

Social networks for ecosystem management: a case study of Kristianstads Vattenrike, Sweden

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1. Introduction

Ecosystem management requires multi-layered governance systems that can match social and ecological structures and processes operating at different spatial and temporal scales (Folke et al. 1998b, Berkes et al. 2003). It also requires flexible, learning-based management systems that can deal with the change and uncertainty inherent in social-ecological systems.

Certain institutional structures can impede and stifle self-organization processes including local initiatives and commitment that otherwise contribute to the diversity of ideas and solutions to environmental problems (Berkes 2002, Bawden 1994). On the other hand, multi-layered or polycentric governance structures can nurture diversity for self-organization. Ostrom (1998) argues that simple, large-scale, centralized governance units do not, and cannot, have the variety of response capabilities that complex, polycentric, multi-layered governance systems can have. Ostrom (1998) has suggested that polycentric, multi-layered systems of governance that are efficiently linked across scales increase the complexity of those systems and therefore the variety of possible responses to change. An advantage of polycentric arrangement in this context according to Imperial (1999) is that it provides "institutionally rich environment [that] improves the prospects of resolving complex problems. It can encourage innovation and experimentation by allowing individuals and organizations to explore different ideas about solving problems". Instead of ready-to-use plans for ecosystem management superimposed on local contexts, the role of central authorities could be to form legislation to enable self-organization processes, provide funding, and create arenas for collaborative learning. Such arrangements, that "frame" creativity, have the potential to create a variety of feedback loops at different scales and contribute to scale matching of social-ecological dynamics.

The ability to self-organize seems to be an important characteristic for building resilience in social-ecological systems (Berkes et al. 2003, Gunderson and Holling 2002, Carpenter et al. 2001). An opportunity to self-organize can materialize

after a disturbance or crisis and may result in alternative pathways or trajectories for socio-ecological systems. Learning is an important part of self-organization and is addressed in adaptive management (Holling 1978) and adaptive governance (Dietz et al. 2003) and operationalized in adaptive co-management systems. We have earlier pointed to the role of social networks in adaptive co-management (Olsson et al. 2004a). Westley (2002) argues that the capacity to deal with the interactive dynamics of social and ecological systems requires the entire network of interacting individuals and organizations at different levels that create the right links, at the right time, around the right issues. In this paper we use a broad definition of social networks based on Granovetter's (1973) description of such networks as interpersonal ties wherein individuals constitute the nodes of the networks.

The overall objective of this paper is to address the role of social networks in adaptive co-management. The aim is to unravel some of the mechanisms of social networks that are essential for implementing ecosystem management. By drawing on the insights from our case study of Kristianstads Vattenrike, southern Sweden we show how social networks help create linkages across scales in ecosystem management and enhance the capacity to deal with change and uncertainty. We discuss the significance of these linkages for building resilience in social-ecological systems.

2. The Kristianstads Wetland case

In Olsson et al. (2004b) we unravel some of the social processes behind the emergence of adaptive co-management of the wetland ecosystems of the lower Helgeå River catchment in southern Sweden and the establishment of Ecomuseum Kristianstads Vattenrike (EKV). EKV was established in 1989 to help the Municipality of Kristianstad to manage the ecosystems of the lower Helgeå River catchment (Kristianstads Vattenrike, KV). EKV is a flexible and dynamic organization, which promotes a management within KV that treats humans as part of ecosystems and includes social, economic and ecological dimensions. EKV is part of the municipality's organization and reports directly to the municipality board, like a municipality administration. However, it is not an authority and has no power to make or enforce rules. EKV plays a key role as a facilitator and coordinator in local collaboration processes that involves international associations, national, regional and local authorities, researchers, non-profit associations and land owners to maintain and restore the natural and cultural values of the area. EKV is also involved in developing policy, designing projects, conflict resolution, coordination and administration of conservation and restoration efforts, and developing goals for KV as well as the production of management plans, agreements, follow-up reports, and updates for specific areas. EKV has made the wetland landscape area more accessible to the public and has established thirteen information sites in the wetlands. In the following section we describe the role of social networks in establishing EKV and in its continuous work, especially in regards to creating vertical linkages that allows for cross-scale interplay.

The role of social networks in transformation

In the 1980's, several individuals of the area, representing different organizations, observed a continuing decline in natural and cultural values despite the fact that the wetlands of the lower Helgeå River had become a Ramsar Convention Site. In

particular they observed declining bird populations, eutrophication and overgrowth of lakes, and a decrease in the use of flooded meadows for haymaking and grazing. As a response to an anticipated crisis, these individuals developed personal ties among them and a social network of concerned individuals and organizations started to emerge to deal with these social-ecological changes. This eventually led to the establishment of EKV and the transformation of the social-ecological system into a trajectory of adaptive co-management.

