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Social-Ecological Transformations for Ecosystem Management: The Development of Adaptive Co-management of a Wetland Landscape in Southern Sweden

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The Development of Adaptive Co-management of a Wetland Landscape
in Southern Sweden

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Abstract

In 1989, the Municipality of Kristianstad adopted a flexible and collaborative approach for managing wetland ecosystems of the lower Helgeå River catchment, southern Sweden. The policy change was accompanied by the establishment of a new municipal organization, Ecomuseum Kristianstads Vattenrike (EKV). Part of the explanation for these changes is found outside the municipality organization and at the level of the individual. We found that several individuals within various local organizations and backgrounds detected decreasing ecological and cultural-historical values and attributed this to the decreasing areas of wet grasslands used for grazing and haymaking. This was despite the fact that the area had been subject to a range of inventories, policy plans and protection efforts, including declaring the wetlands a Ramsar Convention Site. Using a window of opportunity a key steward convinced top municipality politicians to change their management policy and to incorporate EKV into the municipality's organization. EKV has demonstrated an ability to respond to environmental feedback and to develop new knowledge and understanding about ecosystem management needs. Although initial work focused primarily on wet grasslands, EKV has widened the scope of management and initiated new projects to address a broader set of issues related to ecosystems processes across scales. These projects are based on collaborative processes including international organizations, national, regional and local authorities, non-profit associations and landowners. As EKV's focus expands, social networks evolve that connect institutions and organizations across levels and scales and facilitate information flows. 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, mobilizing broad support for change, and initiating collaborative learning involving stakeholders at different levels in society. The initiative of the key steward prevented the wet grassland ecosystems from entering undesirable trajectories that would have resulted in a loss of ecosystem goods and services. We conclude that this social-ecological transformation, and the adaptive co-management approach that was initiated, have the potential to expand the desirable stability domain of the social-ecological system and make it more robust to change.

Introduction

Human wellbeing and progress toward sustainable development are vitally dependent on improved management of Earth's ecosystems. Strengthening the capacity to manage ecosystems sustainably to ensure continued provision of essential services is the focus of the international Millennium Ecosystem Assessment (www.millenniumassessment.org). This process requires developing an understanding of both the ecological and social systems involved (Berkes and Folke 1998).

Social and ecological systems are complex systems with change and uncertainty as inherent features (Gunderson and Holling 2002). Knowledge for monitoring, interpreting and responding to ecosystem feedback is crucial to strengthening capacity for dealing with uncertainty and change and sustaining ecosystem services (Gadgil et al. 1993, Olsson et al. in manus). Knowledge generation of ecosystem dynamics and the capacity to respond to ecosystem feedback among local resource users and steward associations tends to be integrated with management practices and evolves with the institutional and organizational aspects of management in what we refer to as adaptive co-management systems. Adaptive co-management focuses on creating functional feedback loops between social and ecological systems. It relies on collaboration among a diverse set of stakeholders operating at different levels, often in networks, from local users to municipalities to regional and national or supranational organizations. Adaptive co-management systems have been defined as flexible community-based systems of resource management tailored to specific places and situations supported by, and working with, various organizations at different levels (Folke et al, 2003). The sharing of management power and responsibility may involve multiple institutional linkages among user-groups or communities, government agencies, and non-governmental organizations. Hence, adaptive co-management systems build on open institutions and learning, drawing on a variety of sources of information and knowledge and avoiding set prescriptions of management superimposed on a particular place, situation or context. Adaptive co-management includes experimentation that provides opportunities to track desirable and sustainable trajectories (Carpenter and Gunderson 2001).

We have recently proposed that adaptive co-management of ecosystems has the potential to build resilience in social-ecological systems (Olsson et al. in manus). Resilience in social-ecological systems refers to

- the amount of change a system can undergo and still retain essentially the same function, structure and identity (remain in the same state - within the same basin of attraction)
- the degree to which the system is capable of self-organization
- the degree to which the system expresses capacity for learning and adaptation (Carpenter et al. 2001, Walker and Holling, in manus).

