

Guest Editorial, part of a Special Feature on [Strengthening adaptive capacity](#)
Powerless Spectators, Coping Actors, and Adaptive Co-managers: a Synthesis of the Role of Communities in Ecosystem Management

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ABSTRACT. We provide a synthesis of the papers in the Special Issue, the Communities Ecosystems and Livelihoods component of the Millennium Ecosystem Assessment (MA), and other recent publications on the adaptive capacity of communities and their role in ecosystem management. Communities adapt because they face enormous challenges due to policies, conflicts, demographic factors, ecological change, and changes in their livelihood options, but the appropriateness of their responses varies. Based on our synthesis, three broad categories of adaptive communities are identified. “Powerless spectator” communities have a low adaptive capacity and weak capacity to govern, do not have financial or technological options, and lack natural resources, skills, institutions, and networks. “Coping actor” communities have the capacity to adapt, but are not managing social–ecological systems. They lack the capacity for governance because of lack of leadership, of vision, and of motivation, and their responses are typically short term. “Adaptive manager” communities have both adaptive capacity and governance capacity to sustain and internalize this adaptation. They invest in the long-term management of ecosystem services. Such communities are not only aware of the threats, but also take appropriate action for long-term sustainability. Adaptive co-management becomes possible through leadership and vision, the formation of knowledge networks, the existence or development of polycentric institutions, the establishment and maintenance of links between culture and management, the existence of enabling policies, and high levels of motivation in all role players. Adaptive co-managers are empowered, but empowerment is a consequence of the capacity for governance and the capacity to adapt, rather than a starting point. Communities that are able to enhance their adaptive capacity can deal with challenges such as conflicts, make difficult trade-offs between their short- and long-term well-being, and implement rules for ecosystem management. This improves the capacity of the ecosystem to continue providing services.

Key Words: *Adaptive co-management; community-based ecosystem management; governance; livelihoods; Millennium Ecosystem Assessment*

INTRODUCTION

This paper is a synthesis of seven papers (Barthel et al. 2005, Bohensky and Lynam 2005,; Cundill et al. 2005, Lynam et al. 2004, Olsson et al. 2004b, Pereira et al. 2005, Xu et al. 2005) published in the Special Issue “[Strengthening People’s Adaptive Capacity for Ecosystem Management and Human Well-being](#).” It synthesizes the lessons and experiences regarding local communities’ adaptive capacity, and includes lessons from the Millennium Ecosystem Assessment (MA) (www.maweb.org) (Folke et al. 2005a). The ability and capacity of social–ecological systems to adapt is a key factor influencing their resilience (Armitage 2005, Folke

et al. 2005b), and managers’ capacity to respond appropriately to feedbacks is, therefore, critical (Walker et al. 2004, Wilson 2006). In this paper, we assess the adaptive strategies that enable communities to cope with external political, economic, and ecological threats, and focus on those adaptations that strengthen their capacity to manage ecosystems sustainably. We adopt an integrated, social–ecological systems approach, which enables us to assess the entire system, not just its social or ecological components.

Adaptive capacity is an indication of the capacity to deal with change and disturbance, and reflects learning through knowledge sharing and responding

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to feedbacks (Walker et al. 2002, 2004, Folke et al. 2003, Olsson et al. 2004a). It is a measure of the thresholds within which systems are able to deal with change: systems with high adaptive capacities can thus retain their integrity under a broader range of conditions than systems with low adaptive capacities (Smit and Wandel 2006). In social systems, adaptive capacity refers to the ability to learn from mistakes (Adger 2003) and to generate experience of dealing with change (Berkes et al. 2003), which in turn largely depends on the ability of individuals and their social networks to innovate (Armitage 2005). The ability of individuals and organizations to learn, anticipate, and forecast is an important characteristic of the adaptive capacity of social-ecological systems. This capacity for learning and adaptation directly influences the governance of natural resources, i.e., “...the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say in the management of natural resources...” (IUCN CMWG and TILCEPA 2004, p. 1).

We realize that the concept of “community” is fraught with problems (Ainslie 1999, Fabricius et al. 2001, Fabricius 2004, Armitage 2005, Folke et al. 2005a), and have, therefore, adopted a broad and inclusive definition of the term, following that of Capistrano et al. (2005): “A collection of human beings who have something in common. A local community is a fairly small group of people who share a common place of residence and a set of institutions....”

In this paper, we examine the underlying causes of adaptations and adaptability in individuals and institutions, and assess the consequences for ecosystem resilience and community well-being by addressing four questions:

1. Why do communities adapt?
2. How do communities adapt, and what influences their adaptive capacity?
3. What are the benefits of adaptive capacity to communities and ecosystems?
4. What can communities do to promote their adaptive capacity?

