Environmental Conservation **34** (2): 140–152 © 2007 Foundation for Environmental Conservation doi:10.1017/S0376892907003876

Enhancing ecosystem management through social-ecological inventories: lessons from Kristianstads Vattenrike, Sweden

LISEN SCHULTZ[1,2]*, CARL FOLKE[1,3] AND PER OLSSON[1]

[1]*Stockholm Resilience Centre and Centre for Transdisciplinary Environmental Research (CTM), Stockholm University, SE-106 91 Stockholm, Sweden,* [2]*Department of Systems Ecology, Stockholm University, SE-106 91 Stockholm, Sweden, and* [3]*Beijer International Institute of Ecological Economics, Royal Swedish Academy of Sciences, PO Box 50005, SE-104 05 Stockholm, Sweden*

Date submitted: 21 April 2006 Date accepted: 4 April 2007

SUMMARY

Environmental policy increasingly emphasizes involvement of local users and land owners in ecosystem management, but conservation planning is still largely a bureaucratic-scientific endeavour of identifying biological values for protection. Neither biological inventories nor stakeholder analyses, that tend to focus on conflicting interests, capture human resources in the landscape or the social structures and processes underlying biological conservation values. Social-ecological inventories are therefore proposed during the preparation phase of conservation projects as a means to identify people with ecosystem knowledge that practise ecosystem management. The method presented here focuses on local steward groups acting outside official management plans. In a social-ecological inventory of a river basin of southern Sweden, local steward groups, their ecosystem management activities, motives and links to other actors involved in ecosystem management were identified through interviews, participatory observations and a review of documents and other written material. Several hundred active local stewards were organized in 10 local steward groups that managed and monitored a range of ecosystem services at different spatial scales. Contributions of local stewards included on-site ecosystem management, long-term and detailed monitoring of species and ecosystem dynamics, local ecological knowledge, public support for ecosystem management and specialized networks. Two conservation projects are used to illustrate how local steward groups came together in multi-level networks and collaborated around specific conservation issues. The projects have been linked to ecosystem management at the landscape level through a flexible municipality organization, the Ecomuseum Kristianstads Vattenrike (EKV). EKV has acted as a 'bridging organization', coordinating and connecting many of the local steward groups to organizations and institutions at other levels. The process has been guided by social capital and shared visions for the whole landscape. The study shows that ecosystem management likely relies on multi-level collaboration and social-ecological inventories may help identify actors that are fundamental in such management systems. Social-ecological inventories should be employed in any attempt to develop and implement ecosystem management.

Keywords: ecosystem management, Kristianstads Vattenrike, local stewards, multi-level networks, participation, social-ecological inventory

INTRODUCTION

Conservation is an essential tool in ecosystem management and stewardship of larger dynamic landscapes and seascapes (Bengtsson *et al.* 2003; Hughes *et al.* 2005). In the management of biological diversity, conservation plays a significant role in sustaining ecosystems in desired states (Folke *et al.* 1996; 2004), thus ensuring essential ecosystem services for livelihoods and societal development (Millennium Ecosystem Assessment 2005). Successful ecosystem management obviously requires thorough knowledge about ecosystem processes, but just as important is knowledge of the social actors and structures that make these processes viable. For example, decades of ecological and natural history research are not enough to ensure proper ecosystem management of tropical dry forests in Costa Rica (Maass *et al.* 2005). Management strategies must be based on understanding of human–ecosystem interactions (Maass *et al.* 2005) in social-ecological systems (see Berkes *et al.* 2003).

Many of the social processes that support or obstruct conservation take place at the local level (Folke *et al.* 2005*a*), and there are several reasons why conservation efforts need to take these processes into account. In some cases, areas of conservation interest are a result of human behaviour and culture (Nabhan 1997), and engaging local actors may lower the transaction costs of sustained conservation (for example Colding & Folke 2000, 2001; Bhagwat *et al.* 2005). Involving local resource users in environmental planning and decision-making can also improve incentives for ecosystem management (Agrawal & Gibson 1999; Fabricius & Koch 2004). Local people's knowledge of local resources and ecosystem dynamics can complement scientific knowledge in conservation efforts (see Berkes *et al.* 2000; Gadgil

*Correspondence: Lisen Schultz Tel: +46 8 16 12 90 Fax: +46 8 15 84 17 e-mail: lisen@ecology.su.se

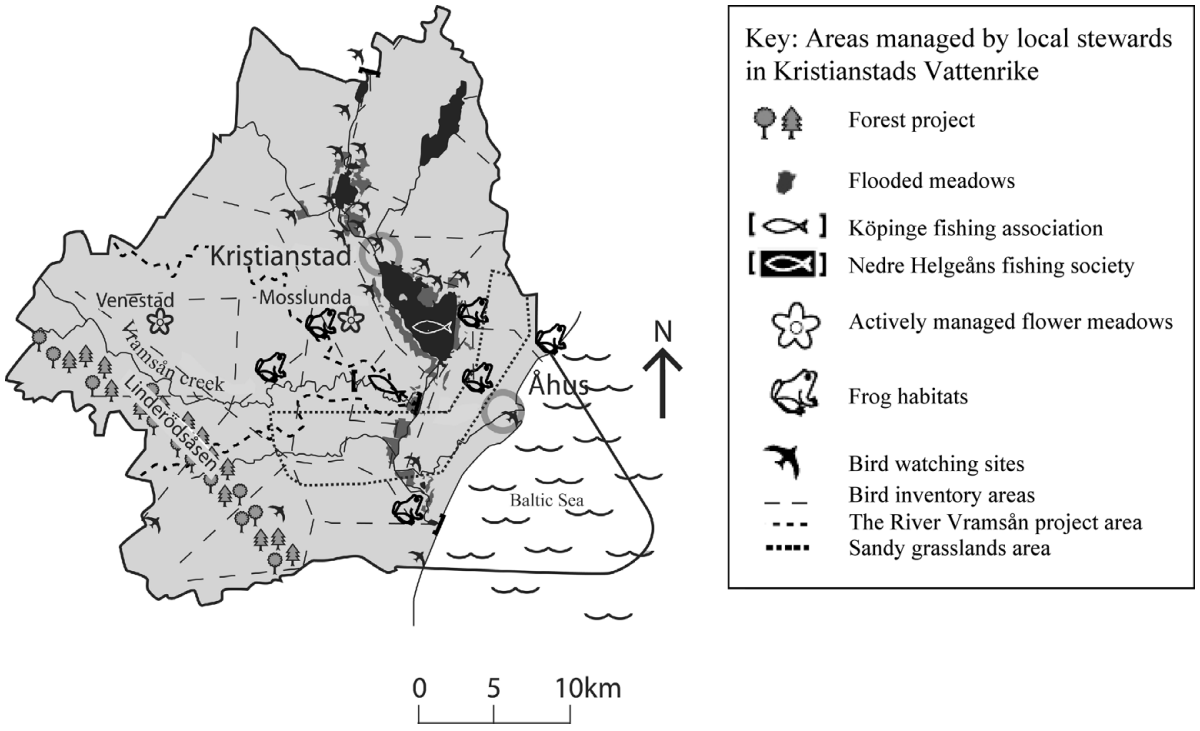

Figure 1 Examples of ecosystem areas in Kristianstads Vattenrike managed or monitored by local stewards. The sizes range from the 400 m^2 meadow managed by Venestad's Village association, to the River Vramsån project covering a tertiary watershed, and to the activities of the Bird Society, the Frog group and the Flora group, who monitor the whole area divided into smaller plots. Flooded meadows/mowed wet grasslands cover 1620 ha (Ovesson 2003), actively managed sandy grasslands cover 2 ha (EKV manager of sandy grasslands project, personal communication 2006).

et al. 2003; Aswani & Hamilton 2004; Sheil & Lawrence 2004), and stakeholder participation and the need to involve communities are explicitly stated in several official documents and agreements on ecosystem management and biodiversity conservation. Examples range from global agreements such as the Malawi principles for the ecosystem approach adopted by the Convention on Biological Diversity, to European Union (EU) Directives such as the EU Water Framework Directive, and Swedish Government communications such as *En samlad naturvårdspolitik* (Swedish Government 2001).