The capacity to adapt to and shape change is an important component of social-ecological system resilience (Berkes et al. 2003). In a social-ecological system with high *adaptive capacity* the actors have the ability to sustain the system in a desirable state in response to changing conditions and disturbance events (Carpenter et al. 2001). What sustains the adaptive capacity of social-ecological systems in a world that is constantly changing? Following the work of Berkes and Folke (1998), Tengö and Hammer (2003) identify a bundle of management practices in a small-holder African agropastoral society as part of adaptive capacity. Colding et al. (2003) summarize practices for coping with environmental variability and disturbance events that seem to confer resilience in social-ecological systems. Trospen (2003) suggests that the potlatch system among Indians on the Northwest Coast of the USA must have been characterized by adaptive capacity since it persisted for two millennia before these tribes had contact with people from the Old World. The characteristics of the system, namely property rights, environmental ethics, rules of earning and holding titles, public accountability, and the reciprocal exchange system, provided all three elements of resilient

social-ecological systems as defined above. Folke et al. (2003) identify and expand on four critical factors in complex social-ecological systems that interact across temporal and spatial scales and that seem to be required for dealing with ecosystem dynamics during periods of change and reorganization: learning to live with change and uncertainty, nurturing diversity for re-organization and renewal, combining different types of knowledge for learning, and creating opportunities for self-organization towards social-ecological sustainability.

It is in particular the last factor that is the focus of this article and it relates to *transformative capacity*, a concept under development within the Resilience Alliance (Walker and Holling in manus). Transformative capacity is the ability of a social-ecological system to move to new or different configurations or create new stability domains; to re-define itself through acquisition of new variables or allowing them to emerge.

In this article we follow the development of an adaptive co-management system for wetland landscape management in southern Sweden, a process that moved the social system into a new configuration of ecosystem management within about a decade. The starting point for our analysis was the observation of a policy change by the Municipality of Kristianstad in 1989 that adopted a flexible and collaborative approach for managing the wetland ecosystems of the lower Helgeå River catchment, southern Sweden (Figure 1). The policy change was accompanied by an organizational change with the establishment of a new municipal organization, Ecomuseum Kristianstads Vattenrike (EKV). These changes seemed to have generated a self-organizing process in which social networks and organizational and institutional arrangements emerged to fit context-specific challenges, problems and needs. The objective was to unravel the social processes behind those changes and analyze how they relate to ecosystem management.

The *first* section of the article gives a background of the area, its geographical characteristics and the methods used in the study. In the *second* section we describe the ecological and cultural values of the area and how perceived threats to these values led to measures such as nature protection. Despite these measures there was a continuous decline of values. The *third* section describes how perceived threats to these values among people and associations led to self-organization towards an adaptive co-management system. We illustrate how certain individuals representing several organizations are important in collecting and coordinating information and activities and building local knowledge and understanding of ecosystem dynamics. They become spiders in the web of social networks and are instrumental in creating cross-scale interaction of organizations and institutions for ecosystem management (Westley 2002). We identify a key steward that was especially important for shaping the policy and organizational changes that included a definition of the area for management (Kristianstads Vattenrike) and establishment of the structure and role of the EKV in the development of the adaptive co-management process. *Finally*, we discuss how the adaptive co-management approach can create functional feedback loops in social-ecological systems, help track sustainable trajectories, and build social-ecological resilience.

Case study

Kristianstad is situated in northeast Scania County (*Skåne Län*) and has 73,000 inhabitants. The city, established in 1614 by the Danish king Christian IV, is the administrative center of the Municipality of Kristianstad. The area that comprises the Municipality of Kristianstad today was defined between 1967 and 1974, during which period ten smaller municipalities of Northeastern Scania were amalgamated to form the Kristianstad greater municipality (Andersson and Lindholm 1995). This fusion was voluntary from the beginning but became statutory in 1969. In the late 1990's the counties of Malmöhus and Kristianstad were united to form Scania County. The county currently has 1.2 million inhabitants.