A key individual was instrumental in leading this transformation which involved preparing the system for change and using a window-of-opportunity. A key individual compiled existing ecosystem knowledge and experience that existed within the network and extending the network by linking people and ongoing projects in the area. This key individual provided the direction for change in the form of overall goals and vision in a holistic approach to wetland management and used a window of opportunity to convince decision-makers of the need for a new organization and improved management of the wetlands. The contact between the initiator of EKV and a local top politician provided a cross-scale link at a critical time, identified as a window of opportunity or policy window that led to the adoption of an adaptive co-management approach to wetland ecosystems by the Municipality of Kristianstad. Knowledge, broad support and funding opportunities were mobilized through the network which in turn helps establish the link to the municipality politician and open a window-of-opportunity for change (*creating the right link at the right time* (Westley 2002). The worldview of a key actor was incorporated in the Municipality organization to guide their work and is an example of a “revolt” connection between different levels identified as crucial for building adaptive capacity and resilience in social-ecological systems (Gunderson and Holling 2002, Berkes et al. 2003). It helped to move away from unsustainable and undesirable trajectories to new ones with the capacity to strengthen and enhance management of desired ecosystem states and associated values in Kristianstads Vattenrike (KV).

In the transformation, the steward played a key role in these processes by building trust, compiling and generating ecosystem knowledge, defining an area for management, developing goals and vision for ecosystem management, and mobilizing broad support for change. The social-ecological transformation and the adaptive co-management approach that was initiated have the potential to expand the desirable stability domains of the wetland and make the social-ecological system more robust to change.

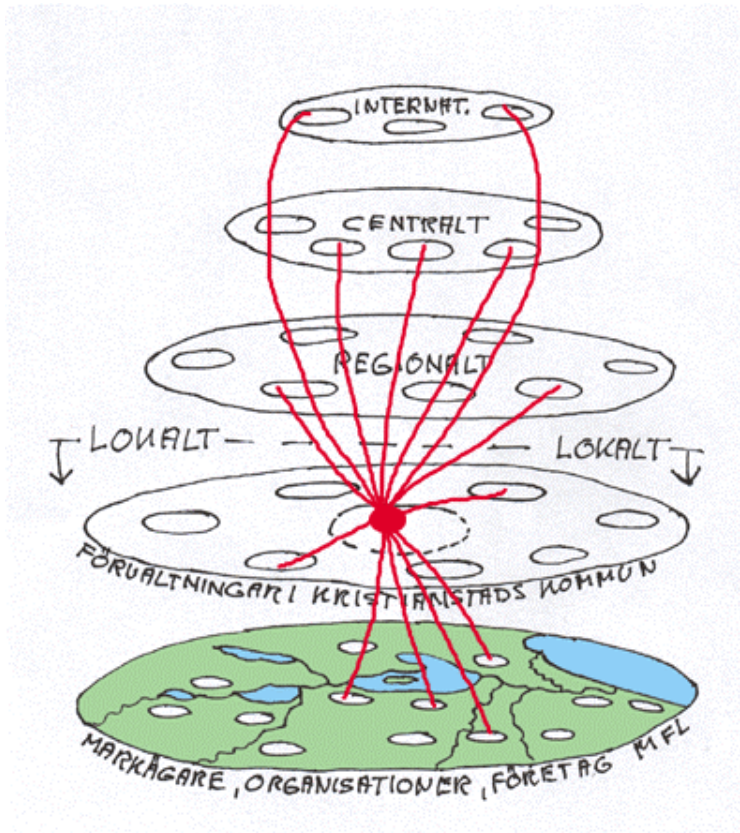
The role of social networks in adaptive co-management

The management of the wetland landscape of KV coordinated and facilitated by EKV rely on a network of international associations, national, regional and local authorities, researchers, non-profit associations and landowners (Olsson et al 2004, Hahn et al in manus). This network in which EKV is an important node, started to emerge during the transformation of the management system. For each problem that arises, actors from the social network that are directly affected are mobilized in *ad hoc* or *ephemeral* organizations to find common solutions.

Since the social network involve a range of actors with different backgrounds, including researchers, landowners and governmental officials, scientific knowledge can be combined with other knowledge systems. EKV and its employees play a key

role in compiling knowledge and information from various sources and interpreting and making sense of it in the local context.

This way, EKV demonstrates an ability to respond to environmental feedback and to develop new knowledge and understanding about ecosystem management needs. Although initial work focused primarily on flooded meadows, EKV has widened the scope of management and initiated new projects to address a broader set of issues related to ecosystems processes across scales. As EKV's focus expands to incorporate new components of the landscape, social networks evolve that connect institutions and organizations across levels and scales and facilitate information flows. By linking people and groups there is also a chance to link the components of the landscape and address cross-scale linkages. These projects are based on collaborative processes including international organizations, national, regional and local authorities, non-profit associations and landowners. EKV has thus established essential conditions for adaptive co-management of wetland landscapes, which in turn can create functioning feedback loops at different scales.



