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Participation, Adaptive Co-management, and Management Performance in the World Network of Biosphere Reserves

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Summary. — Analyzing survey-responses from 146 Biosphere Reserves in 55 countries we investigate how stakeholder participation and adaptive co-management practices are linked to management performance. Effectiveness in conventional conservation was positively affected by participation of scientists, but negatively affected by participation of volunteers. Effectiveness in sustainable development goals was associated to participation by local inhabitants. Adaptive co-management practices were associated with a higher level of effectiveness in achieving development goals, and this higher effectiveness did not seem to be at the expense of biodiversity conservation.

Key words — participation, adaptive co-management, effectiveness, cross-national, Biosphere Reserves

1. INTRODUCTION

Over the last few decades, the participation-paradigm has grown in research, policy, and practice of natural resource management, biodiversity conservation, and stewardship of ecosystem services (Chapin, Kofinas, & Folke, 2009; Dearden, Bennett, & Johnston, 2005; Reed, 2008). In short, the arguments put forward for involvement of stakeholders include increased efficiency (as people are more likely to support and implement decisions they have participated in making), improved accuracy (as a more diverse and broader knowledge base is utilized), and strengthened legitimacy (as people affected by decisions are invited into the process of making them) of management and conservation efforts (Beierle & Konisky, 2001; Berghöfer & Berghöfer, 2006; Colfer, 2005; McCool & Guthrie, 2001; Stoll-Kleemann & O'Riordan, 2002).

The pragmatic reasons for stakeholder participation have gained importance with the growing perception that ecosystems and societies are interdependent, forming social–ecological systems that are complex, adaptive, and nested across scales (e.g., Berkes & Folke, 1998; Holling, 2001). Walker *et al.* (2002, p. 11) provide a step-wise approach to involve stakeholders in assessment and management of social–ecological systems and state that "The chances of success are increased if the full range of stakeholders is engaged." The interdependence between ecosystems and society implies that people-oriented management and conservation of ecosystems are more likely to succeed than "strict protectionism based on government-led, authoritarian practices" (Wilshusen, Brechin, Fortwangler, & West, 2002). For example, many conservation values in cultural landscapes result from a long history of human use and management (Nabhan, 1997). The complexity and the cross-scale interactions of social–ecological systems imply that any management body is dependent on collaboration with others in order to detect, interpret, and respond accurately to feedback from dynamic ecosystems (Folke, Hahn, Olsson, & Norberg, 2005). Adaptive co-management has been put forward as a way of dealing with this complexity in social–ecological systems (Armitage, Berkes, & Doubleday, 2007; Olsson, Folke, & Berkes, 2004a), as it combines the learning-by-doing approach of adaptive management with the collaborative approach of co-management. Adaptive co-management systems are flexible community-based systems of resource management tailored to specific places and situations and supported by, and working with, various organizations at different levels (Armitage *et al.,* 2007). Folke and others (2002, p. 20) define adaptive co-management as a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of learning-by-doing. Adaptive co-management emphasizes two types of stakeholder participation: the participation of actors with different types of ecosystem knowledge (both scientific knowledge and experiential, for example, local, traditional, and indigenous knowledge) and the participation of actors working at different ecological scales and levels of decision-making (e.g., managers of certain habitats and policy-makers at local and national levels) (Charles, 2007; Olsson, Folke, & Berkes, 2004). Recent studies of adaptive co-management have highlighted the need for bridging organizations that can coordinate and facilitate such adaptive collaboration across organizational levels and knowledge systems (Berkes, 2009; Hahn, Olsson, Folke, & Johansson, 2006).

Several studies suggest that participation of stakeholders has the positive effects suggested above (e.g., Mugisha &

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Jacobson, 2004; Sandersen & Koester, 2000; Stringer *et al.*, 2006; Sudtongkong & Webb, 2008). Participation of key stakeholders was found to be the single most important factor in determining project outcomes in a survey of ecosystem management in the United States (Yaffee *et al.*, 1996). In a synthesis of four case studies, Lebel *et al.* (2006) found support for the proposition that participation and deliberation in decision-making around natural resource management enhance society's ability to innovate and respond to crises, suggesting that involvement of non-state actors is a fruitful approach for dealing with complexity. In a case study of Kristianstads Vattenrike Biosphere Reserve, Hahn *et al.* (2006) showed how a bridging organization was able to identify win-win situations between biodiversity conservation and societal development through adaptive co-management processes focused on strengthening the generation of ecosystem services. Positive side-effects of participatory and collaborative approaches have also been described, such as empowerment and increased social capital, which in turn can lubricate future collaboration (Ansell & Gash, 2007; Pretty & Ward, 2001).