THE NEED FOR A FINE-GRAINED, COMMUNITY-CENTERED PERSPECTIVE

The Millennium Ecosystem Assessment (MA; www.maweb.org) was designed to highlight the relationship between ecosystems and human well-being at several spatial scales, from the global to the local. It aimed to raise the awareness of policy makers and managers of the importance of ecosystems in defining human well-being around the globe, and strived to build the capacity of all role players to conduct integrated ecosystem assessments and to manage ecosystems to strengthen their capacity to provide goods and services (MA 2003, 2005). The MA focused on ecosystem services (the benefits people obtain from ecosystems, such as food, water, and climate regulation), how changes in these services have affected human well-being, and how such changes may affect people in the future (Carpenter and Folke 2006). It also focused on the responses that might be adopted at local, national, or global scales to improve ecosystem management, contribute to human well-being, and alleviate poverty.

In accordance with its multi-scale approach (Capistrano et al. 2005), the MA included a series of fine-grained studies in addition to its global and regional perspectives (Folke et al. 2005a). Assessments at the local scale were referred to as community-based by the MA, although they were conducted with varying degrees of community participation. The results were, however, not only expected to apply at the local level, but to have implications for the findings of the assessment at broader scales too.

Folke et al. (2005a) concluded that a community perspective was essential because communities are often neglected, but essential parts of ecosystem management. Their roles, including knowledge, experience, institutions, and organizational capabilities, should be acknowledged and embedded in any governance system that aims at strengthening the capacity to manage ecosystems sustainably for human well-being. Community-based ecosystem assessments are, therefore, the most direct way to understand the complex relationship between ecosystem services and human well-being. Traditional and local communities who live in and manage ecosystems are often the first to detect ecosystem change, and are most immediately and directly affected by it. There are local communities with fine-grained, contextual knowledge about

ecosystems. Such knowledge has evolved over many generations of experimentation, trial, and error, and can be incorporated into ecosystem management policies and strategies. In addition, communities are important decision makers in ecosystem management, affecting ecosystems at all scales (Berkes 2006). It has been shown that participation by several actors in ecosystem assessments not only broadens the information base for ecosystem assessments, but also improves the legitimacy as well as the accuracy of the process (Bohensky et al. 2004).

In their synthesis of community assessments in Chile, Costa Rica, Egypt, India, Peru, Portugal, the Philippines, Papua New Guinea, South Africa, and Sweden, Folke et al. (2005a) found that local communities “are not mere spectators, but active managers of ecosystems’ capacities to deliver services” (Folke et al. 2005a, p. 262). Local people’s knowledge about human–ecosystem interactions invariably affects the sustainability of ecosystem services. Local knowledge can be harnessed to manage and promote the ecosystem’s capacity to generate services by establishing adaptive institutions that share knowledge (Brunckhorst 2004, Carlsson and Berkes 2005). Local knowledge can also, however, be used destructively to undermine ecosystem resilience, e.g., when local experts use their superior knowledge to utilize the last remnants of dwindling wildlife or plant populations. Diversity in ecosystems and livelihood strategies is important to buffer people against shocks and surprises such as climatic and economic fluctuations. Land use and spiritual practices that nurture diversity can support the adaptive capacity of social–ecological systems, while enhancing intangible values such as a sense of place, identity, and pride. These factors are a major motivation for communities to engage proactively in ecosystem management.

An erosion of communities’ collective identity and culture can, however, have the opposite effect. Communities are affected by macroeconomic and policy processes beyond their control, and those groups that are able to cope with these external forces have learned to adapt to, or even take advantage of them by “creating horizontal links with other groups, forming alliances with powerful actors at higher spatial scales, and linking with national or global processes such as policy forums, markets, and multinational agreements” (Folke et al. 2005a, p. 262). When adaptive capacity is low,

people respond reactively by migrating or accepting their reduced well-being and living with it. Such responses may lead to further decline and poverty traps (Gunderson and Holling 2002).

Communities can thus provide valuable information to decision makers in the management of complex social–ecological systems. These include: the value of flexible livelihoods; the importance of cultural practices in maintaining the resilience of ecosystems; the value of learning and adaptation; the role of historical events and practices in shaping contemporary ecosystem function and structure; the role of biodiversity in maintaining or enhancing ecosystem resilience and sustainable livelihoods; and the value of social and institutional networks between communities and actors or institutions at local, sub-national, national, and international levels in maintaining and enhancing adaptive capacity of social–ecological systems (Berkes 2006). An important finding, relevant to this paper, is that it is crucial for communities and other actors to strengthen the capacity of the social–ecological system to adapt to change (Adger 2006).

CHALLENGES TO COMMUNITIES INVOLVED IN ECOSYSTEM MANAGEMENT

National and international policies and interventions, conflict, demographic factors, climatic change, ecological change, and livelihood opportunities and options constantly change, challenging communities in their management of ecosystems and their services. They are forced to cope with or adapt to these changes, without necessarily having the adaptive or governance capacity to achieve this.

