Marine Policy 33 (2009) 818–825

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Performance of community-based coastal resource management (CBCRM) programs in the Philippines: A meta-analysis

Ronald J. Maliao [a,*,1], Robert S. Pomeroy [b], Ralph G. Turingan [a]

[a] Florida Institute of Technology, Department of Biological Sciences, 150 West University Boulevard, Melbourne, FL 32901-6975, USA
[b] University of Connecticut-Avery Point, Agricultural and Resource Economics/CT Sea Grant, 1080 Shennecossett Road, Groton, CT 06340-6048, USA

ARTICLE INFO

Article history:
Received 24 September 2008
Received in revised form
3 March 2009
Accepted 4 March 2009

Keywords:
Marine reserves
Marine protected areas
Co-management
Fisheries management
Community empowerment
Roving bandits

ABSTRACT

Community-based coastal resource management (CBCRM) is a major conservation and fisheries management strategy in the tropics. In this study, the performance of 16 CBCRM programs in the Philippines was assessed using a meta-analysis of eight indicators that represented the perceptions of local resource users. Overall, the CBCRM programs in the Philippines were perceived to have a significant positive impact. However, the performance of each of the indicators was mixed. Although the CBCRM programs were perceived to be effective in empowering the local fishing communities, their perceived impact on improving the state of the local fisheries resources remained limited. This highlights the importance of incorporating ecological and socio-economic considerations in setting fisheries management regimes.

1. Introduction

Coastal resource management (CRM) programs are widely implemented worldwide to meet both conservation and fisheries management goals. In the Philippines, CRM is generally implemented under the co-management framework. The central element of co-management is the empowerment of the community of local resource users (e.g., fishers) by enabling them to participate, control and influence institutional decisions affecting their lives [1–3]. This CRM strategy is referred to as community-based coastal resource management (CBCRM).

In the Philippines, a major component of the CBCRM program is the establishment of marine protected areas (MPAs) [4,5]. MPAs, also known as marine reserves, marine sanctuaries and marine parks, are generally defined as areas in the marine environment where fishing and other activities are regulated. Such regulations include either allowing limited fishing with the use of size- and species-selective fishing gears such as hand spears and fish traps or completely banning the collection of any organisms in the MPA. Approximately 91% of the over 600 MPAs in the Philippines are managed under the CBCRM framework [6].

It is crucial to regularly evaluate the performance of CBCRM programs to allow continuous feedback of information necessary for adaptive management [15]. Although previous reviews have attempted to evaluate the performance of CBCRM programs in the Philippines [7–11 and references therein], thorough understanding of how effective CBCRM is, especially from the perspective of the local resource users, is lacking. In this study, existing published information on Philippine CBCRM programs was meta-analyzed. Meta-analysis provides a more rigorous statistical framework for quantitatively synthesizing disparate studies [12]. Although meta-analysis is widely used in the health sciences [13], it is only recently that it has been utilized in the area of marine conservation. In particular, meta-analysis has been recently used to provide a synthesis of the performance of MPAs across multiple spatial and temporal scales [14]. The objective of this study is to evaluate the overall performance of CBCRM programs in the Philippines in achieving its conservation and fisheries management goals. Although this study cannot claim to be an exhaustive synthesis, it does offer the first quantitative overall estimate of the magnitude and trajectory of the performance of CBCRM programs in the country.

2. Materials and methods

2.1. Study selection and data collection

All studies included in the meta-analyses used the fisheries co-management research framework developed by the Worldwide Collaborative Research Project on Fisheries Co-management (WCRPFC) [10,16,17]. The WCRPFC is a collaborative project

* Corresponding author. Tel.: +1 321 4317599; fax: +1 321 6747238.
E-mail addresses: rmaliao@fit.edu, rjmaliao@gmail.com (R.J. Maliao), robert.pomeroy@uconn.edu (R.S. Pomeroy), turingan@fit.edu (R.G. Turingan).
1 Previous address: Southeast Asian Fisheries Development Center, Aquaculture Department, 5021 Tigbauan, Iloilo, Philippines.

0308-597X/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.marpol.2009.03.003

between the WorldFish Center in Malaysia (originally International Center for Living Aquatic Resources Management or ICLARM and formerly based in the Philippines) and the Institute of Fisheries Management in Denmark, with national partners in Asia and Africa [10]. The fisheries co-management research framework is adapted from theoretical and empirical work on the Institutional Analysis and Development framework developed by researchers at the Workshop in Political Theory and Policy Analysis at Indiana University, USA [18].

The fisheries co-management research framework employed a common set of indicators based on the perceptions of the local fishers to evaluate the performance of fisheries co-management programs (see Table 1 for indicator definition) [16,17]. In the Philippines, these programs were generally implemented under the banner of CBCRM. Based on these indicators, the perceptions of the local fishers on the performance of CBCRM programs were scored using a ladder-like diagram with 10 (or 15 since the earlier work of Pomeroy et al. [16,17] used a 15 step scale) steps, where step 1 represented the worst possible scenario and step 10 (or 15) the best possible scenario. The respondents were asked to score each indicator using the 10 (or 15) step scale both before and after the implementation of CBCRM (see Pomeroy et al. [16,17] for a complete description of the methodology).

A total of 10 independent studies covering 16 CBCRM sites spanning 13 provinces in the Philippines were included in the meta-analyses (Fig. 1; Table 2). These included an array of coastal habitats, from coral reefs to mangrove forests to whole coastal ecosystems. A management intervention common to all the sites was the establishment of MPAs.