The means to map, analyse and manage stakeholder engagement to make conservation projects participatory and viable have been discussed extensively (for example Grimble & Wellard 1997; Thyl De Lopez 2001; Mushove & Vogel 2005). Although participation by a variety of stakeholders may be desirable from a democratic perspective, it is not in itself a recipe for successful ecosystem management. Participation has to be connected to management practices that generate ecological knowledge, draw on experience and learn about and respond to ecosystem dynamics (Berkes & Folke 1998). Here we focus on local actor groups (Folke *et al.* 2005*b*), generally operating at the level below municipalities, who effect management of ecosystems and their services on the ground. Inspired by Nabhan's (1997) concept of cultural stewards of wildlife habitats, we refer to those as 'local steward groups' and propose that they represent an undervalued and sometimes unrecognized source of knowledge and experience for ecosystem management (Olsson & Folke 2001).

We designed a method, a social-ecological inventory, to identify these local steward groups and their activities, with the ultimate aim of drawing on their experience to enhance ecosystem management at the landscape level. Such an inventory complements stakeholder analyses and biological and ecological inventories, and assesses existing management systems behind the generation of ecosystem services, thus providing a starting point for participation.

The 1100 km^2 of Kristianstads Vattenrike (KV) comprise a diversity of habitats, including Sweden's largest area of flooded meadows used for grazing and hay-making, in the catchment of the Helgeå River (Municipality of Kristianstad, southern Sweden) (Fig. 1). Many of the unique biological and cultural values of KV are associated with these social-ecological systems, which require active management and annual flooding to be sustained. KV generates a range of ecosystem services, including highly productive sandy and clay soils, the largest groundwater reserve in northern Europe and biodiversity, including rare plant species (such as fen ragwort *Senecio paludosus* and river water-crowfoot *Ranunculus fluitans*, 40 [7 of which are IUCN red listed species] fish species, 6 [2 red listed] amphibians, 260 [31 red listed]

bird species, 11 [4 red listed] bat species and an abundance of insects and molluscs). Some of the area's unique flora and fauna were described by the Swedish botanist Carl von Linné on his journey through Scania in 1749 (Linné 1751).

Part of KV is a wetland protected by the Ramsar Convention since 1975, yet the area deteriorated in the early 1980s, and people of the area mobilized themselves to forestall the ecological decline. In 1989, the municipal organization Ecomuseum Kristianstads Vattenrike (EKV) was formed as a key bridge between local actors and higher levels of governance. Simultaneously, there was a shift in perception among key actors from seeing KV as 'pristine nature' to be set aside for conservation, to recognizing that the values resulted from a cultural landscape influenced by a variety of actors. Currently, conservation is used as a means for social and economic development of the area (Olsson *et al.* 2004; Hahn *et al.* 2006).

In this area where conservation values are tightly connected to the cultural landscape and managed by a diversity of actors, we pursue the following questions. Who are the local steward groups involved in ecosystem management? Which practices in relation to ecosystem services do they perform? What are their motives for engaging in ecosystem management? How do their activities and abilities relate to other types of ecosystem management in the area? We discuss how official management can facilitate, complement and build on the work of local stewards.

METHODS

For the social-ecological inventory, we investigated existing local management systems and assessed how they related to ecosystem services of the area. Steward groups in the landscape, key individuals in these groups and their management practices were identified. We also identified collaborative links between organizations and individuals. Methods included interviews, participatory observations and an extensive review of other information sources, including project proposals, progress reports, notes, maps, correspondence, internet sites and newspaper clippings. The inventory focused on identifying organizations and individual landowners with management practices that directly or indirectly enhanced ecosystem services or the capacity of the ecosystem to provide these services. In addition, we mapped organizations and individuals that monitored the landscape and responded to ecosystem changes (i.e. local steward groups).

Information about ecosystem management and conservation administrated by official agencies is easily accessed in Sweden, due to the principle of public access to official records. Informal or unregistered management is less known, and there is no systematic assessment of such activities in Sweden. Therefore, our study focused on the management performed outside the official management plans. It does not include management that is imposed upon landowners and steward groups, but rather focuses on on-site management that is conducted in addition to the mandatory requirements and responsibilities, often on a voluntary basis and for a diversity of reasons.

Identifying local steward groups

The inventory started with interviews of EKV staff. Being a key coordinating organization in the network of ecosystem managers, they were asked to identify groups and individuals involved in the management of KV. This led us to a number of farmers, two fishing associations, two village associations, the Bird Society of north-east Scania and the local branch of the Swedish Society for Nature Conservation. Following a snowball sampling technique (Biernacki & Waldorf 1981), these organizations and individuals were asked in turn to provide more examples until we had developed an overview of local steward groups.

We also used a land-use map for KV to identify stewards not explicitly involved in the EKV network. This was used to list activities that could take place in the area, such as hunting, fishing, forestry and farming. We identified the largest landowners and landowners of key habitats or ecosystems, and we contacted the largest environmental and conservation non-governmental organizations (NGOs) in Sweden to obtain information about locally active members. Finally, we searched municipality archives and registers of associations in Kristianstad. We do not claim that the social-ecological inventory is complete, but the groups and individuals interviewed represent a diversity of stewards that may be found in a landscape.

In order to find out how the work of local stewards relates to ecosystem management at other scales, we mapped the networks of two conservation projects. The mapping was made by a run-through of each project's development step-by-step with the respective project manager. Project reports were used to verify and complement information from the interviewees. This method only captured the primary networks, but gave an idea of how the projects brought different groups together. These groups in turn brought their networks, but these were not fully mapped.

Key informants and interviews

Within each group, we asked for individuals knowledgeable about nature and the group's management activities. In some cases, a key individual was the chairman of an association, while at other times the focal person had taken part in forming an association. One of the interviewees was chosen for being active in several organizations. The interviews were semi-structured and open-ended, using a combination of the interview guide approach and informal conversation (Patton 1980). They were conducted after an initial phone call, where the objective of our research was presented. In total, 16 individuals were interviewed.