However, critiques against the participation-paradigm have increased. Brody (2003) discusses the risk that the participation of conflicting interests slows down decision-making and results in unfortunate compromises between biodiversity conservation and economic development. Galaz (2005) shows how decision-making in a Swedish water common-pool-resource institution was blocked by strategic behavior among participating resource users that wanted to avoid costly measures. Such outcomes might erode social capital rather than building it (Conley & Moote, 2003). Several scholars have argued that in a human dominated world, the goals of biodiversity conservation and economic development are competing, and therefore, the participation of economic interests in decision-making on biodiversity conservation will have negative consequences for biodiversity (Brandon, Redford, & Sanderson, 1998; Kramer, van Schaik, & Johnson, 1997; Oates, 1999; Terborgh, 1999 [cited and discussed in Wilshusen *et al.*, 2002]). Others argue that local participation can decrease accuracy of management as it might dilute the impact of scientific knowledge on conservation decisions (du Toit, Walker, & Campbell, 2004). Similarly, it has been questioned whether local and traditional knowledge really has a role to play in today's rapidly changing world (Briggs & Sharp, 2004). The assumption that local participation automatically improves legitimacy of decisions has also been questioned (e.g., Berghöfer & Berghöfer, 2006; Jentoft, 2000). For example, the process of "elite capture," where participatory processes are hi-jacked by actors that have more time and resources to participate than others, has been described several times in the development literature (e.g., Platteau & Abraham, 2002).

Studies that evaluate the effects of stakeholder participation on conservation outcomes and sustainable use of ecosystem services empirically are rare (Conley & Moote, 2003; Kleiman *et al.*, 2000). The ambiguity in the results from case studies calls for larger studies where hypotheses on the effects of participation in general and adaptive co-management in particular can be tested systematically in different settings (Carpenter *et al.*, 2009). The data-sets available to perform such tests are few (e.g., Poteete & Ostrom, 2008), but the World Network of Biosphere Reserves as part of UNESCO's Man and the Biosphere Program provides a potentially useful example, as it contains a large number of sites across the world that have different approaches to participation, but a shared ambition to conserve biodiversity and foster sustainable development. Given this variety, we believe that lessons learned herein should be relevant also to other forms of protected areas.

In this article we use the World Network of Biosphere Reserves to analyze how stakeholder participation and adaptive co-management in different settings correlate with management effectiveness in achieving the objectives of biodiversity conservation and sustainable development of Biosphere Reserves. We start with a background of the World Network of Biosphere Reserves and four contradicting participation claims put forward in the literature that we are testing in this context. This section is followed by the design of the survey and the construction of indexes to estimate the relative impact of participation of different stakeholder groups in decision-making and implementation processes. The next section presents the results of participation in relation to (1) support for biodiversity conservation, (2) integration of conservation and development objectives, (3) management effectiveness and (4) adaptive co-management and Biosphere Reserve effectiveness, followed by a discussion of participation in relation to our key findings.

2. PARTICIPATION AND ADAPTIVE CO-MANAGEMENT IN BIOSPHERE RESERVES

Biosphere Reserves are sites designated by UNESCO with the mission of "maintaining and developing ecological and cultural diversity and securing ecosystem services for human wellbeing" (UNESCO, 2008, p. 8) in collaboration with a suitable range of actors, often including local communities and scientists. They are promoted as "sites of excellence" and "learning sites" in this regard (UNESCO, 1996). Since the program was initiated in 1976, 564 Biosphere Reserves have been designated in 109 countries (UNESCO Official Website, 2010). In the 1970s and 1980s the sites were mainly designated based on their biodiversity values and their capacity to support research and monitoring (Ishwaran, Persic, & Tri, 2008), but since 1995, all Biosphere Reserves are expected to fulfill three functions, stated in the Statutory Framework and the Seville Strategy (UNESCO, 1996): (1) conserving biodiversity, (2) fostering sustainable social and economic development, and (3) supporting research, monitoring, and education. However, many of the older Biosphere Reserves have not yet transformed to fulfill the "sustainable development" function, and so the network now includes examples of "conventional" biodiversity conservation led by scientists and governmental administrations as well as sites managed by communities, NGOs, and networks of multiple state and non-state actors.

These three functions and several of the criteria of Biosphere Reserves correspond to features of adaptive co-management: there is a focus on monitoring, an integrated approach to conservation and development, and recommendations of adaptive management and participation of a suitable range of actors (Schultz & Lundholm, 2010; UNESCO, 1996). Based on the mission, functions, and criteria of Biosphere Reserves, and the results of a case study in one Biosphere Reserve (Hahn *et al.*, 2006; Olsson, Folke, & Hahn, 2004; Schultz, Folke, & Olsson, 2007), we propose that Biosphere Reserves constitute potential sites for testing the effectiveness of participation in general and adaptive co-management in particular. Most Biosphere Reserves have place-based bodies that coordinate its activities, herein called Biosphere Reserve Centers (Stoll-Kleemann & Welp, 2008). Biosphere Reserve Centers can be everything from a single director, coordinator or manager working with the Biosphere Reserve concept in a loosely defined network, to a physical space with researchers, managers, and information personnel.