2.2. Meta-analysis

A total of eight performance indicators were employed in the meta-analyses (Table 1). In the meta-analyses, the perceived mean scores of each indicator before and after years of CBCRM served as the control and experimental treatments, respectively. Each site was treated as an independent study. Response ratio (RR) was used as the metric of effect size in the meta-analyses [12]. Effect size provides information about the magnitude and trajectory of change evident across all studies and for subsets of studies [12,19,20]. Response ratio is appropriate for evaluating the performance of CBCRM because it quantifies the proportionate change as a result of the intervention [19,20]. The natural logarithm of response ratio ($\ln RR$) was used in the meta-analyses because it behaves better statistically [19]. The $\ln RR$ of each indicator was thus calculated as [12]

$$\ln RR = \ln\left(\frac{X^A}{X^B}\right) \tag{1}$$

where X^B and X^A were the perceived mean scores of each indicator before and after years of CBCRM, respectively. The magnitude and significance of the overall mean effect ($\overline{\overline{\ln RR}}$) of each indicator was calculated based on the individual $\ln RR$ values of that particular indicator across sites. In order to comply with large sample theory which states that sites (i.e., each study) with large samples are more precise [21], each site was weighed in the calculation of $\overline{\overline{\ln RR}}$, with more weight given to sites with large sample sizes [20]. Weight (w_i) of each indicator was defined as the inverse of the variance (v_i) of its mean score and calculated as [20]

$$w_i = \frac{1}{v_i} \tag{2}$$

Since most studies included did not report v_i values, they were approximated based on the study sample sizes as [12]

$$v_i = \left[\frac{(N_i^A + N_i^B)}{N_i^A N_i^B}\right] + \left[\frac{(\ln RR_i)^2}{2(N_i^A + N_i^B)}\right] \tag{3}$$

where $N_i{}^B$ and $N_i{}^A$ were the study sample sizes for the before and after years of CBCRM, respectively. Finally, the weighted $\overline{\overline{\ln RR}}$ of each indicator was calculated as [12]

$$\overline{\overline{\ln RR}} = \frac{\sum_{i=1}^{n} w_i \ln RR_i}{\sum_{i=1}^{n} w_i} \tag{4}$$

where n was the number of studies. The corresponding confidence interval (CI) values of each $\overline{\overline{\ln RR}}$ were generated by bootstrapping based on the 95% bias-corrected confidence limits around the mean from 999 iterations [20]. Back-transformed values of $\overline{\overline{\ln RR}}$ and CI were reported. The $\overline{\overline{RR}}$ of each indicator was considered significantly different from 0 when the bounds of its corresponding CI did not overlap with 1 [20]. To determine whether the $\ln RR$ of each indicator between sites was significantly different, the total heterogeneity (Q_T) statistic was calculated as [12]

$$Q_T = \sum_{i=1}^{n} w_i(\ln RR_i - \overline{\overline{\ln RR}})^2 \tag{5}$$

Furthermore, categorical meta-analysis was conducted between indicators to determine whether they were perceived differently. To determine whether the perceptions of resource users varied with the duration of management, sites were categorized according to years of management ($\leqslant$10 [average: 6, range: 2–8]: $\geqslant$11 [average: 14, range: 11–21]) and conducted separate categorical meta-analyses between them. The duration of management was defined as the time elapsed between program commencement and post-program evaluation (overall mean: 10 years; see Table 2). The $\overline{\overline{\ln RR}}$, CI and Q_T values of each management duration category were recalculated. The significance of the difference between indicators and between management duration categories were determined using the statistic Q_b [12]:

$$Q_b = \sum_{j=1}^{c}\sum_{i=1}^{n_j} w_{ij}(\ln RR_i - \overline{\overline{\ln RR}})^2 \tag{6}$$

where c was the number of categories and n_j was the number of sites in the jth group. The significance of both Q_T and Q_b were tested against the χ^2 distribution with $n-1$ degrees of freedom, respectively. The meta-analyses were conducted in categorical fixed-effects model using MetaWin version 2.1 [20].

Table 1
The set of indicators used to evaluate the performance of CBCRM programs in the Philippines.

Performance indicators	Definition
Participation in CBCRM	Level of involvement of local resource users (e.g., fishers) in CBCRM, i.e., in MPA management
Influence over CBCRM	Level of bargaining power of local resource users over decision-making related to CBCRM, i.e., in MPA management
Control over coastal resources	Sense of influence by the local resource users to monitor and regulate the internal use pattern of coastal resources
Fair allocation of **access** right to coastal resources	Fairness of the allocation of rights to enter and withdraw coastal resources to different sectors of resource users
Household **income**	Household profits generated from fishing-related livelihood
Conflict management	Competitiveness and promptness of resolving disputes related to coastal use and appropriation
Fish abundance	General well-being of coastal resources using fish abundance as an index
Community **compliance** with fisheries rules	Conformity of behaviors of local resource users to the prescribed operational-level rules

Bolded texts were the terms used to describe each indicator.

