Formal Co-management Arrangements and MPA Success in the Wider Caribbean

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ABSTRACT

A popular conservation tool in the wider Caribbean, marine protected areas are increasingly being managed through co-management arrangements, where government authorities share planning, management, and decision making responsibilities with local users and other stakeholders. Co-management arrangements are expected to improve the planning and management process and enhance social and ecological impacts of MPAs, yet few empirical studies have examined the relationship between co-management and MPA success. Using social and ecological data from a rapid assessment of twenty-eight MPAs and their associated communities in the wider Caribbean, this study investigates relationships between formalized co-management arrangements and measures of MPA success, which consist of stakeholders' perceptions and measured ecological impacts. Findings indicate that formal co-management arrangements were not associated with stakeholders' perceptions of the management process and social impacts, nor with measured impacts on fish and coral conditions; however, co-management arrangements were related to stakeholders' perceptions of some ecological factors. These empirical results support claims in the resource management literature that simply formalizing a co-management arrangement does not necessarily lead to management success. A variety of factors associated with co-management can affect social and ecological performance of MPAs, and it is important that these factors be carefully considered in the design of co-management arrangements.

KEY WORDS: Marine protected areas, wider Caribbean, co-management

Arreglos de Co-gestión Formales en Éxito de AMP en el Grande Caribe

Un instrumento de conversación popular en el grande Caribe, aéreas marinas protegidas (AMP) ha rápidamente sido mantenidas con arreglos administrativos, donde autoridades gubernamentales comparten planificaciones, administración y la responsabilidad de hacer decisiones con usuarios locales y otros accionistas. Arreglos administrativos son esperados a mejorar la planificación y proceso de gestión y mejorar los impactos sociales y ecológicos de AMPs, aunque pocos estudios empíricos han examinado la relación entre administraciones y el éxito de APM. Usando datos sociales y ecológicos de una evaluación rápida de veintiocho AMPs y las comunidades asociadas en el grande Caribe, este estudio investiga relaciones entre arreglos formalizados administrativos y cierto éxito de AMPs, que consiste de las percepciones de accionistas e impactos ecológicos medidos. Encuentros indican que arreglos administrativos formales no eran asociados con las percepciones de accionistas del proceso de gestión e impactos sociales, ni con impactos medidos a las condiciones de pescados y corales; aunque, arreglos de co-gestión eran relacionados a las percepciones accionistas de algunos factores ecológicos. Estos resultados empíricos apoyan reclamaciones en recursos administrativas literarias que simplifican la formación de un arreglo administrativos que no necesariamente llega a un éxito en la gestión. Una variedad de factores asociados con administración puede afectar socialmente y ecológicamente el rendimiento de AMPs, y es importante que estos factores sean considerados con cuidado en el diseño de arreglos administrativos.

PALABRAS CLAVE: Aéreas marinas protegidas, el grande Caribe, arreglos administrativos

Des Accords Formels de Cogestion et la Réussite des AMP aux Caraïbes et Ses Environs

Des aires marines protégées (AMP) sont gérées de plus en plus par des accords de cogestion, un outil commun de la conservation aux Caraïbes et ses environs, dans lequel des autorités gouvernementaux partagent la planification, la gestion, et la responsabilité de prendre des décisions avec des utilisateurs du lieu et d'autres intéressés. On s'attend à ce que des accords de cogestion améliorent le processus de planification et de gestion et à ce qu'ils augmentent les influences sociales et écologiques des AMP, mais peu d'études empiriques ont étudié le rapport entre la cogestion et la réussite des AMP. En se servant des données sociales et écologiques d'une évaluation rapide de vingt-huit AMP et leurs communautés aux Caraïbes, cette étude examine des rapports entre des accords formalisés de cogestion et des mesures de la réussite des AMP, qui consistent des perceptions des intéressés et des impacts écologiques mesurés. Des résultats indiquent que des accords formalisés de cogestion n'ont ni association avec les perceptions des intéressés du processus de gestion et des impacts sociaux, ni association avec les impacts mesurés sur des conditions de vie des poissons et des coraux ; par contre, des accords de cogestion avaient un effet sur la perception des intéressés de certains facteurs écologiques. Ces résultats empiriques soutiennent des affirmations dans la littérature de la gestion des ressources naturelles que formaliser simplement un accord de cogestion ne produit pas nécessairement une réussite gestionnaire. De nombreux éléments associés avec la cogestion peuvent influencer le fonctionnement social et écologique des AMP, et il faut considérer soigneusement ces éléments dans la conception des accords de cogestion.