The area chosen for this study, Kristianstads Vattenrike¹ (KV), is defined by hydrological and political borders and includes the Helgeå River catchment area and the coastal regions of Hanö Bay within the Municipality of Kristianstad (see Figure 1). KV covers an area of 110,000 ha. The Helgeå River runs through central Kristianstad and drains an area of 4,775 square kilometers. Starting in the forested highlands of Kronobergs County (Figure 1), it runs through boreal forests on archaic rock for 170 km before reaching the Kristianstad plain and wetlands of KV and eventually the Baltic Sea. The pH level is slightly acidic and humus levels fairly high when it reaches the Kristianstad plain. The sedimentary rock and soils of the Kristianstad plain are calcareous and the pH rises when the Helgeå River reaches these areas due to mixing-in of groundwater and high nutrient levels. The natural hydrological regime of the lower Helgeå River is highly dynamic with an annual average water fluctuation of 1.4 meters (-0.2 to +1.2 meters above sea level) which creates extensive floodplains. Occasionally, usually between December and April, the water level can reach over two meters above sea level in central Kristianstad (the average is +0.38 meters above sea level) as has been recorded in 1912, 1917, 1928, 1980, and 2002². The water level of the lower Helgeå River system is occasionally below sea level, which causes saltwater intrusion as far up as Lake Hammarsjön. Most of the tributaries to the lower Helgeå River drain the Linderödsåsen ridge in the western parts of the municipality (Figure 1).

The Ecomuseum Kristianstads Vattenrike (EKV) was established in 1989 to help the Municipality of Kristianstad to manage the wetland landscape. EKV 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. Through EKV, the Municipality of Kristianstad collaborates with international associations, national, regional and local authorities, non-profit associations and land owners to maintain and restore the natural and cultural values of the area. EKV plays a key role as a facilitator and coordinator in local collaboration processes. EKV is also involved in developing policy, designing projects, and developing goals for KV.

Methods

The study identifies and investigates the processes and social mechanisms behind the adoption of a flexible and collaborative management of the wetland ecosystems of the lower Helgeå River catchment and the inclusion of EKV as part of the municipal organization. The study was conducted over a period of eighteen months during 2001-2003.

Open ended, deep interviews (Bernard 1994, Kvale 1996) were performed with four individuals who work within EKV and have been involved from the beginning in 1989. They were interviewed on several occasions throughout the period. The goal was to capture the lived experience of the interviewees regarding the development of EKV and the new management approach. Interviewees were asked to describe events and their own roles and strategies that had relevance for the change. They were also asked to describe the continuous work, strategies, goals and achievements of EKV. The interviews also helped identify relevant literature that was used to describe the history of the wetlands and land-use changes.

The interviews were unstructured at the initial stage of interviewing but became semi-structured as significant events and key individuals started to be identified which guided further questions. These semi-structured interviews focused on strategies for creating and sustaining the EKV and the motivation behind these strategies. During the interviews, other individuals outside EKV but important to its development were identified. Complementary telephone interviews were conducted with a municipal politician identified as important to

¹ *The rich wetlands of Kristianstad*

² <http://www.kristianstad.se/kommunen/c4teknik/organisation/historik/Kanaler.asp>

instituting policy change in 1989 as well as the Kristianstad County Governor who provided funding for the EKV.

An extensive review of other information sources was also conducted to complement the interviews. The history of the wetlands of the lower Helgeå River includes the recognition of natural and cultural values and early assessments and protection of these values. Sources included scientific and governmental inventories and reports, scientific and popular articles and books, policy proposals, and Internet sites. These sources dated from the 1950's and forward, with the exception of Linné (1751). The history of how the EKV developed was found in sources from 1977 to the present including project proposals, inventories, progress reports, notes, maps, correspondence letters, Internet sites, and newspaper clippings. These sources were searched continuously during the study to inform subsequent interviews.