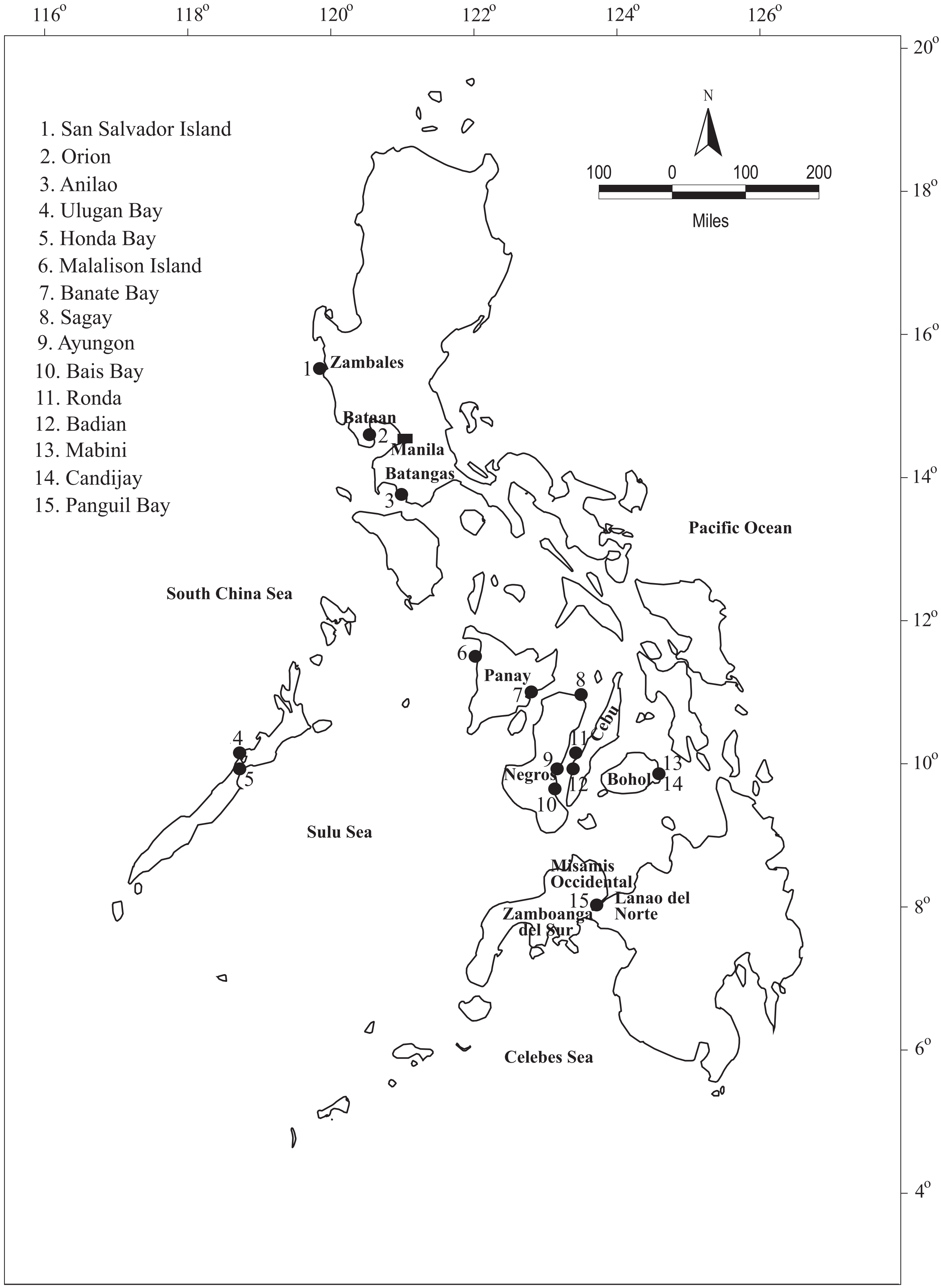

Fig. 1. CBCRM sites included in the meta-analyses.

Table 2
CBCRM sites included in the meta-analyses.

CBCRM site (municipality)	Province	Major CBCRM program[a]	Year started	Year	evaluated	Duration of mgt.		
Major habitat	N[b]	Refs.						
Ayungon	Negros Oriental	Central Visayas Regional Project 1 (CVRP-1)	1984	1996	12	Coastal ecosystem	66	[17]
Badian	Cebu	CVRP-1	1984	1996	12	Coastal ecosystem	64	[17]
Ronda	Cebu	CVRP-1	1985	1996	11	Coastal ecosystem	70	[17]
Ulugan Bay	Palawan	Coastal Environmental Program (CEP)	1994	1996	2	Coastal ecosystem	60	[17]
Honda Bay	Palawan	Honda Bay Resource Management Project	1989	1996	7	Coastal ecosystem	54	[17]
Sagay Marine Reserve (Sagay)	Negros Occidental	CEP	1995	2002	7	Coastal ecosystem	62	[25]
Mabini	Bohol	Rainfed Resources Development Project (RRDP)	1989	2004	15	Mangrove forest	60	[40]
Candijay (Mangrove reforestation)	Bohol	RRDP	1989	2004	15	Mangrove forest	60	[40]
Panguil Bay	Mindanao[c]	Fisheries Sector Program (FSP)	1990	2002	12	Coastal ecosystem	442	[54]
Candijay (Kawasihan Fish Sanctuary)	Bohol	RRDP	1996	2004	8	Coral reef	40	[63]
San Salvador Fish Sanctuary (Masinloc)	Zambales	Marine Conservation Project for San Salvador	1989	1996	7	Coral reef	42	[64]
Orion	Bataan	Sustainable Rural District Development Program; FSP	1994	1998	4	Coastal ecosystem	75	[65]
Malalison Marine Sanctuary (Culasi)	Antique	Community Fisheries Resource Management Project	1991	1996	5	Coral reef	42	[66]
Banate Bay	Iloilo	Canadian International Development Agency-Local Government Support program	1996	2002	6	Coastal ecosystem	60	[67]
Bais Bay	Negros Oriental	CVRP-1; CEP	1984	2005	21	Coastal ecosystem	60	[68]
Anilao Area (Mabini–Tingloy)	Batangas	CEP; Balayan Bay Integrated Coastal Management Project	1990	2005	15	Coral reef	60	[68]

[a] Only referred to major CBCRM programs during the time of evaluation.
[b] Total number of respondents interviewed.
[c] Panguil Bay is located in the southern island of Mindanao and is bordered by three provinces: Lanao del Norte in the east and Zamboanga del Sur and Misamis Occidental in the west.

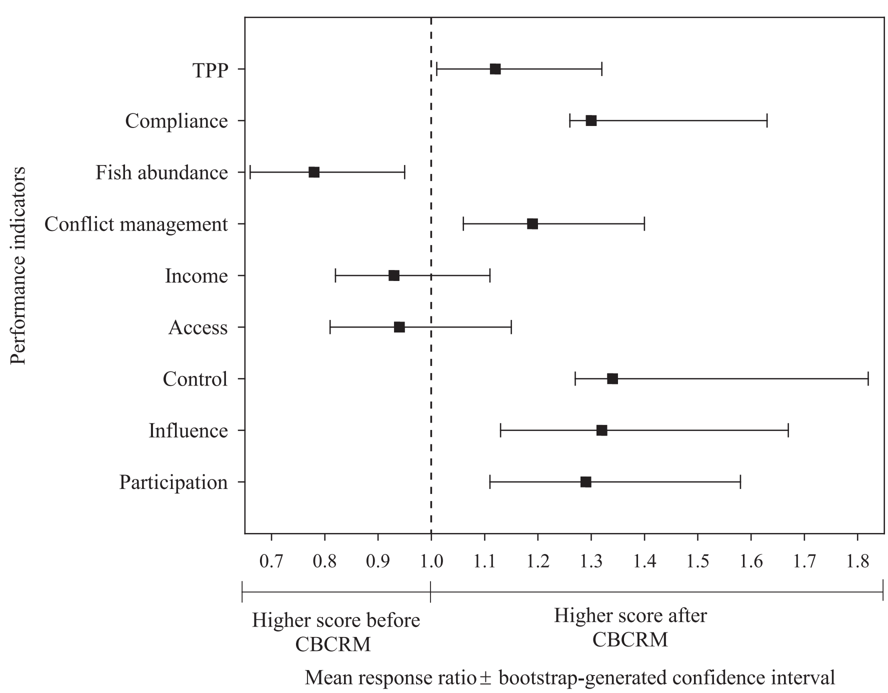

Fig. 2. Performance of CBCRM programs in the Philippines based on the 8 indicators (TPP—total perceived performance).