The interviews centred around three themes. One was the local steward groups' interactions with the ecosystem, and this was revealed through questions about (1) management

Table 1 Local stewards of Kristianstads Vattenrike. Sources of information: [a]total number of farmers in Kristianstad (Municipality of Kristianstad official website 2005, see http://www.kristianstad.se), [b]annual report of Swedish Society for Nature Conservation in Kristianstad (Naturskyddsföreningen i Kristianstad 2004), [c]annual report of the Bird Society of NE Scania (Nordöstra Skånes Fågelklubb 2006), [d]board member of Nedre Helgeåns fishing society, personal communication (2006), [e]chair of Kristianstad-Bromölla hunting circuit, personal communication (2006), [f] board member of Näsby hunting association, personal communication (2003), [g]Swedish Forestry Agency, personal communication (2005), [h]Nature Conservation manager at EKV, personal communication (2005), [i]chair of the Bird Society of NE Scania, personal communication (2005), and [j]chair of Swedish Society for Nature Conservation in Kristianstad, personal communication (2003).

Groups and associations		*Individuals active as local stewards*	*Total number of individuals belonging to the group*
Farmers			1430[a]
	Sandy grasslands	5[h]	
	Flooded meadows	50[h]	
Society for Nature Conservation in Kristianstad			1477[b]
	Flora group	20[j]	
	Bird group	20[j]	
	Frog group	20[j]	
Bird Society of North-east Scania		50[i]	541[c]
Nedre Helgeåns fishing society		10[d]	800 households[d]
Kristianstad-Bromölla hunting circuit		1559[e]	1559[e]
Näsby hunting association		12[f]	12[f]
Private forest owners		Unknown	2537[g]

practices ('Describe what you do in this biotope during a year' and 'How come you do it like that?') and (2) the result and rationale of the practices ('What do you expect the results to be?', 'What have the results been so far?' and 'How is this species important?'). Another theme concerned cooperation and communication with other groups related to ecosystem management. To understand how the work of local steward groups could be facilitated, a third theme regarded the development of management and the motives for continuing, posing questions like 'How did it start?', 'What makes you continue?' and 'How do you envision the future of your group?'. Interviews were tape recorded and fully transcribed. Interviews lasted 1–2.5 hours.

When possible, we conducted participant observations (Jørgensen 1989) at sites and meetings. Annual reports, protocols and websites provided additional information on activities carried out by the groups.

RESULTS

We identified several hundred active local stewards organized in 10 local steward groups ranging from place-based farmers to national NGOs (Table 1). The exact numbers of stewards and steward groups were difficult to determine; some stewards were active in several groups, some were not organized and others were supportive members of associations but not very active. However, the inventory enabled us to investigate how local stewards operate in relation to ecosystems and their services.

Interviews with the local stewards revealed a range of practices used for managing KV (Table 2). Focusing on different ecosystem components, their activities were spread across the whole area (Fig. 1). In addition to on-site management, local steward groups provided detailed and long-term monitoring of species and ecosystem conditions, in some cases on a daily basis. The groups were also interacting with individuals and organizations horizontally and vertically, including landowners, governmental agencies and other steward groups, mainly in specific conservation projects (Figs 2 and 3), but also in formal structures such as the consultancy group advising the EKV. In several cases, the activities of the steward groups complemented ecosystem management at other levels, but they were not always recognized or supported by government agencies in this role.

None of the stewards expected economic gain from their engagement, but instead emphasized the joy of learning, the satisfaction of contributing to something important, aesthetical and recreational values of interacting with nature and the social function of working together.

All of the steward groups had been in place before the bridging organization EKV was established, but the activities of many of the steward groups had been strengthened and coordinated in an adaptive manner by EKV (Olsson *et al.* 2004).

Local steward groups in KV

Farmers constituted the group of local stewards which had the largest impact on KV ecosystems, as their management practices structured the wetland landscape and the sandy grasslands. EKV cooperated with several farmers to keep the flood plains grazed and to sustain the rotational farming system necessary to maintain the sandy grasslands. Anglers and hunters also had steward associations in KV involved in monitoring and management of the resources and supporting ecosystems. Two national conservation associations had local

Table 2 Some examples of local stewards' management practices, favouring different ecosystem components and enhancing different ecosystem services.

Local stewards	*Examples of management*	*Favoured ecosystem component*	*Examples of associated ecosystem services*
Farmers	Grazing of flooded meadows, manual removal of hawthorn bushes	Flooded meadows along Helgeå river	Biodiversity, recreation, aesthetics, quality fodder, nutrient retention, flood buffer, part of KV's identity
	Harrowing the sandy grasslands in a traditional fallow farming cycle	Sandy grasslands unique in Europe	Biodiversity of flora and pollinating insects, aesthetics, cultural values
	Adjusting potato farming to decrease nutrient leakage along the River Vramsån	Water quality	Biodiversity of flora and fauna in the creek, fish production
Forest owners	Saving key biotopes	Diverse habitats in deciduous forests	Biodiversity, timber production
	Thinning or planting forest along the River Vramsån for appropriate proportions of light and shadow	Fish and flora habitats along the creek	Biodiversity, fish production
	Thinning the forest to provide fodder to game	Elk and deer	Meat production, recreation
Fishing associations	Improving fish habitats, catch regulations	Fish	Fish production, recreation
Hunting associations	Feeding game, improving habitats, monitoring, predator and vermin control	Hare, deer, pheasants, elk	Meat production, recreation
Bird Society of North-east Scania	Putting up nesting boxes, feeding birds of prey during winter	Birds	Biodiversity, recreation, seed dispersal
	Helping clear up land to improve habitats	Flooded meadows along Helgeå river	Biodiversity, recreation, aesthetics, quality fodder, nutrient retention, flood buffer, part of KV's identity
	Suggesting and working for bird conservation projects such as the Stork project	A range of habitats suiting different birds	Biodiversity, recreation, aesthetics, education, part of KV's identity
Venestad's village association	Cutting grass for hay-making according to traditional management practices in a small area	Flora species associated with traditional agricultural landscape	Biodiversity of flora and pollinating insects, recreation, aesthetics, cultural values
Swedish Society for Nature Conservation in Kristianstad:			
(a) Flora group	Initiated the sandy grasslands project and other conservation projects	Range of habitats suiting different plants	Biodiversity of flora and pollinating insects, recreation, aesthetics, cultural values
	Cutting grass for hay-making according to traditional management practices in a small area	Flora species associated with traditional agricultural landscape	Biodiversity of flora and pollinating insects, recreation, aesthetics, cultural values
(b) Frog group	Restoring and creating amphibian habitats	Habitats for rare amphibians	Biodiversity, indicators of ecosystem health (informational service)
(c) Bird group	Winter-feeding of white-tailed eagles *Haliaeetus albicilla* since 1968	White-tailed eagles	Biodiversity, aesthetics
	Fetch and release of 70–150 goshawks a year caught by pheasantry owners	Goshawks	Biodiversity
	Involved in the Stork project	Storks	Biodiversity, symbol of Scania

groups in the area, performing a range of management practices, mainly to improve and conserve biodiversity. In addition, one village association performed management practices that enhanced ecosystem services. Once a year they cut grass with scythes to provide a habitat to rare plant species. Some forest owners were identified who had participated in a project on collaborative landscape analysis, initiated by the Swedish Forestry Agency and funded by the EU (Mårsäter *et al.* 2001).