3. STUDY DESIGN: INVESTIGATING THE EFFECTS OF PARTICIPATION AND ADAPTIVE CO-MANAGEMENT

The analysis is based on survey respondents' self-evaluation of effectiveness in reaching the objectives stated in the Statutory framework of Biosphere Reserves (UNESCO, 1996). Drawing on the participation arguments put forward in the literature reported on above, we are specifically interested in evaluating the following contradicting claims about stakeholder participation and adaptive co-management:

1.	"Stakeholder participation *strengthens support* for Biosphere Reserve objectives and management"	*versus*	"Stakeholder participation is too risky – if it fails it creates disappointment and *decreases support* for Biosphere Reserve objectives and management"
2.	"Stakeholder participation leads to *successful integration* of biodiversity conservation and societal development"	*versus*	"Stakeholder participation leads to *unsatisfactory compromises* between biodiversity conservation and societal development in Biosphere Reserves"
3.	"Stakeholder participation *increases* effectiveness of Biosphere Reserve management"	*versus*	"Stakeholder participation *decreases* effectiveness of Biosphere Reserve management"
4.	"Adaptive co-management *improves* performance of Biosphere Reserves"	*versus*	"Adaptive co-management *deteriorates* performance of Biosphere Reserves"

In order to get comparable information from a large set of cases a self-administered questionnaire was developed, targeting coordinators, directors, and managers of Biosphere Reserves. The questionnaire was tested, revised, and uploaded for on-line access in English, French, Spanish, and Chinese, via URL http://www.surveymonkey.com. An introductory letter with a link to the survey was sent via e-mail to the responsible director, coordinator, or manager of 407 Biosphere Reserves that had identifiable and working e-mail addresses. Hard copies were distributed extensively at the 3rd World Congress of Biosphere Reserves held in Madrid in February 2008 to compensate for the fact that 124 of the 531 Biosphere Reserves could not be reached via e-mail. The on-line survey was open from January 15th to June 20th and reminders were sent out twice during this period. The World congress generated 65 hard copy responses, and the e-mails resulted in 107 responses. Duplicate responses from the same Biosphere Reserves, sent in by National coordinators for example, were removed from the data-set.

(a) *Descriptive statistics*

All in all, 146 Biosphere Reserves from 55 countries provided complete answers to the survey, a response rate of 27%. Although this response rate is low, it is reasonable in comparison to other global surveys of Biosphere Reserves. A telephone survey presented in Stoll-Kleemann and Welp (2008) achieved a response rate of 40%, and UNESCO (2001) reports a response rate of 29%. Comparing the geographic distribution of the 146 responding Biosphere Reserves to the World Network of Biosphere Reserves, the responding Biosphere Reserves are fairly representative. However, high-income countries (as defined by the World Bank, 2008) were over-represented in the data-set, amounting to 45% of the responses, as compared to 36% in the overall World Network of Biosphere Reserves. In addition to regional distribution and income-level, an important characteristic of a Biosphere Reserve is its year of designation, as explained above. Forty-three percent of the responding Biosphere Reserves is "post-Seville" (designated after 1995) as compared to 40% of the Biosphere Reserves in the World Network. The total sizes of the represented Biosphere Reserves range from 1500 ha (a mountain lake in Germany) to nearly 30 million hectares (tropical grasslands and savannas in Brazil). 12.1% was smaller than 10,000 ha, 36.1% was 10,000–99,000 ha, 41.2% was 100,000–990,000 ha and 10.6% was 1–30 million hectares (UNESCO, 2010). Sixty-four percent of the responding Biosphere Reserves claimed to be conserving "pristine" or "natural" ecosystems in their core areas, and 36% conserved a landscape at least partly shaped by traditional human interventions, such as traditional agriculture ($N = 143$).

4. EVALUATING THE CLAIMS

(a) *Measuring stakeholder participation in Biosphere Reserves*

In order to estimate the relative impact of participation of different stakeholder groups on BR activities, a number of indexes were constructed. First, estimates were constructed for the degree of participation for each stakeholder category, based on their involvement in seven different management processes: (1) representation in BR coordination team, (2) representation in BR steering committee, (3) goal-setting in BR, (4) BR project design, (5) implementation of projects in BR, (6) day-to-day management in BR, and (7) monitoring of biodiversity changes in BR. Processes 1–4 were summarized into an index measuring stakeholder participation in decision-making processes of the BR, and processes 5–7 were collapsed into a measure of stakeholder participation in implementation processes in the BR. Although not an estimate of the exact number of stakeholder groups involved in BR activities, these two indexes nevertheless give a reasonably accurate picture of relative differences in stakeholder participation in different BR functions. The degree of participation in decision-making and implementation was estimated for a total of four categories of stakeholders: (1) scientists, (2) local resource users (e.g., farmers, fishermen, and hunters) and inhabitants, (3) non-profit organizations and other volunteers, and (4) politicians and governmental administrators. In total, eight separate participation indexes were used (participation in implementation and decision-making for each of the four stakeholder categories).

(b) *Participation and support for biodiversity conservation*

When responding to the survey question "Do you have reason to believe that the groups involved in BR activities have increased or decreased their support for biodiversity conservation as a result of their involvement?" ($N = 134$), almost 80% of respondents chose the alternatives "most groups have significantly-" or "somewhat increased their support for biodiversity management." An additional 14% said that involvement had not had any effect, and only one case reported that support had decreased somewhat as a result of involvement. Judging from this response distribution the hypothesis that participation increases support receives overwhelming support. However, as will be discussed below, this pattern is not obvious for all indexes of participation.