3. Results

Based on overall performance (i.e., the total perceived performance or TPP), CBCRM in the Philippines had significant positive impact ($\overline{\overline{RR}} = 1.12$, $CI = 1.11–1.58$) (Fig. 2). However, the TPP and all indicators were perceived to be significantly different between sites (Table 3). Each of the indicators was also perceived differently ($Q_b = 145.46$, $DF = 7$, $P < 0.001$). Fish abundance was perceived to significantly decrease ($\overline{\overline{RR}} = 0.78$, $CI = 0.66–0.95$) after the implementation of CBCRM. Income ($\overline{\overline{RR}} = 0.93$, $CI = 0.82–1.11$) and resource access ($\overline{\overline{RR}} = 0.94$, $CI = 0.81–1.15$) were perceived to deteriorate over time, but both were not significantly different from the baseline values. On the other hand, participation ($\overline{\overline{RR}} = 1.29$, $CI = 1.11–1.58$), influence ($\overline{\overline{RR}} = 1.32$, $CI = 1.13–1.67$), control ($\overline{\overline{RR}} = 1.34$, $CI = 1.27–1.82$), conflict management ($\overline{\overline{RR}} = 1.19$, $CI = 1.06–1.40$) and compliance ($\overline{\overline{RR}} = 1.30$, $CI = 1.26–1.64$) were all perceived to significantly improve over time.

Perceptions on resource access and conflict management demonstrated categorical differences among management durations (Fig. 3; Table 3). Access to resources was perceived higher in sites with $\leqslant 10$ years of management ($\overline{\overline{RR}} = 1.07$, $CI = 0.70–1.51$) compared with those sites with $\geqslant 11$ years of management ($\overline{\overline{RR}} = 0.87$, $CI = 0.81–1.02$). Similarly, conflict management was perceived higher in sites with $\leqslant 10$ years of management ($\overline{\overline{RR}} = 1.37$, $CI = 1.20–1.57$) compared with those sites with $\geqslant 11$ years of management ($\overline{\overline{RR}} = 1.11$, $CI = 0.98–1.37$).

4. Discussion

4.1. Performance of CBCRM in the Philippines and worldwide

CBCRM program are implemented worldwide to meet both conservation (i.e., ecological) and fisheries management (i.e., socio-economic) goals [2,10,15]. MPAs are generally the centerpieces of CBCRM because they are site-specific and could display tangible benefits through a locally controlled mandate [11]. Evaluating the performance of CBCRM requires the use of indicators that reflect both the ecological and socio-economic

Table 3
Summary statistics of meta-analyses.

Performance indicators	Overall meta-analysis			Categorical meta-analysis according to years of management ($\leqslant 10$:$\geqslant 11$)			
	Q_T	DF	P	Q_b	P	DF	
						$\leqslant 10$	$\geqslant 11$
Participation	41.85	15.00	<**0.001**	0.28	0.60	7.00	7.00
Influence	53.94	14.00	<**0.001**	0.06	0.87	6.00	7.00
Control	51.14	14.00	<**0.001**	0.15	0.70	6.00	7.00
Access	81.78	15.00	<**0.001**	6.27	<**0.01**	7.00	7.00
Income	63.47	15.00	<**0.001**	0.12	0.73	7.00	7.00
Conflict management	31.05	15.00	<**0.001**	6.57	<**0.01**	7.00	7.00
Fish abundance	67.49	15.00	<**0.001**	0.80	0.37	7.00	7.00
Compliance	24.64	14.00	<**0.001**	0.03	0.86	6.00	7.00
Total perceived performance	31.15	15.00	<**0.001**	0.49	0.48	7.00	7.00

Bolded text signified that the difference was statistically significant.