Local stewards' contributions to ecosystem management

Common features emerged from analysing the interview data, and the contributions of the different local steward groups in relation to ecosystem management could be summarized in five categories, namely on-site management, monitoring and response, local ecological knowledge, generating support for ecosystem management and specialized networks.

On-site management

Local stewards used a range of management practices that structured the landscape on different scales (Table 2). Flooded meadows, sandy grasslands and key habitats in deciduous forests were dependent on management by farmers and forest owners. Habitats for rare species of birds, plants and amphibians were being sustained and improved by volunteers from the Bird Society, the Swedish Society for Nature Conservation in Kristianstad (hereafter called the Nature Conservation Society) and a village association. Fish and game populations were being managed by members of hunting and fishing associations through habitat restoration and regulations for hunting and fishing. Hunters and a bird group of the Nature Conservation Society were also engaged in feeding animals during harsh conditions. There were also efforts to save individual wildlife. For instance, the Nature Conservation Society was saving up to 150 goshawks a year through an agreement with local pheasantries to catch and release goshawks from their traps.

Monitoring and response

While the farmers' management practices structured the landscape and formed the basis for the rich biodiversity of the area, monitoring of population changes were mainly conducted by the Bird Society and the Nature Conservation Society. These groups included knowledgeable people living in the area and spending a lot of time in the landscape. They were conducting inventories both on their own initiative and on request, and had done so for decades, covering all of KV and parts of the neighbouring municipality. For example, the Bird Society had conducted inventories in KV since 1976 and had set up a field station used for scientific studies and ringing of birds. The Flora group had conducted regular inventories of certain areas for more than 20 years and arranged 140 excursions since 1983, documentation of most of which were available. Hunters participated in inventories of wildlife, for example of grouse.

In addition to regular inventories, several steward groups were conducting long-term monitoring of populations and habitats. Fishing associations assisted, for example, in measuring and reporting caught catfish (protected by law) before releasing them. Individual farmers were involved in monitoring water quality of the river Vramsån. The Flora group guarded 550 one hectare squares, spread out across the KV, which were habitats of IUCN red-listed species. The Frog group visited all amphibian habitats regularly. Hunters monitored the health of game. Responses to ecosystem feedback ranged from changing management practices to notifying officials and conservation organizations: 'If we see that the game's health is deteriorating, we alert the regional and national hunting association' (hunter, personal communication 2003). Mobilizations by the Flora group and the Frog group had several times been successful in preventing harmful activities, such as road construction in sensitive areas.

Local ecological knowledge

The interviews revealed that there were many learning processes in play in the area. The local stewards acquired the knowledge that they used in management in school, in study circles, in seminars with invited scientists, from each other and through media. Some had travelled to other places in Sweden and even abroad to gain new insights, and individuals from other regions were invited to the KV area to share their knowledge and experience. The stewards combined scientific knowledge and experiential knowledge, generated as ecosystem management projects were monitored and management practices were adjusted according to the results. As the chairman of the Bird Society put it, 'It takes knowledge about the birds' life histories to improve their reproduction sites.' The methods for conducting biological inventories were gained from handbooks or similar, often published by the Swedish Environmental Protection Agency.

The stewards had specific conceptions about habitats, species, links and ecosystem functions in the area. For example, they described population fluctuations and presented reasons behind them. A forest owner said, 'the areas between the forest and the arable land are often very rich, but they don't give much in production. If they were preserved they could function as migration corridors. Another way of increasing diversity is to remove only the older trees, to get a stand with mixed ages. Solitary pines on bogs should be left, since they give habitat to the black woodpecker, who in turn constructs habitats for a range of other bird species. Species such as some insects, mosses and lichens cannot live without the forest. No one knows what would happen if they disappeared. Some organisms keep others down, that would be harmful to us. Others increase production by nitrogen fixation. Others again might have functions we don't know of. Keeping a rich nature will be beneficial to us in the future.'

There was a general notion that ecosystems are complex with inherent uncertainties, and that altering them may lead to irreversible changes. 'You can do as many environmental impact assessments as you like. You will always have consequences you had not predicted. . . . You can never get back what you once have exterminated' (member of several associations, personal communication 2002). There was also awareness of cross-scale interactions, such as effects of land-use change in the migratory bird's winter habitats on migration patterns and survival. 'Reserves are good, but they are not enough. You have to consider surrounding areas as well' (member of several associations, personal communication 2002). The argument for focusing on rare species was that they are indicators or symbols of certain habitats with associated functions and services.

In addition, the local stewards were knowledge carriers of historical management practices and long-term changes in the landscape. Forest owners, farmers, hunters, fishers, bird watchers and flora group members were sources of knowledge of how the landscape has changed and how populations of different species have fluctuated. For example, Venestad's village association had documented local knowledge and local history through literature and story-telling by elders.

Generating support for ecosystem management

The local steward groups of the area were playing an important role in strengthening interest in and a sense of nature, both among their members and the public. The Bird Society and the Nature Conservation Society arranged excursions and study circles. Interviews with hunters, members of fishing associations, forest owners and farmers revealed that their participation in the local steward groups and in the ecosystem management projects increased their engagement and interest in nature and its dynamics.

Specialized networks

All the local steward groups had specialized networks, often including national and international contacts. Many farmers were members of the Federation of Swedish Farmers (LRF). The hunting associations, the Bird Society and the Nature Conservation Society were all local branches of national organizations. They took part in national and international inventories, and they could also get larger support for their work through their mother organizations. The Bird Society had contacts with Denmark within the Stork project. They also exchanged experiences and knowledge with a twin association in Latvia, funded by the Swedish International Development Agency (Sida).

Motives for engaging in ecosystem management

Generally, the main motive for engaging in collaborative ecosystem management was not money. Aesthetic and recreational values, such as the beauty and peacefulness of flooded meadows, colourful flowers and birds in flight were appreciated by farmers and forest owners, as well as bird watchers and Flora group members. The local steward groups also had a social function; the members enjoyed doing things together. The chairman of the Bird Society stated that in order to keep the members, 'it is important that they feel welcome'. Another important aspect for all groups interviewed was the joy of learning: 'The more you learn about nature, the more interesting it gets'. Finally, the groups stressed the importance of what they were doing for ecological functions, sustainability and the responsibility they had as stewards of biodiversity, habitats and ecosystems. Consequently, ecosystem management gave self-esteem to farmers who in other contexts were considered 'environmental bandits'. Even though stewards in general did not expect to earn income from their work with ecosystems, they were not happy about having to pay for expenses other than time. For example, it was important for the individual volunteers in conservation associations to have fuel costs covered when they conducted inventories and monitoring. Usually, these expenses were covered by member fees, support from the municipality, donations and compensation from projects. Cattle-keeping farmers claimed that grants from the EU and the Swedish government made it affordable to keep the flooded meadows grazed.

Local stewards in relation to ecosystem management at larger scales

Most of the interviewees felt that local stewards' contributions to ecosystem management were acknowledged and facilitated by the official managers in Kristianstad. Formal collaboration took place in the Consultancy Group for Nature Conservation, which advised the EKV and assembling representatives from the County Administrative Board, different municipality organizations and eight local associations three times a year. The County Administrative Board regularly sent proposals for counselling to the different groups.