MOT CLÉS: Aires marines protégées, Caraïbes, accords de cogestion

INTRODUCTION

A popular conservation tool in the wider Caribbean, marine protected areas (MPAs) are increasingly being managed through co-management arrangements, where government authorities share planning, management, and decision making responsibilities with local users and other stakeholders. Co-management arrangements are expected to improve the planning and management process and enhance social and ecological impacts of MPAs, yet few empirical studies have examined the relationship between co-management and MPA success. Using social and ecological data from a rapid assessment of twenty-eight MPAs and their associated human communities in the wider Caribbean, this study investigates relationships between formalized co-management arrangements and measures of MPA success.

BACKGROUND

Marine protected areas are designated sites in the ocean where human activities are managed to maintain or enhance natural or cultural features. MPAs have been implemented to conserve fish stocks, protect sensitive habitats, encourage non-extractive uses, promote scientific research, enhance educational efforts, and for other reasons. Wood et al. (2008) estimate that around 4,435 MPAs have been designated around the world, covering about 2.35 million km^2 or 0.65% of the world's oceans. The wider Caribbean region has about 500 MPAs that cover about 125,000 km^2 (Guarderas et al. 2008). MPAs in the Caribbean vary in size, level of protection, and governing arrangements.

One governing arrangement that is being used more frequently to manage Caribbean MPAs is co-management. Co-management involves a sharing of planning, management, and decision making responsibilities among government, local users, and other stakeholders associated with the MPA. The degree to which these responsibilities are shared among parties can vary at different stages of the management process, from pre-implementation planning to evaluation of an established MPA (McCay and Jentoft 1996, Pinkerton 1994, Pomeroy et al. 2004, Sen and Nielsen 1996). Co-management arrangements are expected to result in more appropriate, efficient and equitable management than more traditional management arrangements where government authorities retain most (if not all) planning, management, and decision making responsibilities (Pinkerton 1989). Possible benefits of co-management include the sharing of tasks among different organizations to increase efficiency, sharing of resources like scientific expertise, stronger connections among different organizations, reduced transaction costs, spreading of risk among parties, and reduced conflicts (Carlsson and Berkes 2005).

Formal agreements establishing co-management arrangements between government authorities and other stakeholders have been found to be an important mechanism for achieving anticipated outcomes of co-management (Pinkerton 1989). Co-management agreements that are officially recognized by government authorities and other relevant stakeholders can provide a framework to guide the management process and can lend legitimacy to the process by using a widely-accepted concept (Chuenpagdee and Jentoft 2007).

Co-management is growing in popularity for managing Caribbean coastal resources (Geoghan and Renard 2002, Pomeroy et al. 2004). Several case studies have investigated co-management arrangements at selected MPAs in the Caribbean (e.g., Mahon et al. 2003, McConney and Baldeo 2007, Pomeroy et al. 2004). To complement existing case study research on MPA co-management in the Caribbean, our study uses a quantitative, comparative analysis of 28 MPAs in the wider Caribbean to better understand the relationship between formal co-management agreements and MPA success.

METHODS

In 2006-09, we conducted rapid assessments of twenty -eight marine protected areas and their associated human communities in the wider Caribbean (Figure 1, Table 1). The MPAs offer varying levels of resource protection, but all:

i) Contain coral reef habitat;
ii) Have some area where extractive fishing is prohibited (no take area or NTA); and
iii) Were formally established by a designated government authority.