We used qualitative evaluation methods in our analysis (Patton 1980, Bernard 1994) to understand the social mechanisms for adapting to and shaping change. The analysis is guided by the definition of social conditions for adaptive co-management processes identified by Olsson et al (in manus). Table 1 summarizes how those conditions are reflected in the KV area. In analyzing the history of the development of the EKV organization and the adaptive collaborative approach to ecosystem management, a pattern emerged. It showed that a key individual or steward (Pinkerton 1998, Berkes and Folke 2002, Westley 2002) was important for developing this new approach. To further understand how the social conditions for ecosystem management were created we use the theory described by Kingdon (1995) on policy windows and policy entrepreneurs to tease out certain qualities of key stewards that seem essential for shifting social-ecological trajectories in situations of crisis. We are interested in the capacity for initiating social transformations and move away from unsustainable and undesirable trajectories, and towards new social-ecological trajectories that strengthen and enhance management of desired ecosystem states and associated values in Kristianstads Vattenrike.

Values of the area

The wetlands of the lower Helgeå River contain two shallow lakes with a total area of 22 square kilometers (summer water levels). The lakes are one of a diversity of habitats within Kristianstads Vattenrike. Other habitats include large beech forests on the slopes of the Linderödsåsen ridge and wet forests and willow bushes in the lowlands. Much of the area is agricultural land; the sandy and clay soils around Kristianstad have been and still are important for agricultural production and the area is one of the most productive in Sweden. There are sandy grasslands with unique flora and fauna. The area also holds the largest groundwater reserve in northern Europe. The groundwater aquifer is used for household and industrial purposes and irrigation. Through "leakage" zones it also provides the wetlands with calcareous water, which creates special biotopes in these zones.

The vast wetlands historically provided a defense for the town. Today, the area provides a variety of ecosystem services including recreation for the people living in and around Kristianstad. The area once supported commercial fishing; Anheden (1965) describes an intensive commercial fishery for pike (*Esox lucius*) and eel (*Anguilla anguilla*) in Lake Hammarsjön in the early 1960's. Today, commercial fishing has almost disappeared and to some extent been replaced by recreational fishing.

The KV is known for its rich fauna and flora including rare plant species such as fen ragwort (*Senecio paludosus*) and river water-crowfoot (*Ranunculus fluitans*). The KV also boasts an array of fauna including 40 [7] fish species, 6 [2] amphibians, 260 [31] bird species, 11 [4] bat species, and an abundance of insects and mollusks (IUCN red listed species within brackets). Some of the area's unique flora and fauna were described by Swedish botanist Carl von Linné on his journey through Scania in 1749 (Linné 1751) and the natural beauty and

outstanding values of the lower Helgeå River have been described by several Swedish authors including Carl Fries (1958).

The area includes Sweden's largest wet grassland landscape used for grazing and hay-making and many of the unique values of the area are associated with these social-ecological systems and require active management to be sustained. The dynamics of the Helgeå River including its annual flooding, together with the proliferation of grazing and hay-making, are important factors for maintaining these wet grasslands. The lower demarcation of the wet grasslands is the summer brink of the Helgeå water system and the upper demarcation is appropriate for year-round agriculture.

Utilizing wet grasslands for agricultural purposes is an ancient tradition in Sweden and described for the lower Helgeå River by Carl von Linné on his journey through Scania in 1749 (von Linné 1751). Adaptations to the hydrological dynamics of the lower Helgeå River and associated practices have developed over millennia and provide unique cultural-historical and ecological values (Wendt-Rasch and Cronert 1996, Cronert 1991).

Threats to values of the wetland landscape

There has been increasing pressure on the wetlands and the values they provide since Kristianstad was established in 1614. The size of the lake and wetland area of lower Helgeå River has been considerably reduced over the last four hundred years (Magnusson 1981). This is due to the various measures taken over centuries to increase the amount of arable land and prevent flooding. In 1774, the farmers of Yngsjö village dug a ditch to the sea to prevent the annual high-water from flooding their land. Unfortunately the spring flood of 1775 was so severe that it transformed the ditch into a new channel for the Helgeå River to reach the sea. This venture lowered the water level in the water system by 0.6 to 0.7 meters.