International Scale

Poland
Denmark

National Scale:

Local Investment Program
WWF
EPA
Stockholm University

Regional Scale:

County Adm. Board
Farmers' organizations

Municipal Scale:

EKV
Municipal Administrations

Sub-municipal Scale

Farmers/Landowners
Local Business
Local Steward Organizations

Figure 1. The *ad hoc* organization for the flooded meadow project of Kristianstads Vattenrike (KV). Each project has its unique set of actors. Each node includes one or several key individuals, often a member or employed by an organization. Ecomuseum Kristianstads Vattenrike (EKV) is the central node of the network (modified from Magnusson 2002)

The social arrangements for managing wetland ecosystems that emerged in Kristianstads Vattenrike can be referred to as policy communities. A policy community has been defined as “a diverse network of public and private organizations generally associated with the formation and implementations of policy in a given resource area...Policy communities are interactive networks of alliances around common interests” (Shannon 1998). The policy communities of Kristianstad Vattenrike are framed in local ecosystem contexts; recognize site specific environmental and social conditions and link local, regional, and national levels. Haas (1992) referred to such multi-level arrangements that link institutional and organizational structures across scales as epistemic communities. Policy communities has often no formal power sharing but rather operates within an existing institutional framework in polycentric governance structures, which implies that there are no formal rules that forces actors to collaborate. However, it seems like in the case presented here that institutional arrangements such as formal agreements between parties can emerge from the collaborative processes. It is an example of open institutions (Shannon and Antypas 1997), with the potential to provide flexibility and build adaptive capacity through social learning (Folke et al. 2003).

Trust building processes were important for mobilizing people in these networks and creating vertical and horizontal linkages. Trust is a fundamental characteristic in social self-organizing processes for ecosystem management (e.g. Brown et al. 2002). Trust lubricates collaboration (Pretty and Ward 2001). A lack of trust between people is a barrier to the emergence of collaborative arrangements (Baland and Platteau 1996) such as adaptive co-management systems. All cases of successful co-management involve long periods of trust building (Kendrick 2003, Pretty and Ward 2001). The Kristianstads case (Olsson et al. 2004b) shows the role of a key individual for continuous trust building among stakeholders.

3. Creating mid-level organizations for linkages

The establishment of EKV and the social network meant the creation of a mid-level organization that facilitates cross-scale interactions. Bebbington (1997) identifies key factors that could explain *sustainable* agriculture intensification in the Andes, including social networks and key individuals. In all the cases of sustainable intensification, outsiders have played a key role in bringing in new ideas, but more importantly they have brought in networks of contacts. These *brokers* have different backgrounds, including a priest, university professor, European volunteers and funding agencies. The connections they brought with them helped the members of the local communities gained access to non-local institutions and resources, including access to NGOs with technical assistance and financial resources, sources of technology, donors, and alternative trading networks. These networks spread across national and international boundaries in ways that would have been hard for the locals

to do on their own. Similarly in the Kristianstad case, the key individual with his contacts played the role of a broker.

Apart from brokers, we have identified other *functional groups* of key individuals: knowledge carriers, knowledge generators, leaders and sense-makers. These are all important components of social networks and essential for creating the conditions that we argue are necessary for ecosystem management. This also includes conditions for learning in social-ecological systems.

The ecosystem knowledge and understanding that stewards possess is of crucial importance for determining which trajectory is chosen in response to change (Olsson and Folke 2001, Folke et al. 2003). Leaders can provide visions of ecosystem management and sustainable development that frames self-organizing processes. For example, both the biology teacher in Lake Racken fishing association (Olsson and Folke 2001) and the director of Ecomuseum Kristianstads Vattenrike (Olsson et al. 2004b) provide a vision in form of a holistic approach to the management of natural resources and ecosystems. Also of importance is their ability to manage existing knowledge within social networks for ecosystem management and further develop those networks. Key stewards establish functional links within and between organizational levels in times of change and facilitate the flow of information and knowledge applied in the local ecosystem management context. Social networks develop for this purpose (Scheffer et al. 2002). Through these social networks local users can create cross-scale linkages at critical times and draw on external sources of information and knowledge, such as scientists and practitioners and make it accessible in a local context. Throughout the process they play important roles in sense-making, synthesizing a variety of information into a coherent collective narrative (Waltner-Toews et al. 2003).