Fourteen of the MPAs had established formal co-management agreements where management authority was officially shared between at least one government agency and other stakeholders. The non-government stakeholders officially delegated co-management responsibilities varied among sites, with some sites involving an individual local non-governmental organization (NGO) and others including a board of individuals with multiple interests. We compared perceived and measured social & ecological impacts for MPAs with formal co-management agreements

Figure 1. MPA sites included in the study (circles = formally co-managed; triangles=not formally co-managed).

Table 1. information on MPA sites (co-managed v. not co-managed)

	Formally co-managed	Not formally co-managed
Average size of MPA (km^2)	49	106
Average size of NTA (km^2)	10	88
Average age of MPA at time of study (years)	13	24
Average age of NTA at time of study (years)	11	21
Average human population density (#/km^2)	124	150
Average human population associated with MPA	5,475	10,864

and those with no formal co-management agreements.

To assess measured ecological impacts, we compared two commonly-used measures of MPA performance (harvestable fish biomass & live coral cover) inside NTAs, where extractive fishing is not allowed, and in comparable reference sites outside the NTA. At each site, divers conducted a 45 minute roving swim, counting all diurnal fish of species typically targeted by fishermen that appeared to be > 25 cm in length. We converted estimates of fish body lengths to mass using length-weight regressions from Fishbase (Froese and Pauly 2008) and summed mass estimates to yield the total mass of fish per site, or fish biomass. To estimate the percent cover of live coral, we used the linear point intercept method. At each site, between four to seventeen haphazardly located 30 m transect lines were laid over the reef's surface and, at 20 cm intervals, divers recorded whether or not the tape overlaid live scleractinian coral. The percent cover of live coral was calculated as the fraction of points overlaying coral. We calculated the log-response ratio (lnRR) of harvested fish biomass and live coral cover to capture the proportional response of fish and coral to protection by the MPA.

To assess perceived social and ecological impacts, we conducted structured surveys of community members associated with the marine protected areas. Because population estimates were not available for most of the communities in our study, we tried to capture a broad array of views by sampling survey respondents at docks and fish landing sites, fish and vegetable markets, beaches, convenience stores, restaurants, neighborhoods, and other community gathering locations. We surveyed between 35 and 107 community members at each MPA, depending on the relative population size of the community. Respondents were asked to provide their views on conflict, compliance, local financial impacts, overall MPA success, the planning & management process, fish abundance in/out NTA, and coral conditions.

Mann-Whitney *U* tests were used to compare MPA impacts at sites that have formal co-management agreements in place and those that do not. We expected to find that MPAs with formal co-management arrangements would be more likely to have positive impacts than those without such arrangements.

RESULTS

Formal co-management arrangements were not associated with stakeholders' perceptions of the management process, social impacts, and changes in fish abundance, nor were they associated with measured impacts on fish biomass and coral cover (Table 2). However, co-management arrangements were related to stakeholders' perceptions of changes in coral cover since the MPA was established. Community members at MPAs with formal co-management agreements tended to think that coral conditions had gotten better since the MPA was established, while those at MPAs with no formal co-management agreements tended to think there was a slight decline in coral quality.

DISCUSSION

Our findings support previous studies that suggest simply formalizing a co-management arrangement does not necessarily lead to the potential benefits described in the literature (e.g., Carlsson and Berkes 2005, Fennell et al. 2008, Lowry et al. 2009). As others have suggested, additional features are likely influencing the success of co-management including effective pre-implementation, actual sharing of power among government and other stakeholders, considerations of representation, understanding of local context and cultural diversity, mutual trust among stakeholders, meaningful communication during the process, social learning, considerations of complex multi-scale institutions, strong leadership, robust social capital, conflict resolution mechanisms, and others (e.g., Armitage et al. 2009, Beem 2007, Berkes 2009, Chuenpagdee and Jentoft 2007, Gutierrez et al. 2011, Hoffman 2009, McCay and Jentoft 1996, McClanahan et al. 2006, Pomeroy et al. 2004).