To assess support for BR objectives and activities, two estimates were constructed: one overall and one specific to categories of stakeholders. The overall level of support for the BR from involved groups was measured using estimates given by respondents in the survey question about support mentioned above. Measures of the support from specific categories of stakeholders were constructed using three questions which required the respondent to evaluate the BR's sufficiency of "support from people living in the BR" and "support from local politicians" and "support from relevant governmental administrations" on a scale ranging from 1 (totally insufficient) to 10 (more than sufficient). The latter two items were collapsed into a single index reflecting the combined average score of the two original variables.

To test the effect of participation on overall support, a set of ordered logistic regression models were run in which controls were introduced for designation year of the BR, the income level of the country in which the BR is situated, the size of the BR (log), and whether the protected areas were classified as "pristine nature" or "cultural landscape" (see Table 1).[1] Only one significant effect was encountered: participation of scientists in implementation has a small but significant positive effect on overall support from groups involved. Possibly, participation by scientists adds to the credibility of BR management.

When testing whether the effect of participation on support for BR activities is confined to the groups actually represented in participation processes, two significant effects were encountered. Participation of local resource users and inhabitants in implementation processes has a rather substantial effect

Table 1. *Participation and support for biodiversity conservation. Ordered logistic regression*

	Decision-making	Implementation
Local users/inhabitants	1.074 (.152)	1.154 (.124)
Politicians and administrators	1.043 (.112)	.956 (.128)
Scientists	1.024 (.178)	1.673* (.340)
NGOs and volunteers	1.144 (.239)	.807 (.170)
BR age	1.012 (.021)	1.011 (.021)
Income level (1–4)	.732 (.151)	.729 (.150)
Size of BR area (log)	1.024 (.121)	1.131 (.156)
Pristine (dummy)	2.083 (.819)	2.024 (.837)
Wald	32.98**	41.31**
Pseudo R^2	.06	.09

Table shows odds ratios and clustered robust standard errors within parenthesizes. Number of clusters (countries) is 52 and $N = 131$. Dependent variable is responses to the survey question "Do you have reason to believe that the groups involved in BR activities have increased or decreased their support for biodiversity conservation as a result of their involvement?" Response alternatives ranged from "Most groups have significantly increased their support" (5) to "Most groups have significantly decreased their support." (1).
* $p < .05$.
** $p < .001$.

($b = .35$, $t = 3.18$, $p < .003$) on the level of perceived support from the survey category "People living in the BR" (0–10). Thus, including this stakeholder group in one additional implementation process in the BR raises the BR's perceived support ranking from local inhabitants by .35 points on the 0–10 support scale. A similar but slightly weaker effect is found for participation by local resource users and inhabitants in decision-making processes ($b = .28$, $t = 2.53$, $p < .015$).

In sum, involving local inhabitants and resource users in BR processes does seem to raise their support for BR activities. In addition, a higher level of scientist involvement is linked to a small increase in the general level of support for the BR from groups involved. This effect is, however, not present in the case of politicians and administrators—no linkages between the level of participation of politicians and administrators and their level of support for the BR can be found in the data.[2]

(c) *Participation and integration of conservation and development*

In a survey question about challenges experienced when trying to involve different groups, only 7.2% of the respondents selected the option "We have reached unsatisfactory compromises" ($N = 125$). This suggests that the claim that participation leads to unsatisfactory compromises between biodiversity goals and development goals is mostly not valid. On the other hand, the contradicting claim (participation leads to win-win solutions between these goals) is not valid in all cases either.

A logistic regression model used the survey question "In your BR, is there any project where the objectives of conservation and development have been integrated to produce a satisfactory outcome?" to measure the presence of at least one example of integration of developmental and conservational goals. Indicators of stakeholder participation and control variables were the same as in Table 1. As was the case in the previous model, most indicators of participation were not related to successful integration of development and conservation. However, the level of participation in implementation processes of local resource users or people living in the BR seemed to have a positive effect on the likelihood of a successful project of conservation-development integration. On average, including this stakeholder group in one additional implementation process makes it about 1.4 times more likely to find a successful integration project in that BR. Similarly, involving politicians and administrators in decision-making processes is significantly linked to a 1.3 increase in the likelihood of finding successful integration of development and conservation. Naturally, this finding does not speak to the direction of causal linkages. Possibly, BRs that devote a larger portion of their efforts at integrating conservation and development are more likely to include local resource users and politicians as a consequence of this effort (see Table 2).

(d) *Participation and Biosphere Reserve management effectiveness*

Turning to the issue of BR effectiveness, it should be noted that there are multiple ways of conceptualizing and measuring effectiveness in protected area management (e.g., Bruner, Gullison, Rice, & Fonseca, 2001; Chape, Harrison, Spalding, & Lysenko, 2005; Ervin, 2003). There is a general lack of objective third-party performance data in many protected areas, including Biosphere Reserves (Bertzky & Stoll-Kleemann, 2009), and therefore, we have relied on survey respondents' self-evaluation of effectiveness in achieving seven

Table 2. *Participation and integration of development and conservation. Logistic regression*

	Project integrating development and conservation exists	
	Decision-making	Implementation
Local users/inhabitants	1.217 (.178)	1.435* (.241)
Politicians and administrators	1.314** (.162)	1.229 (.149)
Scientists	.707 (.142)	.943 (.221)
NGOs and volunteers	1.142 (.209)	.994 (.226)
BR age	1.024 (.019)	1.022 (.020)
Income level (1–4)	.756 (.165)	.725 (.160)
Size of BR area (log)	1.279 (.291)	1.302 (.253)
Pristine (dummy)	1.109 (.558)	1.248 (.640)
Wald	19.50**	30.70***
Pseudo R^2	.19	.18

Table shows odds ratios and clustered robust standard errors within parenthesizes. Number of clusters (countries) is 52 and $N = 131$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

different objectives: conserving biodiversity, fostering social development, fostering economic development, supporting research, supporting monitoring, supporting education, and facilitating dialog, collaboration and integration. This means that the estimates are entirely subjective and related to the respondent's ambitions, priorities, and reference points.

