 2012). There are a number of the key social design principles important for progressive management found in the studied CCPs but there were also a couple of systematic weaknesses that, if addressed, could contribute to successful co-management.

The most notable weakness was that none of the CCPs had graduated sanctions, which is common in the East African region (Cinner et al. 2009). Graduated sanctions require that punishments increase with the severity or number of offenses, ranging from warnings, to fines, to jail, etc.

Broadly, the CCPs in Pemba should consider institutionalising graduated sanctions, which lend a sense of fairness to the monitoring and sanctioning process. Secondly, all of the CCPs claimed that they were able to make and enforce their own rules, but CCP leaders noted that the respective legal authorities had not responded to written approvals and in one case, this resulted in confusion about the rules, which had to be resolved at the district administration level. A transparent and timely mechanism for providing CCPs with feedback about the locally developed rules seems necessary. In the case of Ruela, it would seem that the key restrictions on resource use were missing and this may represent avoidance of making difficult and key decisions. Consequently, there is a need to further discuss the more contentious rules and restrictions on resource use and also the often-difficult and contentious process of enforcing rules.

Finally, leadership has been linked to successful co-management in several empirical studies (Gutierrez et al. 2011, Cinner et al. 2012) and to community level social capital, trust and legitimacy to achieve successful outcomes (Krishna 2002). Our evaluation of leadership training suggested several areas whereby the capacity of local leadership could be enhanced. Transparent financial management and accounting is critical to building trust in leadership, but only one out of four of the community leaders surveyed had received any training in this field. Similarly, effective conflict resolution mechanisms are thought to be a critical institutional design principle necessary for commons institutions but only half of the community leaders surveyed had received any training in this field. For most community leaders, training in proposal writing (for example, to help co-finance CCPs), knowledge about laws, regulations, roles, and responsibilities were lacking. Building these types of capacities and increasing legitimacy for both CCP and community leaders is likely to be critical to the long-term success of co-management institutions in Pemba Bay.

Recommendations and conclusions

Here, we studied the perceptions of both managers and resource users in regards to their preferences for key fisheries management strategies and explored key aspects of local capacity to collectively manage natural resources. Our results indicate that the homogeneity in perceptions and actual

benefits of management restrictions is expected to facilitate progressive fisheries management if the social organisation issues around making and enforcing rules can be met and improved. Given the broad support, we suggest that restrictions on gears, minimum size, closures and species can be potential starting points for management if done in close collaboration with government managers. More specifically, a number of broad-scale recommendations arise from this study that, if adopted, may contribute to the success of the existing co-management initiative. These include (1) increasing dialogue, research, and education about the possible costs and benefits of the various management restrictions; (2) beginning the process of research on the minimum sizes for reproduction and optimal yields of key fisheries species and then legalising and enforcing the minimum size restrictions; (3) beginning the process of identifying and legally establishing fisheries closures of around 5–10 km²; (4) increasing the numbers, extent and degree of participation in fishers community organisations; (5) developing greater democracy, legitimacy, and particularly participation of experienced fishers in decision-making; (6) discussing and developing a system of graduated sanctions in all CCPs; and (7) increasing collaboration between CCPs with governments in acknowledging and enforcing CCP bylaws.

In addition, the large size and closeness of the Ruela CCP to a major market may require more than one community organisation within this large urban CCP. There may be a need to divide the community organisation along some boundaries, such as the types of fishers (i.e. nearshore vs offshore) or geographic use of the resource. Regardless, the seven villages contained in this CCP are potentially too unwieldy to be effective. The size of this organisation and the lack of clear resource restriction rules and engagement with government are expected to undermine the successful co-management.

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Appendix 1: Presence/absence of and, in the case of absence, distance to 31 community-level infrastructure items

Services/facilities	Ruela/Paquite		Mikindani		Jimpia		Bandar	
	Present (= 1)	Distance (km)	Present (= 1)	Distance (km)	Present (= 1)	Distance (km)	Present (= 1)	Distance (km)
Hospital		5		16		40		40
Medical clinic	1			2		9		2
Doctor	1			2		9		2
Dentist		5	1			9		2
Pharmacy	1			2		9		2
Primary school	1		1		1		1	
Secondary school		5		2		9		2
Water supply (1 = well; 2 = stand pipe; 3 = piped water)	1 (1,3)		1 (1,2)		1 (1)		1 (1,2,3)	
Sewer pipes or canals		2		16		9		2
Sewage treatment facilities								
Septic or settling tanks		2		16		9		2
Electric service	1			16		25	1	
Telephone landline	1			16		25		Unknown
Mobile phone reception	1		1			25	1	
Internet facilities (mobile connections)	1			56	1			40
Daily newspaper	1			56		40		40
Radio	1		1		1		1	
Police station/booth		5		16		25	1	
Emergency services (ambulance, fire, etc.)		5		16		25		2
Banking services		5		56		65		40
Public transportation		0.5		16	1		1	
Hard-top road		0.1		36		45		20
Mechanic/garage	1			16		25		2
Gas station		5		56		65		40
Food market (1 = weekly market; 2 = daily market)		5		(2) 2		(2) 9		2
Hotel or inn		5		16		25		2
Restaurant	1			16		25		2
Fish freezer		5		16		25		2
Ice machine		5		16		25		40
Fishers' shed/building	1							
Boat jetty/wharf		3						
Service/facilities index (sum all present)	14		5		5		7	

Appendix 2: Operational rules in use in the Ruela, Jimpia and Bandar CCPs

Rule type	Does the CCP enforce this rule/ these rules?	Compliance 1 = Nobody complies 2 = Most people break the rules 3 = A few people break the rules 4 = Everyone complies	Comment
<i>Ruela CCP</i>			
Prohibition of selling fishing products directly from the boats	Limited enforcement. The CCP tries but it doesn't have means to control this vast geographical area	2	– Too much freedom – Too much democracy
Prohibition of physical relief in public areas and bad mouthing		2	– Too few fines
Younger than 18 can't be fishers		2	– Insufficient involvement from government departments
Prohibition of taking sand from the beaches		2	All the above contribute to the actual situation**
Prohibition of damaging another fisher's gear		2	
<i>Jimpia CCP</i>			
Prohibition of mosquito nets	Yes	3	
Creation of closed areas	Yes	3	Closing an area at Anga River and charging for fishing activities there results in another way of funding
<i>Bandar CCP</i>			
Closed areas	Yes	4	
Banning mosquito nets and Chicocota	Yes	4	
Not killing turtles	Yes	4	

** Perspective of the CCP leader, not the investigators