The development of institutional features to facilitate stakeholder coordination in MPA co-management takes time (Beem 2007, Lowry et al. 2009); perhaps formalized co-management arrangements at our study sites have not been in place long enough to fully develop these features. For those co-management arrangements that have been in

Table 2. Mann-Whitney *U* test results comparing MPA sites that have formal co-management arrangements and those that do not (bold = statistically significant difference)

MPA impacts	Description	Formally co-managed (median)	Not formally co-managed (median)	Z	*p*-value
Perceived social & ecological impacts					
Conflict	Perceptions of a change in conflict after MPA was established (1=conflict much worse to 5=conflict much better)	3.06	3.01	-.276	.783
Compliance	Perceptions about how people follow the MPA rules (1=no one follows rules to 5=everyone follows rules)	3.00	4.00	-.978	.328
Local financial impacts	Perceptions that local people benefit financially from the MPA (0=no, 1=yes)	.53	.52	-.368	.713
Overall success	Percentage of respondents stating MPA is successful	87	84	-.529	.597
Process quality	Index of process quality based on perceptions of five important process elements: opportunity for input, influence over decisions, adequate information exchange, transparent decision making, fair decisions. (0=low quality to 5=high quality)	4.00	4.00	-.281	.778
Fish abundance	Perceptions of a change in fish abundance outside MPA (0=fish abundance decreased, 1=fish abundance increased)	.50	.41	-1.706	.088
Coral cover	Perceptions of a change in coral since MPA established (1=coral much worse to 5=coral much better)	**3.58**	**2.86**	**-3.124**	**.002**
Measured ecological impacts					
Effect on harvestable fish biomass	Proportional difference of harvestable fish biomass between the no take area(s) and adjacent sites outside the NTA	.13	.20	-.230	.818
Effect on live coral cover	Proportional difference of live coral cover between the no take area(s) and adjacent sites outside the NTA	.04	.10	-.368	.713

place longer, it is possible that an agreement was officially adopted but there have been little to no changes made in practice. It is not uncommon for MPA policies, like co-management, to be formalized on paper with no mechanisms in place for implementation (Jameson et al. 2002).

It was interesting that community members in our study perceived positive changes in coral cover at MPAs with formal co-management agreements, but we did not measure any differences in coral cover in our biological surveys. There are a couple possible explanations for this finding. First, respondents were asked for their perceptions of ecological change since the MPA was established, whereas measured ecological outcomes were based on a spatial comparison of NTAs and adjacent areas. Ecological analyses of MPA effectiveness have relied heavily on space-for-time substitutions to infer temporal dynamics, but this substitution is only an approximation (Babcock et al. 2010). Another possible explanation is that perceptions of ecological conditions may not align perfectly with measured biological conditions in the marine environment (Daw et al. 2011, Walmsley and White 2003). Perceptions can be influenced by numerous factors including beliefs, knowledge and experiences (Johnson-Laird 1983). Christie (2005) suggests that community members' perceptions of coastal resources in the Philippines were influenced by educational slogans of the coastal management program. In our study, it is possible that community members at MPAs with formal co-management agreements were more likely to hear about possible benefits of MPAs from those involved in co-management, leading them to think the MPA had positively impacted coral conditions.

Although co-management arrangements are increasingly being used to manage Caribbean MPAs, they are not necessarily leading to anticipated social and ecological outcomes. Formal co-management agreements may be one of the mechanisms supporting MPA management, but they alone are not sufficient for achieving MPA success. Our findings suggest that to be successful, co-management arrangements for Caribbean MPAs must extend beyond the formal agreement granting a share of decision making power to local users and other relevant stakeholders, and account for the dynamic, complex relationships among individuals and organizations associated with the MPA (e.g., Armitage et al. 2009, Carlsson and Berkes 2005).

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