Building embankments and dredging to control the river have further decreased the size of the wetland areas. A major dredging project between 1940 and 1945 was carried out to speed the flow of water through the wetlands and prevent flooding. This lowered the water system by an additional 0.35 m. Several small lakes between Lake Hammarsjön and the sea (Lake Ripa sjö, Lake Stora Yngsjö, and Lake Lilla Yngsjö) have disappeared in the process. The largest embankment project in the area was the damming of the Lake Nosaby sjö which was a bay of Lake Hammarsjön. Yet another threat is the fragmentation of the landscape due to urban sprawl and constructions such as roads (Helldén 1984).

The quality of the wetlands has also been compromised. Anheden (1965) argues that the poor water quality and hydroelectric dams are threatening the fish populations of the Helgeå River. The increasingly bad water quality in the early 1900's due to untreated sewage from industrial and households is witnessed by the many public complaints and the fact that the City of Kristianstad stopped taking its drinking water from the Helgeå River in 1941.³ In the summer of 1964 there was a massive incidence of fish mortality in the lower 50 km of the river (Anheden 1965). Measurements showed high levels of organic substances that caused oxygen depletion, which was traced to a pulp-mill 20 km north of Torsebro. The situation was made worse by the extremely low water levels in that particular summer. It is believed that this event wiped out the river's population of the rare European catfish (*Silurus glanis*). The water quality has since improved, due to better sewage treatment and industrial discharge regulations. Also, the European catfish has been successfully reintroduced in a joint project between EKV, World Wildlife Foundation, and the lower Helgeå River fishing association, Fishery department, and the Swedish Environmental Protection Agency.

Helgeå is the largest river in Scania and a major source of nutrients to the Baltic Sea. The use of fertilizers in agriculture increased after World War II and agriculture at the

³ <http://www.kristianstad.se/kommunen/c4teknik/organisation/historik/Vatten.asp>

periphery of the wetlands of lower Helgeå River has become more intensive. For years, there has been an awareness of the eutrophication of the shallow lakes, caused by nutrient loads of mainly nitrogen and phosphorus from surrounding agriculture. The groundwater is threatened by nitrates and biocides from agriculture (Kristianstads Kommun 2000).

An unforeseen long-term effect of lowering the lake level in 1775 has been that the shallow lakes have become more vulnerable to eutrophication and both Lake Araslövssjön and Lake Hammarsjön are under threat of becoming overgrown by reed and other macrophytes. This state was actually enhanced by the dredging projects in the 1940's.

Hay-making and grazing of wet grasslands almost ceased in Sweden around the end of the 19th century, when fodder cultivation on arable land became widely practiced. However, the wetlands of the lower Helgeå River were an exception and the agricultural practices for cultivating these wet grasslands has to some extent survived the reformations and rationalizations of agriculture that occurred elsewhere (Larsson 1972, Helgesson et al. 1994, Emanuelsson 2002). However, Magnusson et al. (1989) show that these wetlands became threatened due to the abandonment of haymaking and grazing. After cultivation ceases, the wet grasslands are overgrown by reed, sedge and willow, as a stage in the transition from cultivated wet grassland to forest (Cronert 1991, Ljungberg 1995, Svensson 2002). Hence, the desired ecosystem state is sustained by the management practices used for cultivating the wet grasslands and if these practices are discontinued, the area will eventually become forested. The rate of transition from wet grassland to forest depends partly on hydrological conditions. Drier areas show a more rapid transition to forests of alder, ash or birch. In wetter areas the reed-sedge-willow community can persist for a longer time period (Cronert 1991).