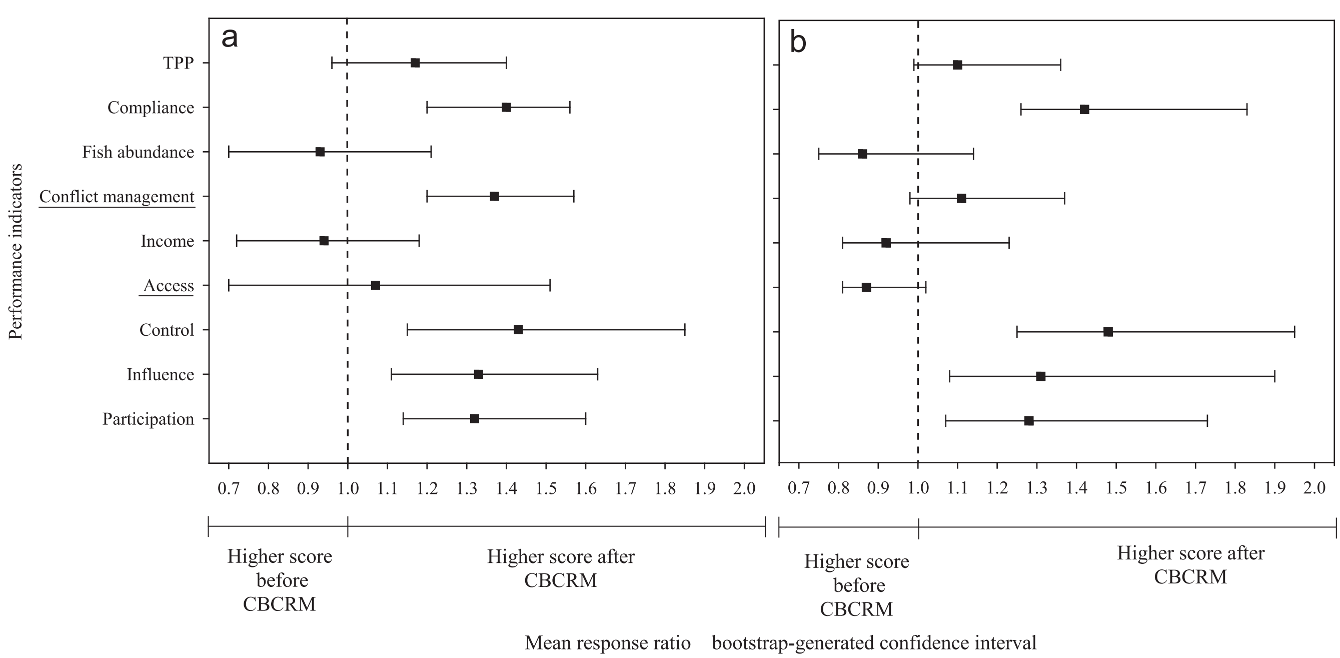

Fig. 3. Result of categorical meta-analysis with the duration of management: (left) $\leqslant 10$ years and (right) $\geqslant 11$ years. Conflict management and resources access (underlined) were significantly different between categories (TPP—total perceived performance).

goals of the program to ensure a holistic evaluation [15]. Examples of ecological indicators include the diversity, abundance, biomass and size of focal species [14,15,22–24]. Examples of socio-economic indicators include increase cooperation among resource users, income generation, equity of benefit distribution and other community livelihood parameters [2,7,8,10,15,24]. Recently, The World Conservation Union's World Commission on Protected Areas—Marine and the World Wide Fund for Nature jointly initiated the MPA Management Effectiveness Initiative to develop performance indicators and provide guidelines in evaluating the performance of the MPAs worldwide (see [15,24] for the details of the methodology). Ideally, evaluating the performance of CBCRM requires the comparison of the performance of each indicators used before and during (or after) the program is implemented [8,15–17,24]. In situations where baseline information is lacking, a proposed alternative is to assess the performance of each indicator based on the perceptions of the local resource users [16,17,25–27]. Hence, perception indicators represent a crucial tool in performance evaluation, particularly in data-depauperate situations common in the developing countries [16,17,28–30].

The overall outcome of the meta-analyses in this study, which indicates a mixed view of how the CBCRM program works in the Philippines, is consistent with the assessment of previous reviews. In 1997, Pomeroy and Carlos [8] reported that only 19% of the 47 completed CBCRM programs in the Philippines from the period 1984 to 1994 are sustained after external supports were terminated. Similarly, in 1999, Pajaro et al. [31] reported that only 10% of the over 439 MPAs in the Philippines are well-enforced. Since then, more CBCRM programs and MPAs have been implemented nationwide [5,32]. More recently, White et al. [6] evaluated the performance of 156 MPAs in the Philippines and reported that 44.2% of these MPAs have good to excellent management, indicating an increase in management performance.

The mixed reviews of the performance of CBCRM programs in the Philippines, as perceived by the local resource users, reflect the global trend. In Kenya, McClanahan et al. [33] reported that only a slight majority of the local fishers perceived that they benefited from MPA implementation. Kelleher et al. [34] reported that only 31% out of 1306 MPAs worldwide are considered to meet their management objectives. More recently, using poaching as an indirect measurement of performance, Mora et al. [35] found that only 10% of 980 MPAs worldwide are well-enforced. In Southeast Asia, the global epicenter of marine biodiversity, only 14% of 332 MPAs are effectively managed [36]. The high perception that the establishment of MPAs have failed to achieve their major goals is perhaps a reflection of the apparent lack of good management and law enforcement mechanisms following their implementations [36]. Thus, it is likely that the numbers, ages and sizes of MPAs in a given locale are inadequate indicators of an effective CBCRM strategy.

4.2. Ecological dimension

The mixed perceptions regarding the fisheries impact of CBCRM programs (primarily through its MPA component) reflect the multitude of factors that could potentially influence the rate of fish recovery after protection (see the review of Russ [37]). The capacity of MPAs to enhance the local fish populations (e.g., abundance, size and biomass) within its borders is largely influenced by the level of management both within the MPA and outside its borders [37–40]. Lack of effective management mechanisms outside the borders of MPAs, coupled with possible localized concentration of fishing effort in the surrounding areas, could potentially negate its efficacy [41]. In the Philippines, these factors are exacerbated by the small sizes of MPAs ($\sim<1\,km^2$) and weak enforcement, making them more vulnerable to poaching [8,10,25,36,37,42]. The modeling simulation of Sethi and Hilborn [43] demonstrated that a high level of poaching can totally negate MPA effects. In Italy, several of the implemented MPAs are poorly enforced and no effects were detected on the local fish assemblages [44]. Similarly, in the Philippines, the magnitude of MPA effects are dependent on good enforcement mechanisms [5,22,37–40].

One ecological trait to consider in evaluating the efficacy of MPA as a CBCRM tool is that fish response to protection is species-specific [14,23,37,38]. Based on life history theory [45], fish species that are characterized by long-age at maturity (e.g., target species like groupers) are predicted to have gradual, slower responses to protection and therefore their recovery may take several decades [23,37,41]. Thus, the relatively short duration of protection in this study (overall mean: 10 years), coupled with the very low abundance of fishes (due to over-fishing) during the initiation of protection [46], could partly explain the perceived minimal impact of the establishment of MPAs on the enhancement of fisheries resources in the Philippines. However, the persistence of the perceived non-recovery of the fish populations even in older reserves managed >11 years (average: 14 years) indicates that other factors could play a role, such as habitat modification, low rates of recruitment success, trophic reorganization and possible cultivation–depensation effects (see reviews of Russ [37], Gerber et al. [41] and Hutchings [45]).