National and International Policy Interventions

Large-scale interventions such as dams (World Commission on Dams 2000), urban expansion, tourism infrastructure (Wang and Wall 2007), and mega-protected areas (Schmidt-Soltau 2003, Biggs et al. 2004) are a result of national and international policy interventions that are often disconnected to local contexts. Communities have to adapt to mitigate the social impacts such as resettlement, loss of access to resources (Fabricius and De Wet 2002), and loss of traditional knowledge (Xu et al. 2005). Policies such as those that force nomadic people to become sedentary (Madzwamuse and Fabricius

2004) may also undermine communities' adaptive capacity, particularly when there are no effective links to larger social networks and other levels of organization that enable and support transitions.

External interventions may of course also be positive, for example the Biodiversity Convention, which protects local knowledge (Article 8j), the Indian and South African Biodiversity Strategy and Action Plans, which incorporate local rights and knowledge into biodiversity planning (Folke et al. 2005a), and new policies such as those in Yunnan province, China and in Botswana, which promote indigenous cultures (Xu et al. 2005, Madzwamuse and Fabricius 2004). Their contribution to social-ecological resilience will require dynamic cross-level and cross-scale institutional and governance arrangements (e.g., Cash et al. 2006), sometimes captured in systems of adaptive governance (Dietz et al. 2003, Folke et al. 2005b).

Conflict

Large-scale armed conflicts affect people's flexibility and curb their access to ecosystem services. Bedouin communities in the Sinai are negatively affected by conflict in the Middle East (Folke et al. 2005a). Conflicts within communities, and between communities and agencies, may limit their access to important resources such as firewood and water (Brockington 2002, Koch 2004). Conflicts between communities and authorities over resource use can have severe negative effects on their motivation to be involved in co-management (Brockington 2002). Conflict, if appropriately managed, can also have a positive effect on communities' capacity to deal with external threats. A conflict at Nqabara on South Africa's Wild Coast, for example, resulted in a more cohesive community after a prolonged conflict management process, facilitated by conflict management specialists (C. Fabricius, pers. obs.).

Demographic Factors

Demographic change presents an important challenge to communities. Depopulation of rural areas such as Sistelo, Portugal (Pereira et al. 2005) and Macubeni, South Africa (Fabricius and Collins, in press) can place great stress on communities. Young and able people are often the first to leave, leaving behind a rapidly aging population of retired

people who have neither the will nor capacity to innovate. Population increases through immigration can have disparate effects on communities. An increase in households and users can place greater stress on natural resources, leading to scarcity. Sometimes, however, more people may result in innovative management practices and provide a larger and more diverse labor force for ecosystem management (Tiffen et al. 1994).

Ecological Change

Ecological change can put pressure on local communities to adapt their livelihood strategies. This may place great strain on traditional knowledge systems, which may not be able to keep abreast with ecosystem change (Ford et al. 2006, Krupnik and Jolly 2002). Even short-term climate fluctuations, such as floods and droughts, challenge local people to adapt their cultivation, hunting and grazing practices (Madzwamuse and Fabricius 2004, Hendricks et al. 2005).

Changes in Livelihood Options and Opportunities

The diversity of options available to communities influences their ability to pursue desired livelihood activities. These services may be affected by population change, biophysical trends such as climate change (Adger 1999), broader-scale economic (Mertens et al. 2000) and policy trends (Korf 2004, Bruck 2003), and also the technological options available to individuals, households, and communities (Department for International Development (DFID) 2000). Livelihood options are equally influenced by crisis events and surprises, such as flood, drought, and conflict.

HOW DO COMMUNITIES ADAPT TO OR COPE WITH THESE CHALLENGES?

Communities can adapt to change by using coping strategies, or by evolving adaptive strategies (Table 1). "Coping strategies" refer to ad hoc and reactive adaptations aimed at short-term survival, where social learning and institutional change are lacking (Smit and Wandel 2006). Examples include land-use change (e.g., stocking rates or crop types), changes in resource management, changes in assets (e.g., livestock, savings), changes in labor allocation

(e.g., gender division of labor, migration), and changes in market relationships (e.g., reciprocal or local exchanges) (Ruben et al. 2001).

“Adaptive strategies” refer to proactive adaptations, aimed at promoting long-term ecosystem integrity and human well-being (Nayak 2004). They are associated with social learning and institutional change based on shared experiences, often over long periods and transferred over several generations (Adger 1999, Berkes and Folke 1998, Berkes and Jolly 2001, Folke et al. 2003). Examples of adaptive strategies include: ensuring mobility and flexibility, strengthening social networks, and intercommunity trade (Berkes and Jolly 2001).