The EKV coordinated ecosystem management (Olsson *et al.* 2004; Hahn *et al.* 2006) and relied heavily on local participation. They had a well-developed local network, and were aware of how different groups could contribute to ecosystem management, as well as the motives behind their contributions. Based on this information, the staff of EKV tried to create win-win situations tailored to different needs. They also made an effort to acknowledge good initiatives and the work of local stewards. Several groups emphasized the collaborative atmosphere in KV, and said that EKV forestalled conflicts through good communication among land owners, hunters, members of fishing associations, forest owners and conservation associations. They also stressed the importance of having a participatory approach: 'Everybody that is affected by a decision should be called personally to participate in a discussion. Participation is not just a tool to make decisions smooth. Local people know about ecology, and they don't accept being overrun' (member of several organizations, personal communication 2002).

Ecosystems in the area were often being managed in projects by collaborative networks spanning multiple levels in society,

including local stewards and the EKV. We describe two such projects, investigating how the activities of local stewards fitted into a larger context of ecosystem management.

The River Vramsån project

According to the project manager and the project report, the River Vramsån project aimed to restore habitats for rare species and improve water quality in one of Sweden's most diverse and well-preserved creeks. The project also aimed to raise awareness among users and managers of the creek's values and problems and possible responses to these problems. The creek hosts several rare species, such as river water-crowfoot *Ranunculus fluitans*, freshwater pearl mussel *Margaritifera margaritifera*, sea trout *Salmo trutta trutta*, stone loach *Barbatula barbatula* and natterer's bat *Myotis nattereri* and, in contrast to most other creeks in Scania, it has not been straightened or deepened. It was mainly used for fishing and irrigation, and problems included nutrient loading from surrounding farms and household sewage, and water scarcity during dry periods, resulting in decline of biotopes and species. The project was initiated in 1999 by the EKV and ended in 2004. Funding was provided mainly by the WWF-Sweden, but Region Scania, the County Administrative Board and a potato crisp company also contributed (Dahlman 2004; manager of the River Vramsån project, personal communication 2006). The manager's progress notes showed that the project involved a range of local steward groups, researchers, the private sector and governmental organizations (Fig. 2, Table 3). Local steward groups were mainly engaged in monitoring, inventories and practical management. They also provided access to land and local ecological knowledge, and some participated in an advisory group.

The sandy grasslands project

The sandy grasslands project aimed at reintroducing traditional management practices to restore sandy grasslands that were disappearing in Europe (EKV manager of Sandy grasslands project, personal communication 2006). It was initiated when the Flora group suggested that the grasslands near Åhus should be restored, which catalysed the realization of an idea that had been 'put on hold' at the Ecomuseum for several years. After a meeting between the Flora group, the EKV, the park manager of Åhus and the Municipality ecologist, the project started. The park manager had some funding for managing the municipal lands, which could be put into the project. In addition, there was a plan to sell municipal land to a golf course entrepreneur, and the City architect could fund an inventory of valuable areas as part of the environmental impact assessment for the golf course. EKV had some funding for their application to become a Man and the Biosphere Reserve, which was also used for the sandy grassland project.

The EKV coordinated the project, but relied on other actors for different parts of the project (Fig. 3, Table 2). The Flora group provided botanical knowledge and local knowledge about sandy grassland habitats in the area. They also had a well-developed network of members through which they could provide information and motivation for harrowing the sandy grasslands. Through guided tours and other activities, the Flora group hoped to inform and increase interest in the sandy grasslands among a broader public. The Flora group was also involved in long-term monitoring. To identify interesting fallow areas in the preparation phase of the project, an expert from the group was employed to ensure results would be delivered on time. 'It is not a matter of quality, they (the local stewards) are competent enough to do good inventories, but we do not want to sponge on them or take advantage of volunteer work. You cannot demand results from volunteers on a deadline, so sometimes initially it is better to employ an expert' (Director of EKV, personal communication 2004).

Farmers provided knowledge of management practices associated with the sandy grasslands and experimentation for further learning has been part of the process. The EKV compiled knowledge of the fallow farming through interviews with several farmers in the area, to document management practices and get an overall picture of the sandy grassland and the fallow areas in north-east Scania. Farmers also had access to land, animals and machines to perform these management practices.

The EKV has helped raise funding and intended to apply for grants from the Local Nature Conservation Funds or Region Scania. They have served as mediators and put the project in a larger context, linking it to other societal goals. For example, in the case of the golf course, the EKV were not trying to stop it, as a more radical conservation organization would have, but instead make the municipality consider environmental issues when choosing which golf entrepreneur to sell the land to. The EKV has also put a lot of effort into strengthening the public's interest in and sense of nature, through outdoor exhibitions, an informative website, regular meetings with local media, the nature school and several other activities (Olsson *et al.* 2004; Hahn *et al.* 2006). They have provided the link between scientists and local inhabitants, making sure that research results have been conveyed to area managers and the broader public.

DISCUSSION

The social-ecological inventory illustrates that ecosystem management can be enhanced through recognition and collaboration with local steward groups. These groups conduct on-site management, long-term and place-based monitoring and provide quick responses to environmental change. They also generate local ecological knowledge employed in management practices, develop new initiatives in an adaptive management fashion, help gain support for ecosystem management, and act as guardians of species and habitats. Even if some may seem to have a narrow focus, aiming at favouring certain habitats or species, their activities need to be recognized as a potential source of stewardship of biodiversity and ecosystem services.