Even if MPAs are effective in enhancing the population parameters of fishes within their borders [14,22,23,37–39,41,50], their impacts on the fisheries are determined by the magnitude of biomass spillovers and recruitment subsidies [23,37,41,50]. Although there is indirect evidence of biomass spillover, as indicated by a gradient in catch per unit effort and fish abundance from the MPA, it is predicted that spillover from MPAs is only important at the scale of a few hundred meters [37,47–49]. Hence, the potential impact of spillover to the fisheries may be limited. Abesamis et al. [48] estimated that the fishery yield attributable to biomass spillover in Apo Reserve in the Philippines is only 10% or less of the total fishery yield. In Mombasa Marine Park and Reserve in Kenya, McClanahan and Mangi [50] indicated that while fish biomass inside the park over the 7 year protection period has increased, local catches in the adjacent fishery remained below the pre-protection levels. The limited fisheries impacts of the Philippine MPAs could have profound negative externalities on the compliance behavior of the local resource users in the long term [18].

4.3. Socio-economic dimension

The adoption of several Codes in the Philippines in the last two decades which decentralized various authorities to the local government units (LGUs) (e.g., Local Government Code of 1991 and Fisheries Code of 1998) provided the impetus for the institutionalization of CBCRM [4,11,32]. This paradigm shift in resource governance provided an avenue for the integration of the local fishing communities in the decision-making process [4,11,32]. The perceived overall improvement of the performance of the CBCRM programs in the Philippines was principally brought about by the significant progress in performance indicators associated with community empowerment (e.g., participation, influence, control, conflict management and compliance). This suggests that the CBCRM in the Philippines was successful in empowering the local communities of resource users.

However, the deterioration of conflict management with the duration of management presents a major challenge to the sustainability[2] of the CBCRM. This breakdown is perhaps a reflection of the dependence of the CBCRM in the Philippines on external support, in which funding is withdrawn once the project is terminated [8,32,52]. Pomeroy and Carlos [8] found that the majority of the previous CBCRM programs in the Philippines were not sustained after the external supports were terminated. It is likely that the sustainability of the CBCRM in the Philippines will now increase as both local and national governments allocate more funds for CBCRM [32]. However, the parochial interests of the LGUs and the short tenure of the local executives could also hinder CBCRM sustainability [5,40,53,54]. There are many documented cases in the Philippines where the CBCRM disintegrated due to the local politics. MPAs in Sumilon (Cebu) [5] and Sagay (Negros Occidental) [25] were opened to fishing in 1984–1985 and 1986, respectively, due to changes in local executives who were not supportive of the MPA concept. Christie et al. [55] reported that the management of the MPAs in Sal Salvador (Zambales), Twin Rocks (Batangas) and Balicasag (Bohol) have deteriorated due to the inconsistent support of the relevant LGUs. Similar breakdowns have occurred in Batan Bay (Aklan) [56] and in Cogtong Bay (Bohol) [40]. Apparently, the sustainability of CBCRM hinges on continuous and broad-based supports from both the local resource users and the LGUs that authorize them [8,51].

There are several socio-economic issues that may complicate the assessment of the efficacy of the CBCRM approach to MPA governance in the Philippines. First, the deterioration of conflict management over time, despite the continuous improvement of local compliance, suggests that resource-use conflicts may be caused by resource users coming from outside the local communities. Such intrusions are reminiscent of 'roving bandits' [57], causing local 'fish wars' [58] and severely taxing local enforcement and could potentially erode local support and compliance [43]. Second, a shift in resource-use patterns from farming to fishing further increased conflicts in coastal areas [40]. This is a reflection of the open-access nature of the fishery and signifies that fishing offers an alternative source of livelihood in the tropics when other natural resources are depleted. Third, rapid population growth, as well as technology and economic transformations could contribute to the breakdown of communal property mechanisms [40,59]. An example of this is the promotion of ecotourism in MPAs. Ecotourism has been demonstrated to bring economic benefits to local communities [5], but has the potential to cause economic disempowerment of the host communities if only few individuals could take advantage of the economic opportunities associated with ecotourism activities [60–62]. Finally, the reallocation of resource right and access associated with MPA implementations further constrict the limited livelihood opportunities available to the local resource users.

5. Conclusions

This study demonstrates that although the CBCRM programs in the Philippines are effective in engaging the local community of resource users in resource management, the resource users remained sceptical about the programs' impact on uplifting their livelihood. This highlights the importance of incorporating ecological considerations in making conservation and fisheries management targets and communicating these to the local resource users. The continuing and emerging threats to locally successful CBCRM programs in the Philippines are inconsistent political support and 'roving banditry'. To address these, there is a need to network CBCRM programs across the political spectrum to cement collective and cohesive management actions at a wider spatial scale (i.e., across LGUs). Finally, the limited fisheries impact of CBCRM, through its MPA component, should not be taken as evidence against the implementation of MPAs in the Philippines and elsewhere. MPAs implemented through CBCRM represent a novel approach in managing multispecies fisheries particularly in developing countries where conventional techniques (input/output/technical control) are notoriously hard to implement.

[2] Sustainability is defined here as consistent support of the government and continuous participation of the local resource users on the CBCRM programs [51].

Acknowledgments

Maliao is supported by the Fulbright-Philippines Agriculture Scholarship Program. We are thankful to van Mulekum and Subade for information on Bataan and Iloilo CBCRM programs. The critical comments of Webb, Polohan, Didoha, Kerfoot, Wittenrich and Piloton in the initial drafts of this manuscript are greatly appreciated. Pomeroy acknowledges the Oak Foundation for their support. Finally, the comments of an anonymous reviewer are greatly appreciated.