During a careful analysis of the Special Issue papers, MA case studies, and other literature on communities, ecosystems, and livelihoods, it became evident that three types of communities can be identified on the basis of their capacity to adapt, and capacity for governance. The first type of community severely lacks empowerment and capacity, often because of factors beyond their control, such as political oppression, weak land and resource tenure systems, financial impoverishment, and inappropriate governance structures. They are powerless against external threats and rarely, or with great difficulty, respond to them. We call them “Powerless Spectators.” A second type of community has the capacity to respond, but lacks institutions for social learning, and has, therefore, not evolved long-term adaptive strategies. They deal with adversity through reactive coping strategies (cf. Table 1). We call them “Coping Actors.” A third type of community has both the capacity to respond to and deal with change, and possesses institutions for social learning. They take a longer-term perspective in dealing with threats, and their adaptive strategies (cf. Table 1) focus on sustainable management. They frequently collaborate with other groups and constantly invest in their own capacity, and that of the ecosystem, to deal with change. We call them “Adaptive Co-managers” (Fig. 1). A more detailed analysis follows.

Powerless spectators have weak adaptive capacity and little capacity to govern. Examples are rural, formerly politically and economically disadvantaged groups living in degraded communal areas of South Africa (Fabricius and Collins, in press), Bedouin communities affected by war in Sinai (Folke et al. 2005a), communities that are controlled by inappropriate policies forcing them to use

inappropriate agricultural practices (Xu et al. 2005), and sedentarized mobile indigenous people who are confined to villages and affected by alcoholism and oppressive policies (Chatty and Colchester 2002). In each case, then, it appears that inappropriate outside intervention is a key determining factor in the creation of powerless spectators. Powerless spectator communities do not have financial or technological options, and lack the minimum endowments of natural resources, skills, institutions, and networks. Because of lack of knowledge, they are either unaware of the threats facing them, or have a misguided awareness.

Coping actors have the capacity to adapt to change, but are not managing social-ecological systems. They include most urbanized people who rely on financial capital, infrastructure, and technology to cope with droughts, floods, resource scarcity, economic and political change, and conflict (Biggs et al. 2004), as well as many rural communities who rely on ecosystem services and everyday resources (Shackleton and Shackleton 2004) without investing in their management. Such communities have the capacity to adapt, have options, and are even aware of threats, but are not taking appropriate adaptive management actions. They lack the capacity for governance because of shortages in leadership and vision, and their responses are short term, e.g., to make ever-increasing investments of their time and finances in coping with scarcity (Lynam et al. 2004), moving their households or livestock, import resources from elsewhere (Bohensky et al. 2004), or exploiting ecosystems for commercial gain.

An example of coping with dry periods is mobility and nomadism, used by the Bedouin in Sinai, the San in Botswana, and pastoralists in Richtersveld, to cope with climatic change (Folke et al. 2005a, Madazwamuse and Fabricius 2004). These strategies seldom do damage and may have cultural and institutional benefits, but there is little evidence of conscious attempts to manage the ecosystem’s capacity to produce services. Another example is migration, a strategy to cope with socioeconomic challenges such as shifting markets or deteriorating infrastructure, adopted by rural communities in Sistelo, Portugal (Pereira et al. 2005) and in Macubeni, South Africa (Mafa Environment and Development 2003). Those left behind may cope with depopulation by abandoning land-based livelihoods and living off old-age pensions or remittances. Rural-urban migration is a well-

Table 1. The characteristics of coping and adaptive strategies in communities

	Coping strategies	Adaptive strategies
Aims	Survival	Both survival and sustainable management of social–ecological systems
Time frames	Short term, immediate	Long term, evolving over several generations
Response types	Reactive, opportunistic	Proactive, planned
Learning	Limited, through individual experience and innovation	Extensive, through knowledge exchange, inter-generational transfer, and institutional development