Protection of values

Some of the first documented efforts to identify and protect the natural values of the wetlands of the lower Helgeå River from exploitation and degradation began in the 1950's and 1960's (e.g. Ramel 1952, Bengtsson 1963, Anheden 1965, Uddling 1967, Björk 1971). Conflicts between conservation and exploitation were exacerbated in 1966 when the municipality, with support from the county administration board, planned to establish a garbage dump on the wet grasslands (*Härlövs Ängar*) nearest Kristianstad (Sandström 1981). Despite protests from local and national conservation interests emphasizing biological and aesthetic values, the meadows were transformed to a city dump. This reflects a view among local decision makers that the area was not worth conserving. Indeed, the public health committee at the Municipality of Kristianstad stated in 1958 that the "water infested and unhealthy swamp areas should immediately be cleaned-up" (cited in Sandström 1981). This view is also indicated by Fries (1958).

Plans to embank wet grasslands further south of the city (*Håslövs Ängar*) to permanent agricultural land in 1967 prompted renewed protests among conservation interests. Supported by the inventory of natural values carried out by Uddling (1967) the county administrative board decided to protect 150 hectares of these cultivated wet grasslands by establishing a nature reserve.

Around the same time, a plan for restoring Lake Araslövssjön and Lake Hammarsjön was produced (Björk 1971). This was to protect the lakes from becoming overgrown by reed and other macrophytes (Jönsson 1971). The restoring of Lake Hammarsjön started in 1974 when the Municipality of Kristianstad took on the responsibility for culling the lake vegetation. Responsibility for the lake's restoration has now been taken over by EKV.

In 1975, the 35 km stretch of wetlands along the lower Helgeå River from Torsebro to the Hanö Bay in the Baltic Sea was designated as having international importance by the Convention on Wetlands of International Importance and became known as the Ramsar Convention Site, RCS (Figure 1). The area had already been declared to be of national interest

for nature conservation and parts of it to be of national interest for cultural heritage, fishing, and recreation. Sweden signed the Ramsar Convention on Wetlands in 1974; the Convention came into force in 1975 and was immediately ratified by Sweden, making the county administration boards responsible for management of the RCS.⁴ In its official plan from 1975, the Kristianstad County Administrative Board (now Scania County Administrative Board) suggested that almost the whole area, 49 square kilometers, should become a nature reserve. In 1989, only three percent of the RCS were protected by reserves (Magnusson et al. 1989).

The Ramsar Convention on Wetlands provided a framework for protecting the wetland areas from further exploitation. However, despite all the inventories, plans, policy documents, and protection efforts several inventories and observations during the 1980's indicated that the values of the lower Helgeå River and the RCS continued to disappear. This was linked to the fact that wet grasslands used for haymaking and grazing had decreased dramatically (Magnusson et al. 1989). Even wet grasslands in nature reserves on state owned land were threatened due to neglect and insufficient management practices (indicated in Johansson and Cronert 1989). There was a growing concern that giving the wetlands of the lower Helgeå River RCS status was not enough to sustain the natural and cultural values of the area. The problems of implementing and fitting Ramsar Convention on Wetlands to local contexts have been recognized by Adger and Luttrell (2000).

Organizing change

In the following section we investigate and analyze the processes behind the changes in policy and organization for managing the wetland ecosystems of the lower Helgeå River that took place in: 1988-1989. This included creating EKV, a flexible and dynamic network organization, which promotes and facilitates management within KV that (1) treats humans as part of ecosystems, (2) includes social, economic and ecological dimensions, and (3) builds on collaborative processes that include international associations, national, regional and local authorities, non-profit associations and land owners. It may be argued that EKV has established essential conditions for adaptive co-management of wetland ecosystems, which in turn can create functional feedback loops and build resilience in social-ecological systems.

We found that several local individuals, 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 wet grasslands for haymaking and grazing. The perception of a crisis developed.