Two indexes of effectiveness were constructed using a principal component factor analysis of respondents' estimates of effectiveness in reaching these seven objectives. The factor analysis produced two distinct factors explaining about 75% of total variance. The first factor displays strong loadings on the objectives of conserving biodiversity and supporting research, monitoring and education and can, therefore, be understood as a reflection of a latent variable measuring effectiveness in achieving pre-Seville BR goals, that is, "conventional" biodiversity conservation. The second factor loads strongly on the objectives of "facilitating dialog, collaboration and integration of different objectives," "economic development," and "social development," and is, therefore, interpreted as having to do with perceived effectiveness in achieving post-Seville BR goals, that is, sustainable development.

Factor regression scores of these two latent variables were then used as dependent variables in four OLS regression models aiming at estimating the effect of stakeholder participation (see Table 3). Stakeholder participation was again measured in terms of the level of participation in decision-making- and implementation processes in the BR.

Not entirely surprising self-estimated effectiveness in "conventional conservation" goals seems to be linked to a higher level of participation of scientist in both decision-making and implementation. More surprising is the rather strong negative effect of a higher level of participation of non-profit organizations and volunteers in BR decision-making and implementation—BRs with a higher level of voluntary organizations participating in decision-making and implementation tend to rank their performance lower in relation to conventional conservation goals. Possibly, a high presence of NGOs and volunteers is an indication of lacking or insufficient resources, making it difficult for BRs to conserve biodiversity and support monitoring, research, and education. The level of participation of local resource users and politicians and administrators does not influence effectiveness ratings in relation to "conventional conservation" goals.

Table 3. *Biosphere Reserve self-estimated effectiveness. Factor analysis*

	Conventional conservation	Sustainable development
Conserving biodiversity	.809	.181
Economic development	.137	.918
Social development	.183	.854
Support research	.860	.216
Support monitoring	.901	.149
Support education	.696	.491
Facilitate dialog, integration	.329	.740

Table shows rotated (varimax) factor loadings with Kaiser normalization. $N = 124$.

Participation of local resource users and inhabitants in implementation is the only form of participation significantly linked to a higher level of effectiveness in "sustainable development" goals. The rather large coefficient for participation of voluntary groups in decision-making is borderline significant ($p = .051$), which points to the existence of a real effect in this respect that may have been more pronounced in a larger sample. Involving politicians and local and national administrations does not seem to influence effectiveness in achieving "sustainable development" goals, and neither does the involvement of scientists (see Table 4).

(e) *Adaptive co-management and Biosphere Reserve effectiveness*

In the last step of the analysis we consider the possibility that BR effectiveness is linked to the extent to which BR management practices approximate those suggested in the adaptive co-management literature. This research field is young and there are no definite definitions of what constitutes adaptive co-management (Plummer & Armitage, 2007; Plummer & Fitzgibbon, 2007). Thus, rather than providing an absolute definition that would classify each Biosphere Reserve as adaptive co-management or not, we identify practices captured in the survey that BRs express to varying extents, and that reflect essential features of adaptive co-management, namely: (1) involvement of both local inhabitants/communities and governments in decision-making (a defining condition for co-management), (2) conservation and sustainable development efforts pursued in concert (social–ecological systems approach), (3) dialog, collaboration, and integration of different objectives, (4) monitoring and responding to ecosystem feedback performed combining different knowledge systems, including science, and (5) a shared vision has developed.

These features enable us to assess the level of adaptive co-management in the 146 Biosphere Reserves. For this purpose we developed a grading scheme presented below. Features given higher grades reflect key conditions for adaptive co-management processes. Features that could take place in other management approaches as well, but nevertheless contribute to adaptive co-management in Biosphere Reserves are given somewhat lower grades. Our classifications are by necessity subjective but help us generate a rough assessment of the relative grades of adaptive co-management in the Biosphere Reserves.