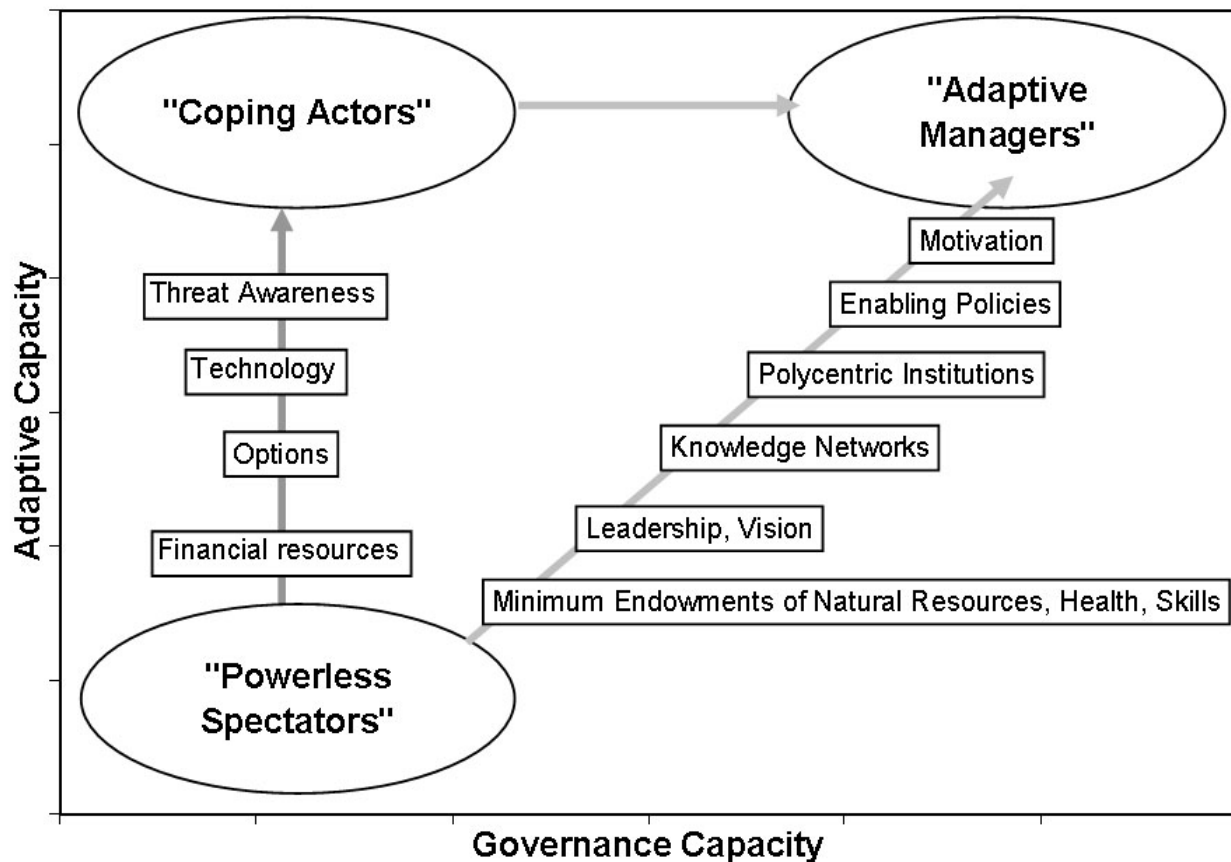
documented coping strategy in rural livelihoods around the world (Adger 1999, Sporton et al. 1999, Campbell et al. 2002, Korf 2004). In Botswana, population migration was found to be a significant coping strategy employed by communities forced to deal simultaneously with both environmental variability and externally induced land-use change (Sporton et al. 1999). Evidence from Sri Lanka (Korf 2004) and Vietnam (Adger 1999) suggests that households reduce their vulnerability by migrating, which enables them to use their different capital assets more efficiently. Households may, for example, draw on human capital, in the form of knowledge and skills, in order to increase financial capital by migrating in search of wage labor.

Many income-generating activities used by communities are less benign and may undermine the capacity of ecosystems to produce service. Communities exploit ecosystems by cooperating with large corporations, e.g., timber or mining companies in Tibet (Xu et al. 2005), overharvesting medicinal plants in partnership with commercial extractors in South Africa (Dold and Cocks 2002, Keirungi and Fabricius 2005), and mismanaging rangelands and croplands (Rowntree et al. 2004). People everywhere are extracting and using natural resources such as fruit, fuelwood, bushmeat, fish, and medicinal plants in their everyday lives (Shackleton and Shackleton 2004) without paying attention to the ecosystem’s capacity to generate such services. Critical landscapes such as wetlands, rivers, and other key resource areas (Illius and O’Connor 1999) are sometimes opportunistically

used without any plan or intention to maintain their capacity to generate services. Local ecological knowledge about locating and extracting resources is very well developed, but the motivation and capacity to manage the ecosystem processes behind such services frequently seems to be lacking (Magome and Fabricius 2004). Sometimes communities have to cope by changing their livelihood strategies or land-management practices in response to changes in resources on which they depend. People become aware of resource scarcity through the greater distances they have to travel to find resources (Nayak 2004), changes in the condition of their livestock (Hendricks et al. 2004), reduced yields of harvested resources, or greater vulnerability to droughts and floods (Mafa Environment and Development 2003). Communities may respond to resource scarcity by travelling greater distances to find resources, or may take greater risks by harvesting resources in taboo areas or through illegal use (Bohensky et al. 2004, Lynam et al. 2004). Increases in abundance can also precipitate livelihood change. An increase in forest land cover at Nqabara on South Africa’s Wild Coast has forced people to shift from large cultivated fields, which had become overgrown, to smaller home gardens (Chalmers and Fabricius 2007).