From a resilience perspective it seems to be beneficial if the capacity to deal with complex issues is widely dispersed across a set of actors located at different levels of multiple centers or polycentric governance (Imperial 1999b, McGinnis 2000). As problems solving develops in each of the cases, different clusters of players can assume different decision-making roles. Such a dynamic structure implies flexible coordination of nodes so that subsets of the adaptive co-management system can be envisioned as pulsing in active response to change (Olsson et al. 2004a). The social networks of Kristianstad Vattenrike constitute cross-scale arrangements that are particularly appropriate for solving problems of complex adaptive systems because there is experimentation and learning going on in each of the nodes. It seems like such experimentation, combined with the networking of knowledge, may create a diversity of experience and ideas for solving new problems, stimulate innovation and contribute to creating feedback loops at different scales. It also leads to increased response options to deal with uncertainty and surprise.

What we show here is that the knowledge applied in the local context of KV, is network knowledge. The social networks and the functional groups of people are important for accessing and combining the network knowledge to match ecosystem structures and processes across scales.

Social memory seems to play an important role in the self-organization process and key individuals draw on social memories of other scales in the

reorganization following change (Folke et al. 2003). Social networks can be key mechanisms for drawing on the social memory at critical times and enhance information flow across scales.

Understanding ecosystem processes and how to manage them seems to be a progression of social-ecological co-evolution, and it involves learning and accumulation of ecosystem knowledge and understanding in a social memory (Berkes et al. 2003). The knowledge system itself becomes part of the process of social learning about how to deal with ecosystem dynamics (Lee 1993). In this sense a collective learning process that builds experience with ecosystem change evolves as a part of social memory, and it embeds practices that nurture the dynamic capacity of ecosystems to generate essential ecosystem services, including the role of functional diversity in this context (Folke et al. 2003). Social memory is important for linking past experiences with present and future policies. Such social learning processes are linked to the ability of management to respond to environmental feedback and direct the coupled social-ecological system into sustainable trajectories (Berkes et al. 2003).

There are knowledge systems and associated institutions that represent a reservoir, a memory, of long-term social-ecological adaptations to dynamics and change (Berkes and Folke 2002). Over time, the ability to deal with uncertainty and surprise seems to be improved, which increases the capacity to deal with future change. Carpenter et al. (2001) describe the several decade long research process needed to develop an understanding of key variables that structure lakes and rangelands. In this context, Dale et al. (1998) point to the need for an “institutional memory” of large-scale ecosystem disturbances as a part of ecosystem management, in order to reduce the risk of management responses that are not in tune with ecosystem dynamics. Institutional memory is an accumulation of experiences concerning management practices and rules-in-use and is particularly important during periods of change and crisis. It provides the foundation for the modification of rules (Hilborn 1992). An adaptive co-management process can build memory. This memory provides the context for social responses to ecosystem change and thus increases the likelihood of flexible and adaptive responses, particularly during periods of crisis and reorganization. Adaptive co-management therefore draws on experience but allows for novelty and innovation. It provides a repertoire of general design principles that can be drawn on by resource users at multiple levels to aid in the crafting of new institutions to cope with changing situations (Ostrom et al. 2002).

Social structures and processes can build social memory of ecosystem management, a memory that seems to be of significance for mobilizing adaptive capacity in times of change. In Kristianstads Vattenrike (Olsson and Folke 2004b) key individuals can draw on the social memory of the network to quickly respond to social-ecological change. The Lake Racken fishing association (Olsson and Folke 2001) developed a social network to organize collective action as a response to acidification. This started to generate a social memory for crayfish management in a catchment context, implemented in management practices and then stored. In the time series of events the ability to deal with uncertainty and surprise is improved which increases the capacity to deal with future change. The social memory has the potential to maintain social and ecological structures and functions in times of stability and gradual change and thereby build adaptive capacity for social-ecological resilience

and renewal in times of rapid change (Berkes and Folke 1998). Key individuals are important for accessing and sustaining this memory.

4. Conclusions and Challenges

Social networks play a crucial role in the dynamic relationship between key individuals, social memory and resilience. They operate with a range of actors at different levels of society and create nodes of expertise and a diversity of experiences and ideas for solving new problems. Social networks in polycentric governance structures should have the potential to link different scales and help create functional feedback loops in social-ecological systems. Furthermore, social networks can serve as storage of social memory for ecosystem management, a memory that can be revived and revitalized in the reorganization following change. There is a need to further investigate the role of social networks and their cross-scale linkages in creating flexibility and resilience and in providing response options in times of social-ecological change. We also need to understand in what ways such cross-scale dynamics can widen desirable social-ecological stability domains and make systems more robust to change.

Further investigation of key individuals and functional groups in social-ecological systems in relation to adaptive capacity, cross-scale interactions and enhancement of resilience is also needed.

Research needs to continue to tease out elements of social-ecological transformations towards management designs that build adaptive capacity for resilience in social-ecological systems. Such investigations should involve the role of social networks and key individuals for shaping change and creating new and desirable configurations for social-ecological systems.

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