References

[1] Wilson DC, Ahmed M, Siar SV, Kanagaratnam U. Cross-scale linkages and adaptive management: fisheries co-management in Asia. Marine Policy 2006;30:523–33.
[2] Pomeroy RS, Viswanathan K. Experiences with fisheries co-management in Southeast Asia and Bangladesh. In: Wilson DC, Nielsen RJ, Degnbol P, editors. The co-management experience: accomplishments, challenges and prospects. Dordrecht, The Netherlands: Kluwer Academic Publishers; 2003. p. 99–115.
[3] Jentoft S. Fisheries co-management as empowerment. Marine Policy 2005;29:1–7.
[4] White AT, Courtney CA, Salamanca A. Experience with marine protected area planning and management in the Philippines. Coastal Management 2002; 30:1–26.
[5] Alcala AC, Russ GR. No-take marine reserves and reef fisheries management in the Philippines: a new people power revolution. Ambio 2006;35:245–54.
[6] White AT, Meneses ABT, Ovenden MF, Tesch S. Sustaining marine protected areas through continued monitoring and evaluation: the MPA report guide and management rating system. In: Paper presented at the 10th International Coral Reef Symposium, Okinawa Convention Center, Okinawa, Japan; 28 June–02 July 2004.
[7] Pomeroy RS. Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia. Ocean and Coastal Management 1995;27:143–62.
[8] Pomeroy RS, Carlos MB. Community-based coastal resource management in the Philippines: a review and evaluation of programs and projects, 1984–1994. Marine Policy 1997;21:445–64.
[9] Pomeroy RS, Katon BM, Harkes I. Conditions affecting the success of fisheries co-management: lessons from Asia. Marine Policy 2001;25:197–208.
[10] Pomeroy RS, Ahmed M. Fisheries and coastal resources co-management in Asia: selected results from a regional research project. In: WorldFish Center Studies and Reviews, vol. 30, The WorldFish Center, Penang, Malaysia; 2006.
[11] White AT, Gomez E, Alcala AC, Russ G. Evolution and lessons from fisheries and coastal management in the Philippines. In: McClanahan TR, Castilla JC, editors. Fisheries management: progress towards sustainability. IA, USA: Blackwell Publishing Ltd.; 2007. p. 88–111.
[12] Hedges LV, Olkin I. Statistical methods for meta-analysis. San Diego, CA, USA: Academic Press; 1985.
[13] Fazey I, Salisbury JG, Lindenmayer DB, Maindonald J, Douglas R. Can methods applied in medicine be used to summarize and disseminate conservation research? Environmental Conservation 2004;31:190–8.
[14] Mosquera I, Côté IM, Jennings S, Reynolds JD. Conservation benefits of marine reserves for fish populations. Animal Conservation 2000;3:321–32.
[15] Pomeroy RS, Watson LM, Parks JE, Cid GA. How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas. Ocean and Coastal Management 2005;48:485–502.
[16] Pomeroy RS, Pollnac RB, Katon BM, Predo CD. Evaluating factors contributing to the success of community-based coastal resource management: the Central Visayas Regional Project-1, Philippines. Ocean and Coastal Management 1997;36:97–120.
[17] Pomeroy RS, Pollnac RB, Predo CD, Katon BM. Impact evaluation of community-based coastal resource management projects in the Philippines. Research Report no. 3 of the Fisheries Co-management Research Project. ICLARM, Manila, Philippines; 1996.