People may sometimes inadvertently promote ecosystem diversity to improve their incomes and reduce their vulnerability. In Papua New Guinea, for example, communities living on different islands plant different crops, which they trade between islands. This also enables them to maintain

Fig. 1. Three types of adaptive communities along gradients of adaptive capacity and governance capacity, respectively. “Powerless spectator” communities have a low adaptive capacity and weak capacity to govern, do not have financial or technological options, and lack natural resources, skills, institutions, and networks. “Coping actor” communities have the capacity to adapt, but are not managing social–ecological systems. They lack the capacity for governance because of lack of leadership, of vision, and of motivation, and their responses are typically short term. “Adaptive manager” communities have both the capacity to adapt and the governance capacity to sustain and internalize this adaptation. They invest in the long-term management of ecosystem services. Such communities are not only aware of the threats, but also take appropriate action for long-term sustainability. Adaptive co-management becomes possible through leadership and vision, the formation of knowledge networks, the existence or development of polycentric institutions, establishing or maintaining links between culture and management, the existence of enabling policies, and high levels of motivation in all role players.



a larger and more resilient variety of produce. In Trinidad, turtle eggs are protected and sold, but this also has spin-offs for beach conservation (Folke et al. 2005a), whereas communities in China are generating income from the sale of cultural artefacts and non-timber forest products to tourists, which enhances their cultural identity and motivates them to conserve ecosystems (Xu et al. 2005).

Adaptive co-managers have both the capacity to adapt and the governance capacity to sustain and internalize this adaptation in the long term. They invest in the long-term management of ecosystem services. Such communities are not only aware of the threats, but also take appropriate action for long-term sustainability (Olsson et al. 2004a, Barthel et al. 2005). Their actions are generally supported by institutions at higher levels, including enabling legislation and bridging organizations (Olsson et al. 2004a,b, Hahn et al. 2006). Adaptive co-management is possible through leadership and vision, the formation of knowledge networks, the existence or development of multiple institutions, the establishment or maintenance of links between culture and management, the existence of enabling policies, and high levels of motivation in all role players. Adaptive co-managers are empowered, but empowerment is a consequence of the capacity for governance and the capacity to adapt (Carlsson and Berkes 2005), rather than a starting point. Six key strategies can be adopted to enhance communities' adaptive capacity and thus their empowerment: leadership and vision, knowledge networks, institutions that are nested across scales, linking culture with management, enabling policies, and motivation. These strategies are discussed below.

Leadership and Vision

It is often the "policy entrepreneurs" among adaptive managers who identify "policy windows," which they use to precipitate change when the system is ready for it (Barthel et al. 2004, Olsson et al. 2004). Visionaries and champions build trust between different actors and organize them toward a common goal or vision, cement community cohesion, and prevent ecosystem mismanagement (Westley 2002, Olsson et al. 2004b, Folke et al. 2005b). It is, of course, possible for devious champions to manipulate interventions to suit their own needs, thereby sowing conflict in communities (C. Fabricius, pers. obs.).

Knowledge Networks

Learning becomes even more effective when knowledge networks are formed, which enable adaptive actors working at different levels to share information (Olsson et al. 2006). This increases the knowledge base for management and creates new awareness about the processes underlying the functioning of social and ecological systems. Knowledge about history, the key role players and their roles and impacts, information about the key policies and local institutions that could affect people's well-being and ecosystem services, of threats and opportunities are critical for adaptive management (Lambin 2005). Awareness can be precipitated by an environmental crisis (Olsson et al. 2004b), but it can also be maintained through traditions, or enhanced by constant monitoring (Berkes and Jolly 2001).

Knowledge networks also enable communities to co-opt new technologies from outsiders or newcomers. For example, the practice of using Mokoro (dug-out canoes) to navigate the extensive Okavango Delta in Botswana was introduced to the resident Banoka by newcomer Bayeyi and Hambukushu-speaking people from contemporary Zambia (Madzwamuse and Fabricius 2004). Other examples are the merging of computer-based mapping technology with local ecological knowledge to create ecosystem management plans (Cundill et al. 2005), incorporating novel agricultural management practices and land-care techniques brought in by outsiders (Fabricius and Collins, in press), forest and water management practices (Becker and Ghmire 2003), selective fishing (Aswani and Hamilton 2004) or resource extraction technologies. At Kristianstad, volunteer groups played important knowledge networking roles, whereas scientists were catalysts for knowledge sharing in the MA (Cundill et al. 2005, Folke et al. 2005a).

Kinship networks (Adger 2006) are especially important in reducing people's vulnerability to economic change, with communities in Lesotho, South Africa, and Fiji relying on family networks for income, support with agricultural production, and diversification of their sources of household income. Mobile communities such as Bedouins in Sinai or Banoka in Botswana's Okavango Delta, who live in small groups, lack such support networks and are, therefore, more vulnerable to external forces (Madzwamuse and Fabricius 2004, Folke et al. 2005a).

Adaptive co-managing communities are aware of the need to deal with change, often through informal monitoring and observation of resource and ecosystem dynamics. At Laguna Lake in the Philippines, for example, local observations spurred conservation action to prevent degradation of the Lake (Folke et al. 2005a), and in Peru traditional communities are able to forecast El Niño events by watching the stars (Orlove et al. 2000). Swedish fishermen use indicators to track change in marine ecosystems, thereby enhancing their capacity to manage fish stocks (Olsson 2003) and nomadic communities in Sinai and Richtersveld, South Africa, use sophisticated cues from ecosystems to decide when to move livestock (Bohensky et al. 2004, Folke et al. 2005a).