(f) *Measuring adaptive co-management practices*

(1) A defining condition for co-management is the involvement of both communities and governments (Berkes, 2007). We assigned 2 points to the BRs responding that local inhabitants and/or resource users participate in decision-

Table 4. *Participation and Biosphere Reserve effectiveness. OLS regression*

	Conventional conservation		Sustainable development	
	Decision-making	Implementation	Decision-making	Implementation
Local users/inhabitants	.001 (.049)	.022 (.050)	−.011 (.040)	.107** (.041)
Politicians and administrators	−.014 (.034)	−.031 (.059)	.029 (.032)	−.057 (.053)
Scientists	.210** (.083)	.310** (.105)	−.100 (.078)	.017 (.107)
NGOs and volunteers	−.177* (.082)	−.241** (.084)	.130 (.065)	.105 (.068)
BR age	−.018 (.009)	−.017* (.008)	.015 (.008)	.011 (.008)
Income level (1–4)	−.086 (.112)	−.091 (.091)	−.207* (.098)	−.193 (.087)
Size of BR area (log)	−.017 (.061)	−.012 (.061)	.081 (.066)	.109 (.060)
Pristine (dummy)	.292 (.246)	.308 (.240)	.056 (.210)	.056 (.198)
Constant	35.947 (18.975)	34.226* (16.290)	30.844 (16.260)	−23.610 (16.977)
F	3.35**	2.82*	4.84***	5.00***
Adj. R^2	.12	.16	.16	.19

Table shows OLS regression coefficient and clustered robust standard errors within parenthesizes. Number of clusters (countries) is 49 and $N = 118$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

making and 2 points to the BRs responding that politicians and/or governmental administrations participate in decision-making.

(2) In the adaptive co-management approach development cannot be achieved at the expense of ecosystem integrity (Olsson, Folke, & Berkes, 2004). We assigned 1.5 points to the BRs that give at least medium priority to the objective of conserving biodiversity. In addition, we assigned 1 point to BRs that give at least medium priority to the objective of supporting monitoring, an objective that relates both to conservation and to enabling learning as part of adaptive management (see point 4 below). Furthermore, we assigned 1 point to Biosphere Reserves that give at least medium priority to the objectives of fostering social development and 1 point if they give at least medium priority to fostering economic development. The adaptive co-management approach is grounded in a perception of social and ecological systems as integrated (Folke, Colding, & Berkes, 2003). We assigned 1 point to the Biosphere Reserves that responded "yes" to the question "In your BR, is there any project where the objectives of conservation and development have been integrated to produce a satisfactory outcome?"

(3) Facilitating dialog, collaboration, and integration of different objectives are core concepts of the adaptive co-management approach (Plummer & Fitzgibbon, 2007). We assigned 1.5 points to BRs giving at least "medium priority" to this objective and an additional 1.5 points to BRs giving at least "high priority" to this objective.

(4) Adaptive co-management for conservation and sustainable use of ecosystems is information intensive and learning oriented, and draws on multiple sources of knowledge as a means to deal with complexity (Plummer & Armitage, 2007). Monitoring, interpreting, and responding to ecosystem feedbacks are important components of adaptive co-management (Folke *et al.*, 2003). As said above, we assigned 1 point to BRs that give at least medium priority to the objective of supporting monitoring. Scientific knowledge is of significance for adaptive co-management of ecosystems (e.g., Reid, Berkes, Wilbanks, & Capistrano, 2006). We assigned 1.5 points to the BRs that responded that scientists participate in decision-making.

(5) A final feature of adaptive co-management is that information exchange leads to shared understanding or agreement (Plummer & Fitzgibbon, 2007), expressed for example in a shared vision (Olsson, 2007). We assigned 1 point to the BRs that responded "yes" to the question "Have you and your team developed a shared vision for your BR?" (Olsson, 2007).

The grading of the adaptive co-management features was used to construct an interval level variable measuring the extent to which a BR is practicing adaptive co-management. The maximum score is 15, which indicates that all selected features are fulfilled. Forty-nine sites score 5.5–10.5, 51 sites score 11–13.5 and 46 sites score 14–15. Adaptive co-management and effectiveness when average self-assessed effectiveness ratings are plotted over scores on the adaptive co-management scale an interesting pattern appears. First of all, the average biodiversity conservation effectiveness rating is relatively constant over different levels of adaptive co-management scores. For effectiveness ratings of economic and social development, a different pattern emerges (Figure 1). Here, levels of adaptive co-management scores are more or less linearly associated with increasing effectiveness ratings, albeit on a consistently lower level than conservation effectiveness ratings. Only when a maximum adaptive co-management score is achieved are effectiveness ratings for social and economic development reaching an average of over 5 ("acceptable").

The overall pattern illustrated in Figure 1 is confirmed by two OLS regression models using factor regression scores for effectiveness in achieving "conventional conservation" goals and "sustainable development" goals as dependent variables and the adaptive co-management score together with controls for BR age, size, income level of BR country, and pristine/cultural landscape dummy as independent variables. The adaptive co-management score has a significant effect on development effectiveness ratings ($b = .170$, $t = 4.76$, $p = .000$), but is not significantly related to effectiveness in biodiversity conservation ($b = .035$, $t = .93$, $p = .36$).

To sum up, adaptive co-management does not seem to be associated with higher ratings of effectiveness in biodiversity conservation. On the other hand, adaptive co-management does not seem to lower conservation effectiveness either. In contrast, self-assessed effectiveness in achieving social and economic development is consistently linked to adaptive co-management practices in the BR. Adaptive co-management practices are associated with a higher level of effectiveness in achieving sustainable development goals, but this higher effectiveness does not seem to be achieved at the expense of biodiversity conservation.