[18] Ostrom E. Governing the commons: the evolution of institutions for collective action. NY, USA: Cambridge University Press; 1990.
[19] Hedges LV, Gurevitch J, Curtis PS. The meta-analysis of response ratios in experimental ecology. Ecology 1999;80:1150–6.
[20] Rosenberg MS, Adams DC, Gurevitch J. MetaWin 2.0: statistical software for meta-analysis. MA, USA: Sinauer Associates; 2000.
[21] Cooper HM, Hedges LV. The handbook of research synthesis. NY, USA: The Russell Sage Foundation; 1994.
[22] Maliao RJ, Webb EL, Jensen KR. A survey of stock of the donkey's ear abalone, *Haliotis asinina* L. in the Sagay Marine Reserve, Philippines: evaluating the effectiveness of marine protected area enforcement. Fisheries Research 2004;66:343–53.
[23] Alcala AC, Russ GR, Maypa AP, Calumpong HP. A long-term, spatially replicated experimental test of the effect of marine reserves on local fish yields. Canadian Journal of Fisheries and Aquatic Sciences 2005;62:98–108.
[24] Pomeroy R, Parks J, Watson L. How is your MPA doing? A guidebook of natural and social indicators for evaluating marine protected area management effectiveness. IUCN, Gland, Switzerland and Cambridge, UK; 2004. Available at: 〈http://www.effectivempa.noaa.gov/guidebook/guidebook/html〉.
[25] Webb EL, Maliao RJ, Siar SV. Using local user perceptions to evaluate outcomes of protected area management in the Sagay Marine Reserve, Philippines. Environmental Conservation 2004;31:138–48.
[26] Johannes RE, Freeman MMR, Hamilton RJ. Ignore fishers' knowledge and miss the boat. Fish and Fisheries 2000;1:257–71.
[27] Berkes F, Colding J, Folke C. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications 2000;10:1251–62.
[28] Pollnac RB, Crawford BR, Gorospe MLG. Discovering factors that influence the success of community-based marine protected areas in the Visayas, Philippines. Ocean and Coastal Management 2001;44:683–710.
[29] Suman D, Shivlani M, Milon JW. Perceptions and attitudes regarding marine reserves: a comparison of stakeholder groups in the Florida Keys National Marine Sanctuary. Ocean and Coastal Management 1999;42:1019–40.
[30] Bunce M, Rodwell LD, Gibb R, Mee L. Shifting baselines in fishers' perceptions of island reef fishery degradation. Ocean and Coastal Management 2008;51: 285–302.
[31] Pajaro M, Olano F, San Juan B, Nozawa CM. Inventory of marine protected areas in the Philippines. In: Uychiaoco et al., editors, Proceedings of the workshop on marine protected areas in the Philippines. Philippine Council for Aquatic and Marine Resources and Development (PCAMRD), Los Baños, Philippines; 1999.
[32] White A, Deguit E, Jatulan W, Eisma-Osorio L. Integrated coastal management in Philippine local governance: evolution and benefits. Coastal Management 2006;34:287–302.
[33] McClanahan T, Davies J, Maina J. Factors influencing resource users and managers' perceptions towards marine protected area management in Kenya. Environmental Conservation 2005;32:42–9.
[34] Kelleher G, Bleakley C, Wells S. Global representative system of marine protected areas. Washington DC, USA: The World Bank; 1995.
[35] Mora C, Andrefouet S, Costello MJ, Kranenburg C, Rollo A, Veron J, et al. Coral reefs and the global network of marine protected areas. Science 2006;312:1750–1.
[36] Burke L, Bryant D, McManus JW, Spalding M. Reefs at risk in Southeast Asia. Washington DC, USA: World Resources Institute; 2002.
[37] Russ GR. Yet another review of marine reserves as reef fishery management tools. In: Sale PF, editor. Coral reef fishes: dynamics and diversity in a complex ecosystem. San Diego, CA, USA: Academic Press; 2006. p. 421–43.
[38] Samoilys MA, Martin-Smith KM, Giles BG, Cabrera B, Anticamara JA, Brunio EO, et al. Effectiveness of five small Philippines' coral reef reserves for fish populations depends on site-specific factors, particularly enforcement history. Biological Conservation 2007;136:584–601.
[39] Walmsley SF, White AT. Influence of social, management and enforcement factors on the long-term ecological effects of marine sanctuaries. Environmental Conservation 2004;30:388–407.
[40] Maliao RJ, Polohan BB. Evaluating the impacts of mangrove rehabilitation in Cogtong Bay, Philippines. Environmental Management 2008;41:414–24.
[41] Gerber LR, Botsford LW, Hastings A, Possingham HP, Gaines SD, Palumbi SR, et al. Population models for marine reserve design: a retrospective and prospective synthesis. Ecological Applications 2003;13:S47–64.
[42] Christie P, White A. Best practices for improved governance of coral reef marine protected areas. Coral Reefs 2007;26:1047–56.
[43] Sethi SA, Hilborn R. Interactions between poaching and management policy affect marine reserves as conservation tools. Biological Conservation 2008; 141:506–16.
[44] Guidetti P, Milazzo M, Bussotti S, Molinari A, Murenu M, Pais A, et al. Italian marine reserve effectiveness: does enforcement matter? Biological Conservation 2008;141:699–709.
[45] Hutchings JA. Collapse and recovery of marine fishes. Nature 2000;406: 882–5.
[46] Alcala AC, Russ GR. Status of Philippine coral reef fisheries. Asian Fisheries Science 2002;15:177–92.
[47] Russ GR, Alcala AC, Maypa AP, Calumpong HP, White AT. Marine reserve benefits local fisheries. Ecological Applications 2004;14:597–606.
[48] Abesamis RA, Russ GR. Density-dependent spillover from a marine reserve: long-term evidence. Ecological Applications 2005;15:1798–812.
[49] Abesamis RA, Alcala AC, Russ GR. How much does the fishery at Apo Island benefit from spillover of adult fish from the adjacent marine reserve? Fishery Bulletin 2006;104:360–75.
[50] McClanahan TR, Mangi S. Spillover of exploitable fishes from a marine park and its effect on the adjacent fishery. Ecological Applications 2000;10: 1792–805.
[51] Christie P, Lowry K, White AT, Oracion EG, Sievanen L, Pomeroy RS, et al. Key findings from a multidisciplinary examination of integrated coastal management process sustainability. Ocean and Coastal Management 2005;48: 468–83.
[52] Salamanca AM. The cost of action: CRM investment in the Philippines. Naga 2003;26:25–9.
[53] Alcala AC. Community-based coastal resource management in the Philippines: a case study. Ocean and Coastal Management 1998;38:179–86.
[54] Israel D, Adan EY, Lopez NF, de Castro JC. Household perceptions of the long-term impact of coastal resources management in Panguil Bay. Discussion Paper Series no. 2004-02, Philippine Institute for Development Studies, Manila, Philippines; 2004.
[55] Christie P. Marine protected areas as biological successes and social failures in Southeast Asia. American Fisheries Society Symposium 2004;42:155–64.
[56] Fernandez PR, Matsuda Y, Subade RF. Coastal area governance system in the Philippines. Journal of Environmental Development 2000;9:341–69.
[57] Berkes F, Hughes TP, Steneck RS, Wilson JA, Bellwood DR, Crona B, et al. Globalization, roving bandits, and marine resources. Science 2006;311: 1557–8.
[58] Pomeroy R, Parks J, Pollnac R, Campson T, Genio E, Marlessy C, et al. Fish wars: conflict and collaboration in fisheries management in Southeast Asia. Marine Policy 2007;31:645–56.
[59] Berkes F. From community-based resource management to complex systems: the scale issue and marine commons. Ecology and Society 2006; 11:45.
[60] Oracion EG, Miller ML, Christie P. Marine protected areas for whom? Fisheries, tourism, and solidarity in a Philippine community. Ocean and Coastal Management 2005;48:393–410.
[61] Thiele MT, Pollnac RB, Christie P. Relationships between coastal tourism and ICM sustainability in the central Visayas region of the Philippines. Ocean and Coastal Management 2005;48:378–92.
[62] Majanen T. Resource use conflicts in Mabini and Tingloy, the Philippines. Marine Policy 2007;31:480–7.
[63] Maliao RJ. Impact assessment of Kawasihan Sanctuary in Bohol, Philippines. Research Progress Report, Central Visayas State College of Agriculture, Forestry and Technology—Candijay Fisheries Campus, Bohol, Philippines; 2005.
[64] Katon BM, Pomeroy RS, Garces LR, Salamanca AM. Fisheries management of San Salvador Island, Philippines: a shared responsibility. Society and Natural Resources 1999;12:777–95.
[65] van Mulekom L, Tria E. Community-based coastal resource management in Orion, Bataan, Philippines: a case study on the development of a municipal-wide community-based fisheries co-management system. Fisheries Co-management Research Project, Working Paper no. 38, ICLARM, Manila, Philippines; 1999.
[66] Baticados DB, Agbayani RF. Co-management in marine fisheries in Malalison Island, Central Philippines. International Journal of Sustainable Development and World Ecology 2000;7:343–55.
[67] Baylon CC. Evaluation of the integrated municipal council as an institution for co-management in the coastal zone. Fisheries Co-management Project Research Report no. 18, WorldFish Center, Penang, Malaysia; 2002.
[68] Pomeroy RS, Oracion EG, Pollnac RB, Caballes DA. Perceived economic factors influencing the sustainability of integrated coastal management projects in the Philippines. Ocean and Coastal Management 2005;48: 360–77.