Institutions that are Nested across Scales

Communities that manage adaptively are able to reorganize existing institutions, or establish new institutions to lobby for change when a policy window opens. An example is the Ecomuseum Kristianstads Vattenrike (EKV) (Olsson et al. 2004b), which emerged when local groups perceived ecosystem degradation. This discovery coincided with a general environmental awareness in Sweden and connections to individuals and networks at higher levels of organization who could implement action. Institutions like the EKV can assist in building knowledge, to improve people's awareness of threats, through, e.g., community-based inventories and mapping (Schultz et al., in review), People's Biodiversity Registers (Gadgil et al. 2000), and participatory assessments of ecosystem trends (Lynam et al. 2004, Cundill et al. 2005).

Institutional networking can lead to the formation of "polycentric management networks" that cut across scales, and that may involve local communities, municipalities, and central government managing ecosystem services across scales, from the level of a village to a catchment (Xu et al. 2005). An advantage to institutional diversity is that it promotes alignment of rules and policies at different scales, and it becomes more difficult for "free riders" to break diverse sets of rules (Dietz et al. 2003). Such networks are a key component of the India Biodiversity Strategy, but lessons from South Africa have shown that they are notoriously difficult to formalize when capacity at any tier of governance is low (Fabricius and Collins, in press). The creation of knowledge networks and polycentric institutions

across spatial scales can also hold dangers for communities involved in natural resource management. In particular, powerful stakeholders might use information and resources from cross-scale interactions to undermine trust and reinforce their own authority (Adger et al. 2005). At the same time, however, institutional networks can also strengthen the power of communities to avert external policy and economic threats from local to global (Barthel et al. 2004, Smit and Wandel 2006) by, e.g., obtaining legal support to avert threats from developers. Communities in Papua New Guinea and Richtersveld have linked with national and international networks to assist them with their battles against mining companies (Folke et al. 2005a). Bridging organizations, which bridge the divide between communities and other levels of government, are often vital in ensuring that governance capacity is developed or maintained (Hahn et al. 2006).

Linking Culture with Management

Communities that link culture with ecosystem management by, e.g., viewing ecosystems as deities or sacred places, show potential as adaptive managers. Mountain communities in Costa Rica, Tibet, and the Peruvian Andes see mountains as living beings or gods (Xu et al. 2005, Folke et al. 2005a) and worship mosaics of landscapes consisting of rivers, peaks, valleys, and agricultural landscapes. These links between the spiritual world, livelihoods, and ecosystem management were prevalent in many of the community-based assessments of the MA. Sacred pools ("isiziba" in South Africa's Eastern Cape and "machhiyal" in northern India), sacred forests in India, East Africa (Ylhaisi 2003), and South Africa (Bohensky et al. 2004) or sacred grazing areas in India (Folke et al. 2005a) are subject to rigorous codes of conduct. They can, therefore, function as remnant sources of critical natural capital during times of crisis such as severe droughts and wild fires (Bohensky et al. 2005). Many communities in India, Sweden, and South Africa offer special protection to totemic plant and animal species, which are protected through traditional institutions. Such conservation activities strengthen people's identity with positive feedbacks for ecosystem conservation (Folke et al. 2005a). Adaptive management is possible when tradition and management interact through "mutual training" (Barthel et al. 2004, Olsson et al. 2004b) over long periods of time.

For example, households may prepare for and respond to crises in rainfall, food supply, livestock management, and degradation by a) managing variability, b) selectively and experimentally adapting technologies, c) modifying labor allocation, and d) using markets to improve livelihoods and cope with crisis (Mortimore and Adams 2001). Over time, households and individuals may develop technical and institutional innovations in managing natural resources that are aimed at reducing risk (Tiffen et al. 1994, Forsyth et al. 1998). In Zimbabwe, reciprocity within familial networks was found to be an important factor in spreading wealth within communities during times of crisis (Campbell et al. 2002). Trading livestock for credit at local shops during drought years, for example, indicates the conversion of one type of capital to another in order to cope with an external shock such as drought.

Enabling Policies

Well-defined formal policies that are easy to understand can facilitate adaptive capacity (Lambin 2005) by, for example, making provision for secure property rights (Barthel et al. 2004), providing tax or other incentives for good ecosystem management (Lambin 2005), or enabling communities to participate in and influence policy processes (Bohensky and Lynam 2005). There must, however, be congruence in scale between policies and ecosystem processes they intend to influence (Capistrano et al. 2005), and the powers of actors to participate in policy making or implementation have to be congruent with the sphere of influence of the policy. Policies that are conducive to adaptive co-management allow for the integration of different environmental sectors and different types of knowledge between scales, e.g., South Africa's National Water Strategy (Bohensky and Lynam 2005). Policies that promote economic development through cultural revival, such as a provincial government policy to promote Yunnan in China as a cultural and green economy Province, could stimulate cultural revival and revive indigenous knowledge about natural resource management (Xu et al. 2005). Inappropriate policies, on the other hand, such as those that promote large-scale development without regard for ecosystem services or which undermine local governance can undermine adaptive co-management and community empowerment (Biggs et al. 2004).