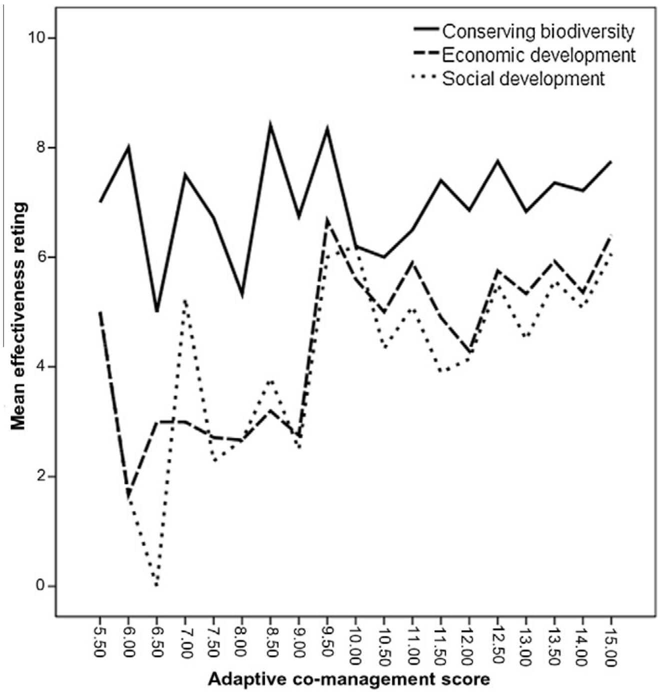

Figure 1. *Average effectiveness ratings and adaptive co-management scores.*

5. DISCUSSION

This study was designed to go beyond individual case studies, using a large-*N* data-set to test some of the contradicting claims about effects of stakeholder participation that are put forward in the literature on natural resource management, biodiversity conservation, and management of ecosystem services. UNESCO's World Network of Biosphere Reserves provides an interesting platform for such tests, as it contains sites with a range of approaches to participation, from conventional biodiversity conservation led by scientists or government administrations in isolation from local communities, to integrated approaches where conservation is part of sustainable development efforts, managed in collaboration with multiple state- and non-state actors (Ishwaran *et al.*, 2008; Stoll-Kleemann & Welp, 2008; Schultz & Lundholm, 2010).

We would first like to highlight two important findings of our analysis. Integrating biodiversity conservation and sustainable development through participation of stakeholders does not seem to have a negative effect on conservation effectiveness, judging by the respondents' self-evaluation. On the other hand, stakeholder participation is no panacea or shortcut to improve conservation either. Rather, there are many different ways of achieving conservation success. But what stakeholder participation in the case of Biosphere Reserves seems to add is an expanded focus and improved efforts of fostering sustainable development, where conservation becomes a part of and not apart from development (Folke, 2006). Such an approach is at the heart of management of ecosystem services, which aims at securing ecological functions to sustain human wellbeing (Millennium Ecosystem Assessment, 2005).

"Participation" as a management approach is probably too general to evaluate as positive or negative in terms of different outcomes. Consequently, Brody (2003), who tested the effect of stakeholder involvement on the quality of ecosystem management plans, found that simply having a wide range of participants present in the planning process did not guarantee higher quality plans. Instead, certain stakeholders had positive effects, whereas the effects of others were negative. Here, we have unpacked participation both in terms of who is participating (stakeholder categories) and when participation occurs (decision-making or implementation). We have also tried to assess the extent of participation of each stakeholder category in each of these two processes. However, we have no data on how these participatory processes are designed and led, and our data does not allow us to evaluate to what extent the different groups are actually able to influence the decisions made, or the representativeness of the groups involved. This means that we cannot speak to the discussion on legitimacy of participatory processes in BRs, such as the risk of "elite capture" mentioned in Section 1. It should also be noted that participatory processes take time to develop, and therefore, some of the effects on effectiveness may not be the result of current levels of participation. Concerning the evaluation of outcomes, we have unpacked management performance in terms of the objectives stated in the Statutory framework of Biosphere Reserves (UNESCO, 1996), but the evaluation of management performance in relation to these objectives is based entirely on the respondents' perception of effectiveness. So is the assessment of support from various stakeholder categories.

This said, the analysis of 146 survey responses from Biosphere Reserve Centers reveals that the involvement of local resource users (such as farmers and fishermen) and local inhabitants in decision-making and implementation of Biosphere Reserve management has three positive effects. Such local participation increases support from people living in the Biosphere Reserve, and increases the likelihood that projects that integrate conservation and development produce satisfactory outcomes. Furthermore, local participation in implementation processes is linked to higher ratings of the self-evaluated effectiveness in reaching sustainable development goals. There are no negative effects of local participation on self-evaluated effectiveness in reaching conventional conservation goals. This is in line with Brody (2003), who found that the presence of resource-based industry groups (agriculture, forestry, marine, and utilities) in planning had the strongest positive influence on ecosystem plan quality. It also supports the conclusions from a case study of the Kristianstads Vattenrike Biosphere Reserve, which found that the involvement of local stewards (people active in on-site management and monitoring of the landscape) can enhance the capacity for ecosystem management (Schultz *et al.*, 2007).

The participation of politicians and governmental administrators seems to increase the likelihood that projects that integrate conservation and development produce satisfactory outcomes, but no other effects of their participation were found, neither positive, nor negative. This result contradicts Brody (2003), who found that the presence of local government bodies in the planning process had a negative effect on the plan quality in terms of management's ability to protect ecosystems. But it supports the argument for co-management that suggests that there are scale-dependent comparative advantages of both communities and governments (Carlsson & Berkes, 2005; Cash & Moser, 2000).