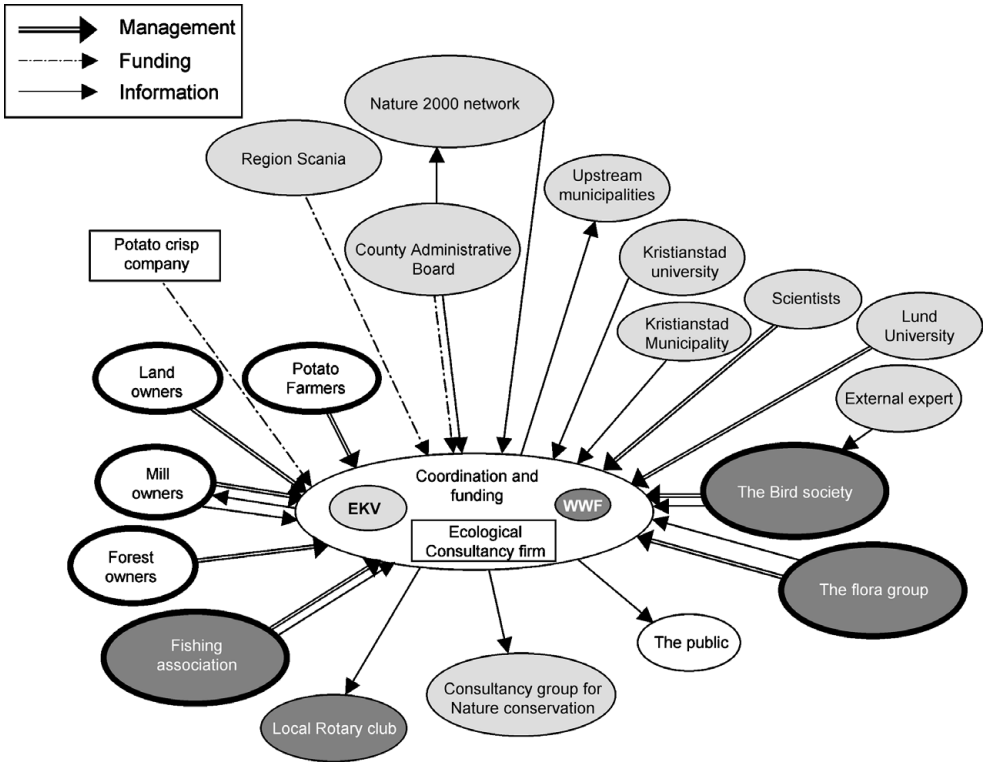

Figure 2 The network of the River Vramsån project. Information arrows represent legal support, ecological knowledge and monitoring. Dark ellipses with white text represent NGOs, grey ellipses represent governmental organizations, rectangles represent private companies and white ellipses represent individuals acting outside organizations. Bold black outlines mark the local stewards. WWF = Worldwide Fund for Nature.

Table 3 Contributions of different actors to the River Vramsån project.

Project components	*Actors*															
	EKV	*Ecological consultancy firm*	*Potato crisp company*	*Private land owners*	*Potato farmers*	*Mill owners*	*Forest owners*	*Fishing associations*	*The Flora group*	*The Bird Society*	*WWF*	*Universities*	*Municipality organizations*	*County Administrative Board*	*Region scania*	*Nature 2000 network*
Initiating the project	×															
Coordination/ connecting actors and projects	×	×									×					
Funding	×		×								×			×	×	
Generating political support	×										×					
Providing institutional support						×		×						×		×
Generating public support	×										×					
Ecological knowledge	×	×					×	×	×	×		×				
Maps	×											×		×		
Access to technology													×			
Access to land				×												
Monitoring, inventories, suggested measures		×						×	×	×		×				
Practical management					×	×	×	×		×		×				
Experimentation												×				

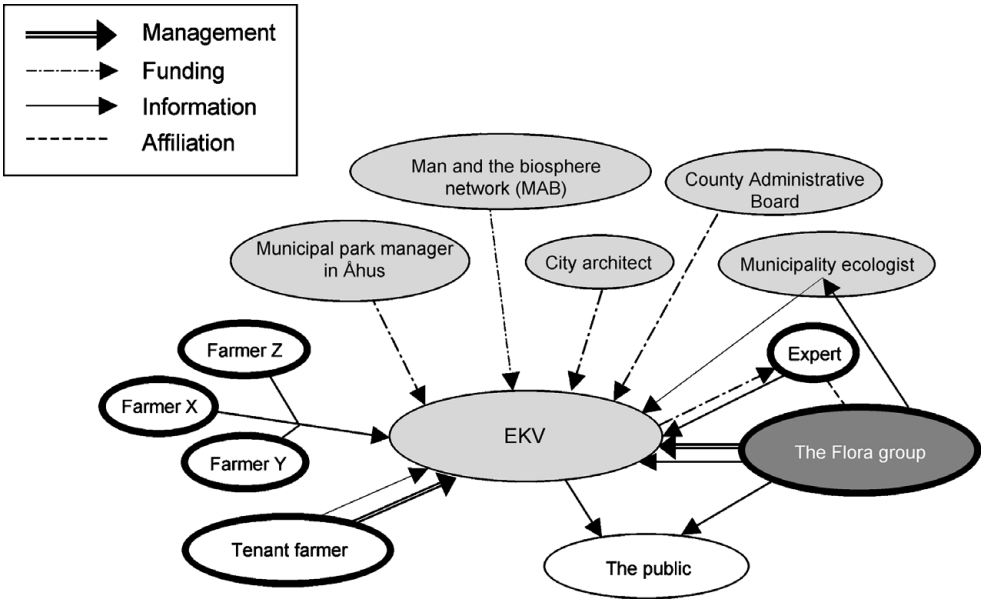

Figure 3 Groups involved in the sandy grasslands project. Dark ellipses with white text represent NGOs, grey ellipses represent governmental organizations and white ellipses represent individuals acting outside organizations. Bold black outlines mark the local stewards.

Table 4 Contributions of different actors to the sandy grasslands project. MAB = Man and the Biosphere Network.

Project components	*Actors*							
	MAB	*County AdministrativeBoard*	*City architect*	*Municipal ecologist*	*Municipal park manager*	*EKV*	*The Flora group*	*Farmers*
Initiating the project							×	
Coordination/connecting actors and projects				×		×		
Funding	×	×	×		×	×		
Generating political support	×					×		
Providing institutional support		×				×		
Generating public support						×		×
Experimentation								×
Knowledge of traditional management practices								×
Knowledge of current ecosystem condition							×	×
Access to land						×		×
Practical management such as plowing and harrowing								×
Ecosystem monitoring							×	

Steward groups are often organized in collaborative networks involving local inhabitants, other associations and contacts on other levels. Many of them take part in national and international networks for information sharing and common action. However, being local, small-scale and built on voluntary efforts also poses constraints such as lack of power and limitations on the time and effort that can be put into conservation and ecosystem management projects. Thus, although local steward groups play important roles in responding to changes and managing the landscape, it

should not be concluded that the work of these groups can be substituted for the efforts of formal management, but rather that their self-organizing ability can complement them. It seems that to be truly effective, local stewards need a larger framework and links to organizations and institutions at higher levels.

It is in this context that social-ecological inventories become useful. Such inventories help illuminate ongoing local place-based efforts for conservation and ecosystem management. They reveal the groups' foci, motives, knowledge and networks, generating a map of actors and links that can be revived in different phases of change in a social-ecological system (Folke *et al.* 2003). A social-ecological inventory is different from a stakeholder analysis in that it focuses on people with ecosystem knowledge and local stewards who practise ecosystem management, rather than analysing all stakeholder groups. In other words, it is conducted with the aim of unravelling current local capacity for ecosystem management rather than identifying conflicting interests, and emphasizes the human-in-nature perspective which is the basis for analyses of integrated social-ecological systems (Berkes *et al.* 2003). Because they are made with the assumption that people in the landscape can be local stewards as opposed to mere users of ecosystem services, social-ecological inventories can function as vehicles for trust-building among stakeholders.

Using local stewards' understanding of long-term landscape changes, gained through voluntary monitoring and management practices, and building on local institutions might lower transaction costs of conservation. Neglecting ongoing management when deciding on, for example, protected areas will surely create unnecessary conflict, remove local incentives for conservation and alienate people. Furthermore, the generation of ecosystem services may deteriorate when local stewards and social features of ecosystem management are neglected.

An example from southern Madagascar illustrates this point. Here, the landscape is heavily fragmented, except for small forest patches that serve as refuges and hold an abundance of rare species. Analyses of movements of animals illustrate that the landscape is fairly well connected and that the forest patches support pollination of staple crops important to local livelihoods (Bodin *et al.* 2006). A national government or an international conservation NGO may conclude that to conserve biodiversity and ecosystem services these forest patches need to be urgently protected from human use. But a social-ecological inventory would reveal that they are in fact already protected by social taboo systems (Tengo 2004). Lack of recognition of the social and cultural dimension of conservation may lead to collapse of such systems (Colding & Folke 2001). However, with this information in mind, the NGO and the national government could instead support such management institutions, for example, through what Ostrom and Schlager (1996) refer to as umbrella organizations. Incentives should be created that strengthen social networks of steward groups for ecosystem management in multi-level governance systems (Folke *et al.* 2005*b*).