Motivation

Motivation may be catalyzed by need or crisis (Olsson et al. 2004b, 2006), but can also be driven by policy-led financial or non-financial incentives, the managers' ability to gain financially from ecosystem management (Lambin 2005), the existence of common interests and vision amongst stakeholders (Barthel et al. 2005), and cultural factors, ethics, and value systems that are conducive to adaptive ecosystem management and governance (Troster 2003).

WHAT ARE THE BENEFITS TO COMMUNITIES THAT ADAPT APPROPRIATELY?

Communities that have created social mechanisms that enhance their adaptive capacity are able to deal with challenges such as conflicts, making difficult trade-offs between short- and long-term well-being, and implementing rules for ecosystem management. They are also better able to assert their rights to land and resources, and to exclude or regulate use by outsiders (Dietz et al. 2003). Under the correct conditions, complete transformation of mismanaged or unmanaged social-ecological systems becomes possible (Olsson et al. 2004b, Barthel et al. 2005). This improves the capacity of the ecosystem to continue providing services such as cultural services, watershed protection, and ecosystem products (Xu et al. 2005).

People who have been successful in establishing institutional and knowledge networks are able to use innovative strategies to improve their livelihoods by bridging the divide between informal traditional knowledge and formal technical knowledge (Cundill et al. 2005). Creative disturbance through, e.g., swidden agriculture enable people to make a living from a broad range of ecosystem services (Fox 2005). By maintaining key resource areas such as sacred pools and forests through cultural practices (Bernard 2000), vulnerability is reduced and options are kept open.

Communities may respond to change in a fashion that increases their vulnerability and leads to major negative changes in their well-being. People may experience profound changes in their health or financial income due to loss of ecosystem services (Biggs et al. 2004). They could be forced to rely on inappropriate technological solutions (Lebel et al.

2005) or make unfavorable trade-offs between provisioning, cultural, regulating, and supporting services (Rodrigues et al. 2006).

Assessing whether a local response is appropriate for the external threat or environmental change in question is considered one of the major difficulties in research dealing with coping and adaptive strategies (Scherr 2000). Shifting emphasis between different types of capital in response to shocks and surprises is generally seen to depict rational decision-making and, therefore, arguably appropriate responses (DFID 2000). Local responses to political crisis in South Africa, however, provoked arguably irrational responses, such as breaking social networks, degrading the resource base through rule breaking, risk taking, and abandonment of arable field cultivation at a time when food security was at low point (Cundill 2005). These decisions appear irrational in the absence of an understanding of processes taking place at broader scales. In this case, political crisis occurred alongside severe drought and economic depression, which meant that trust and cooperation were reduced during a critical time when coping and adaptive strategies were most sorely needed. Similar instances of inappropriate responses are to be found in Sri Lanka (Korf 2004) and other areas of South Africa (Grundy and Cocks 2002).

Many analysts of coping and adaptive strategies (e. g., Adger 2003, 2006, Armitage 2005, Bruck 2003, Ford et al. 2006) have tended to focus mainly on the social domain, without assessing the links between social adaptive capacity and the capacity of an ecosystem to sustain human well-being with essential ecosystem services. A major contribution made by the MA to research into adaptive capacity is its simultaneous focus on the adaptive capacity of societies and ecosystems. The MA concluded that social and ecological systems cannot be treated as separate systems, as they are not only linked but intertwined with complex interactions across levels and scales (Capistrano et al. 2005).

CONCLUSIONS

How can peoples' adaptive capacity be strengthened to deal with a world in transformation? The issue is complex, with numerous angles. Here, we have focused on community responses of social-ecological systems, i.e., not solely the social or the ecological part, but the integrated system and its use of ecosystem services, drawing on the contributions

contained in the special feature and on work with the community-based assessments of the subglobal part of the MA. We have used the concepts of Powerless Spectators, Coping Actors, and Adaptive Co-managers to address adaptive capacity of communities, and have identified features in the social domain of social-ecological systems that help build adaptive capacity. Short-term coping responses may lead to reduced adaptive capacity, which implies loss of social-ecological resilience. With inappropriate responses, communities' options for coping with change—whether political, economic, or ecological—are diminished or lost, and they may become trapped in a downward spiral of increased vulnerability. Intervention and support from external sources and other levels of organization may be a precondition for transforming communities from such traps into improved livelihood situations and management of ecosystem services for this purpose (Fabricius and Collins, in press). Therefore, policies and incentives should be implemented to empower communities and create institutional frameworks that enhance their potential, in collaboration with other organizational levels, to respond to change and self-organize without eroding ecosystem resilience.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/vol12/iss1/art29/responses/>

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