Our results are in line with arguments by du Toit *et al.* (2004) that the involvement of scientists in implementation processes increases effectiveness in reaching "conventional" conservation goals, and their involvement does not seem to be at the expense of sustainable development goals. Participation of scientists also seems to increase the overall support from groups involved in management. We have observed this phenomenon in our studies of the Kristianstad Vattenrike BR, where key leaders and the Biosphere Reserve Center collaborate with scientists as part of their strategies in "navigating the larger environment."

The only negative effect of participation found in the analysis was the involvement of non-profit organizations and volunteers in implementation processes, which had a slightly negative effect on the self-evaluated effectiveness in reaching "conventional" conservation goals. We interpret this finding as an indication that management relying mainly on volunteer efforts is not sufficient in reaching the ambitious objectives of Biosphere Reserves. This is in line with Schultz *et al.* (2007), who suggest that although contributions by volunteers are valuable, they should complement rather than substitute formal, funded management. If extensive volunteer participation indicates a lack of resources, it could very well be that even though volunteer efforts cannot fully compensate for this lack of resources, the Biosphere Reserve would have been even worse off had the volunteers not been there. However, our research design and choice of material does not allow us to test this hypothesis.

It goes without saying that Biosphere Reserves are not structured participation experiments with controls. Instead, the structures and contexts of the 146 Biosphere Reserves are all different, and the differences in effectiveness might have other explanations than the extent of participation by diverse stakeholder groups. For instance, the Biosphere Reserve Centers have most likely adapted their selection of stakeholders to involve in decision-making and implementation to the context of the Biosphere Reserve. If so, potential positive and negative effects of stakeholder participation are masked in the data-set.

The results suggest that if the focus is solely on achieving "conventional" conservation goals, then adaptive co-management would not be better than other forms of management. But according to the respondents' self-evaluations, adaptive co-management arrangements enhance the BRs' effectiveness in reaching sustainable development goals, without impairing effectiveness in achieving conventional conservation goals. In this sense, conservation becomes part of development through adaptive co-management. As has been argued many times before, we stress that the feasibility of adaptive co-management is context-dependent and should not be promoted as a panacea (e.g., Ostrom, Janssen, & Andereis, 2007). However, if adaptive co-management is defined as a flexible management system that tailors collaborative networks to each management problem, continuously adapting the institutional arrangements in a process of learning-by-doing (Olsson, Folke, & Berkes, 2004), the avoidance of panaceas is built into the concept.

Berkes (2009) suggests that bridging organizations are essential to initiate, coordinate, and sustain adaptive co-management processes, and the survey analysis shows that Biosphere Reserve Centers can indeed fulfill such a role. Forty-six of the 146 responding Biosphere Reserve Centers collaborate successfully with local inhabitants, government bodies, and scientists to integrate the efforts of conserving biodiversity and fostering sustainable development. They support monitoring, facilitate dialog, and collaboration, and in most of these cases, they have developed a shared vision for the Biosphere Reserve management. As such, they provide learning platforms that enable management to respond to ecosystem feedback, and facilitate learning among stakeholders.

Returning to the various claims about participation, this study found little evidence of negative effects of participation and adaptive co-management. The results suggest that the worries about participation resulting in unsatisfactory compromises between conservation and development, decreased conservation effectiveness, and disappointing outcomes leading to eroded support may be exaggerated, at least in the context of Biosphere Reserves. However, the positive effects of participation are not self-evident either, and the study highlights that qualitative dimensions of participation are of significance in determining the outcomes. We have shown how the effects depend on which stakeholder categories are involved and whether they are involved in decision-making or implementation of management. But as many scholars have pointed out, there are many other factors at play in participation and co-management, such as the design of the process, the skills of the facilitators that mobilize participation, the history of conflict and trust, and the capacities and interests of the participants (Ansell & Gash, 2007; Carlsson & Berkes, 2005; Stringer *et al.*, 2006; Westley, Zimmerman, & Patton, 2006). For example, Folke *et al.* (2003, 2005) exemplify that it is not only the representation of certain stakeholder categories that matter, but that certain roles are fulfilled by the individuals involved, such as knowledge carriers, interpreters, leaders, visionaries, and how these roles play out during different stages of development. Hahn *et al.* (2006) describe how a bridging organization selects partners strategically, initially only inviting individuals who are trusted among their peers and are interested in contributing. Only when these individuals are on board, and when projects have shown some positive results do they expand collaboration to others (Hahn *et al.*, 2006). Such processes are of course difficult to capture meaningfully in surveys, but we have identified 46 Biosphere Reserves that provide an interesting set of cases for comparative, in-depth studies. Such studies could further unravel the processes of adaptive co-management and deepen our understanding of what governance and management practices that enhance the generation of ecosystem services in different contexts.

NOTES

1. All regression models reported in this paper were run using clustered standard errors to control for possible intragroup correlations between BRs located in the same country.

2. The design of the survey does not allow for estimating the corresponding effects of participation of NGOs/volunteers and scientist on their respective level of support.

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