Although the need to involve local users and land owners in management is widely recognized, conservation planning is still predominantly a bureaucratic-scientific endeavour. For example, the local-user dimension is part of the Natura 2000 directive of the European Union, yet local users have often been excluded from the process of identifying areas to be conserved. When implemented in the municipality of Karvia (Finland), the Natura 2000 process caused severe controversy and conflict (Hiedanpää 2002). Stakeholders were locked in old positions and felt excluded from the decision-making process. In other cases, local inhabitants may refuse participation because they lack interest in the special issues discussed and landowners may be precipitated into exploiting an area to be conserved to avoid its appropriation by the state. It is time to move conservation beyond confrontation to collaboration (Wondolleck & Yaffee 2000) and recognize that ecosystem management is also to a large extent people management.

In Kristianstad, the Ecomuseum plays a unique role in coordinating efforts around different projects and connecting them to larger scales. This collaboration is facilitated by and strengthens social capital in the area. Social capital is a widely discussed concept (Coleman 1988; Putnam 1993; Dasgupta & Serageldin 2000; Ostrom & Ahn 2003), but our interpretation is in line with Pretty and Ward (2001) and three of their four features of social capital are identified in our social-ecological inventory, namely relations of trust, reciprocity and exchanges, and connectedness in networks and groups. The processes and strategies used by EKV in relation to these features have been dealt with in our earlier work (Hahn *et al.* 2006). Here, we stress the significance of a coordinating team, like the EKV, which can bridge levels and narrow foci by providing overview and mitigating between one-sided opinions, supplying links to decision-makers and scientists, and presenting a professional framework where volunteers can contribute without being burdened with too much responsibility. The EKV interprets and provides the larger picture, mediates between special interests and supports conservation for development of the region. Furthermore, EKV can identify funding sources from organizations at higher levels and has an advisory role in societal planning processes. Local stewards often take initiatives, but they then need the EKV to take the lead for the project to gain momentum.

The EKV is an example of an organization that bridges local actors and communities with other organizational levels. Such 'bridging organizations' can serve as filters for external drivers (Alcorn *et al.* 2003) and provide opportunities by bringing in resources, knowledge and other incentives for ecosystem management. A bridging organization like the EKV provides an arena for trust-building, sense-making, learning, vertical and horizontal collaboration and conflict resolution (Olsson *et al.* 2004; Hahn *et al.* 2006). It uses networks of local steward groups to mobilize knowledge and social memory, which in

turn help deal with uncertainty and shape change (Folke *et al.* 2003, 2005*b*). Such structures of social capital need to be recognized and nurtured in conservation and ecosystem management efforts.

We propose that governmental agencies and NGOs devoted to environmental conservation should take advantage of and stimulate the self-organizing ability of local steward groups and avoid policies and actions that exclude and alienate people from the land. Social-ecological inventories complement biological inventories and stakeholder analyses, clarifying the web of social interactions in the landscape that can contribute to conservation and help develop viable ecosystem management. If they are conducted in the preparatory phase of conservation planning, through personal interactions with the local stewards, and with the intention to learn about activities and abilities, they can support a trust-building process and facilitate continuous collaboration. Therefore, they should be given high priority and be applied in programmes like the EU Water Framework Directive and UNESCO's Man and the Biosphere reserves.

ACKNOWLEDGEMENTS

We thank all interviewees for sharing their information and Gustav Schultz for drawing the map. Thanks also to two reviewers for valuable comments. The study was conducted as part of the Millennium Ecosystem Assessment and financed by The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, Formas.

References

Agrawal, A. & Gibson, A. (1999) Enchantment and disenchantment: the role of community in natural resource conservation. *World Development* **27**: 629–649.

Alcorn, J.B., Bamba, J., Masiun, S., Natalia, I. & Royo, A. (2003) Keeping ecological resilience afloat in cross-scale turbulence: an indigenous social movement navigates change in Indonesia. In: *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*, ed. F. Berkes, J. Colding & C. Folke, pp. 299–327. Cambridge, UK: Cambridge University Press.

Aswani, S. & Hamilton, R. (2004) Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of bumphead parrotfish (*Bolbometopon muricatum*) in the Roviana Lagoon, Solomon Islands. *Environmental Conservation* **31**: 69–83.

Bengtsson, J., Angelstam, P., Elmqvist, T., Emanuelsson, U., Folke, C., Ihse, M., Moberg, F. & Nyström, M. (2003) Reserves, resilience and dynamic landscapes. *Ambio* **32**: 389–396.

Berkes, F. & Folke, C. (1998) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge, UK: Cambridge University Press.

Berkes, F., Colding, J. & Folke, C. (2000) Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* **10**: 1251–1262.

Berkes, F., Colding, J. & Folke, C. (2003) *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge, UK: Cambridge University Press.

Bhagwat, S., Kushalappa, C., Williams, P. & Brown, N. (2005) The role of informal protected areas in maintaining biodiversity in the Western Ghats of India. *Ecology and Society* **10**(1): 8 [www document]. URL http://www.ecologyandsociety.org/vol10/iss1/art8/

Biernacki, P. & Waldorf, D. (1981) Snowball sampling: problems and techniques of chain referral sampling. *Sociological Methods Research* **10**: 141–163.

Bodin, Ö., Tengö, M., Norman, A., Lundberg, J. & Elmqvist, T. (2006) The value of small size: loss of forest patches and ecological thresholds in Southern Madagascar. *Ecological Applications* **16**: 440–451.

Colding, J. & Folke, C. (2000) The taboo system: lessons about informal institutions for nature management. *The Georgetown International Environmental Review* **12**: 413–445.

Colding, J. & Folke, C. (2001) Social taboos: 'invisible' systems of local resource management and biological conservation. *Ecological Applications* **11**: 584–600.

Coleman, J.S. (1988) Social capital in the creation of human capital. *The American Journal of Sociology* **94**: S95–S120.

Dahlman, M. (2004) WWF Projekt Slutrapport. Projektnummer 25 2040. Vramsån i Kristianstads Vattenrike (WWF Final project report. Project number 24 2040. The River Vramsån in Kristianstads Vattenrike). WWF Sweden, Stockholm, Sweden.

Dasgupta, P. & Serageldin, I. (2000) *Social Capital: a Multifaceted Perspective*. Washington, DC, USA: The World Bank.

Fabricius, C. & Koch, E. (2004) *Rights, Resources and Rural Development: Community-based Natural Resource Management in Southern Africa*. London, UK: Earthscan.

Folke, C., Holling, C.S. & Perrings, C. (1996) Biological diversity, ecosystems, and the human scale. *Ecological Applications* **6**: 1018–1024.

Folke, C., Colding, J. & Berkes, F. (2003) Synthesis: building resilience and adaptive capacity in social-ecological systems. In: *Navigating Social–ecological Systems: Building Resilience for Complexity and Change*, ed. F. Berkes, J. Colding & C. Folke, pp. 352–387. Cambridge UK: Cambridge University Press.

Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L. & Holling, C.S. (2004) Regime shifts, resilience and biodiversity in ecosystem management. *Annual Review of Ecology, Evolution, and Systematics* **35**: 557–581.

Folke, C., Fabricius, C., Cundill, G., Schultz, L., Queiroz, C., Gokhale, Y., Marín, A., Camac-Ramirez, E., Chandola, S., Tawfic Ahmed, M., Talukdar, B., Argumedo, A. & Carbonell Torres, F. (2005*a*) Communities, ecosystems, and livelihoods. In: *Ecosystems and Human Well-being: Multiscale Assessments: Findings of the Sub-global Assessments Working Group*, Millennium Ecosystem Assessment, pp. 261–277. Washington, DC, USA: Island Press.

Folke, C., Hahn, T., Olsson, P. & Norberg, J. (2005*b*) Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* **30**: 441–73.

Gadgil, M., Olsson, P., Berkes, F. & Folke, C. (2003) Exploring the role of local ecological knowledge for ecosystem management: three case studies. In: *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*, ed. F. Berkes, J. Colding & C. Folke, pp. 189–209. Cambridge, UK: Cambridge University Press.

Grimble, R. & Wellard, K. (1997) Stakeholder methodologies in natural resource management: a review of principles, contexts, experiences and opportunities. *Agricultural Systems* **55**: 173–193.

Hahn, T., Olsson, P., Folke, C. & Johansson, K. (2006) Trust-building, knowledge generation and organizational innovations: the role of a bridging organization for adaptive co-management of a wetland landscape around Kristianstad, Sweden. *Human Ecology* **34**: 573–592.

Hiedanpää, J. (2002) European-wide conservation versus local well-being: the reception of the Natura 2000 Reserve Network in Karvia, SW-Finland. *Landscape and Urban Planning* **61**: 113–123.

Hughes, T.P., Bellwood, D.R., Folke, C., Steneck, R.S. & Wilson, J. (2005) New paradigms for supporting the resilience of marine ecosystems. *Trends in Ecology and Evolution* **20**: 380–386.

Jørgensen, D.L. (1989) *Participant Observation: a Methodology for Human Studies.* Newbury Park, CA, USA: Sage Publications.

Linné, von C. (1751) *Skånska resa år 1749 (The Scania Journey 1749).* Stockholm, Sweden: Wahlström och Widstrand.

Maass, J., Balvanera, P., Castillo, A., Daily, G.C., Mooney, H.A., Ehrlich, P., Quesada, M., Miranda, A., Jaramillo, V.J., García-Oliva, F., Martínez-Yrizar, A., Cotler, H., López-Blanco, J., Pérez-Jiménez, A., Búrquez, A., Tinoco, C., Ceballos, G., Barraza, L., Ayala, R. & Sarukhán, J. (2005) Ecosystem services of tropical dry forests: insights from long-term ecological and social research on the Pacific Coast of Mexico. *Ecology and Society* **10**(1): 17 [www document]. URL http://www.ecologyandsociety.org/vol10/iss1/art17/

Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being. Biodiversity Synthesis.* Washington DC, USA: World Resources Institute: 100 pp.

Mushove, P. & Vogel, C. (2005) Heads or tails? Stakeholder analysis as a tool for conservation area management. *Global Environmental Change* **15**: 184–198.

Mårsäter, B., Sandström, E., Lindgren, P.-A., Persson, S., Carlborg, N., Isacsson, G., Avilov, A., Böling, R., Eklund, S., Schneider, H. & Lassheikki, M. (2001) Projekterfarenheter av landskapsanalys i lokal samverkan (Experiences of landscape analysis in local collaboration). Rapport 9. Skogsstyrelsen, Jönköping, Sweden.

Nabhan, G.P. (1997) *Cultures of Habitat: on Nature, Culture, and Story.* Washington, DC, USA: Counterpoint.

Naturskyddsföreningen i Kristianstad (2004) Årsberättelse för 2003 (Swedish Society for Nature Conservation in Kristianstad. Annual report of 2003) [www document]. URL http://kristianstad.krets.snf.se/eb/2003/AB2003.pdf

Nordöstra Skånes Fågelklubb (2006) Verksamhetsberättelse för Nordöstra Skånes Fågelklubb 2005 (Annual report of the Bird Society of NE Scania 2005) [www document]. URL http://www.spoven.com/verks05.pdf

Olsson, P. & Folke, C. (2001) Local ecological knowledge and institutional dynamics for ecosystem management: a study of Lake Racken watershed, Sweden. *Ecosystems* **4**: 85–104

Olsson, P., Folke, C. & Hahn, T. (2004) Social-ecological transformations for ecosystem management: the development of adaptive co-management of a wetland landscape in Southern Sweden. *Ecology and Society* **9**(4): 2 [www document]. URL http://www.ecologyandsociety.org/vol9/iss4/art2/

Ostrom, E. & Ahn, T.K. (2003) *Foundations of Social Capital.* Cheltenham, UK: Edward Elgar.

Ostrom, E. & Schlager, E. (1995) The formation of property rights. In: *Rights to Nature*, ed. S. Hanna, C. Folke & K.G. Maler, pp. 127–156. Washington, DC, USA: Island Press.

Ovesson, P. (2003) *Markhävdkartering 2002: hävdtillståndet på betesmarker och slåtterängar inom Nedre Helgeåns våtmarksområde i Kristianstads Vattenrike. (Mapping of land-use practices 2002. Status of flooded meadows in the wetland area of Lower Helgeå River in Kristianstads Vattenrike).* Kristianstad, Sweden: County board administration of Scania, Kristianstad Municipality and Kristianstad University.

Patton, M.Q. (1980) *Qualitative Evaluation Methods.* Beverly Hills, CA, USA and London, UK: Sage Publications: 197 pp.

Putnam, R.D. (1993) *Making Democracy Work: Civic traditions in Modern Italy.* Princeton, USA: Princeton University Press.

Pretty, L. & Ward, H. (2001) Social capital and the environment. *World Development* **29**: 209–227.

Sheil, D. & Lawrence, A. (2004) Tropical biologists, local people and conservation: new opportunities for collaboration. *Trends in Ecology and Evolution* **19**: 634–638.

Swedish Government (2001) *Regeringens skrivelse 2001/02/173: En samlad naturvårdspolitik. (Swedish Government Communication 2001/02/173: A shared policy for nature management)* .Stockholm, Sweden: Ministry of Sustainable Development.

Tengö, M. (2004) Management practices for dealing with uncertainty and change: social-ecological systems in Tanzania and Madagascar. Doctoral thesis, Department of Systems Ecology, Stockholm University, Stockholm [www document]. URL http://www.diva-portal.org/su/abstract.xsql?dbid=309

Thyl De Lopez, T. (2001) Stakeholder management for conservation projects: a case study of Ream National Park, Cambodia. *Environmental Management* **28**: 47–60.

Wondolleck, J.M. & Yaffee, S.L. (2000) *Making Collaboration Work: Lessons from Innovation in Natural Resource Management.* Washington, DC, USA: Island Press.