One individual played a particularly significant role in creating and shaping the organizational change. He started a dialogue with other concerned individuals and groups and initiated a social network as a response to ecosystem change. He compiled existing ecosystem knowledge and experience found within the network in a project proposal, and linked people and ongoing projects in the area. He also provided overall goals and vision in a holistic approach to wetland management and used a window of opportunity to convince political decision-makers of the need for a new organization and improved management of the wetlands. This steward coined the term *Kristianstads Vattenrike* (the rich wetlands of Kristianstad) and developed and realized the idea of EKV of which he is also the director. In this article we use his initials (SEM) and start this section by giving a background of this key steward and how he developed the ideas and strategies that were realized in EKV.

⁴ http://www.ramsar.org/profiles_sweden.htm

Linking nature and culture

Originally trained as a geologist, SEM was employed by the Kristianstads County Museum, first as an assistant and eventually as the curator of the department of natural history. One of his first assignments in 1977 was to host a traveling exhibit on Swedish wetlands arranged by the Swedish National Museum of Natural History and hosted by the Kristianstad County Museum. The exhibit did not include the wetlands of the lower Helgeå River and the Ramsar Convention Site. SEM saw an opportunity to call attention to these wetlands including their history and ongoing restoration and therefore added material to the exhibit. For instance he described the restoration project of Lake Hammarsjön that had started in 1974. He also linked nature and culture in illustrating the history of the wetlands of the lower Helgeå River. He compiled several maps based on general and detailed maps from the military record office and other more recent maps. These together represented a period from the seventeenth century to the present. He could distinguish four significant changes over time due to human activity in the Lower Helgeå River catchment (Magnusson 1981). This resulted in four maps that were included in the exhibit. The exhibit showed how the wetlands had shrunk over the past three centuries and discussed the social processes that had caused these changes.

SEM was involved in several other exhibits at the County Museum that linked nature and culture. For example, in 1978 the museum recognized the 200-year anniversary of the Swedish botanist Carl von Linné's death in 1778. SEM notes that "it was an eye-opener regarding important connection between natural and cultural history...reading old accounts of someone's travels helps us understand today's landscape, fauna and flora as originating in landscapes of ancient times. Without the landscape history there will be poor understanding of how today's landscape functions and why species of different kinds exist where they do". The Linnaeus exhibit gave insights into how the wetlands had historically been utilized by people and highlighted the fact that many of the biodiversity values described by Linné actually resulted from agricultural practices, making local people cultural stewards of wildlife habitats (Nabhan 1997)

At the County Museum, SEM also worked with "outdoor museums", a term that he coined. The idea of an outdoor museum is to give visitors on-site information that helps them interpret the landscape around them and hopefully increase their interest in and commitment to maintaining the values associated with the landscape (Magnusson 1987). An outdoor museum usually consists of screens in selected places throughout the landscape with information about for example the site's geology, ecology and cultural history. Some outdoor museums include buildings designed and built to fit a specific place and enhance the experience of the area. The County Museum and SEM was involved in the establishment and pilot operation of several outdoor museums around the county during the 1980's.

During his tenure as a curator at the County Museum, SEM gained knowledge and understanding of the history and dynamics of the cultural landscape and how local agricultural practices had for millennia shaped the landscape and ecosystems of the lower Helgeå River, which in turn provided ecological values. He had also an opportunity to develop a range of methods to inform the public of the County Museum's activities and the area's natural and cultural values and increase commitment in maintaining these values. This included a close relation to the local press. These methods were eventually applied in EKV.

Building local ecosystem knowledge

The 1980's was a period of growing awareness of the disappearing ecological values of the wetlands of the lower Helgeå River, and SEM became increasingly concerned. He saw the need to quantify these values and understand changes in the underlying processes that sustain them. He focused on the wet grasslands within the Ramsar Convention Site, since many unique values were associated with these grasslands and the site provided a well-defined

focus area. Where grazing and haymaking was still practiced within this area, unique values were maintained; where they had been abandoned, values were decreasing.

In 1986, the Municipality of Kristianstad initiated a cultural heritage programme (*kulturminnesvårdsprogrammet*) that was completed in 1989. This program included inventories of buildings, archeological sites, and the cultural landscape. SEM was responsible for the part of the program dealing with the cultural landscape, which aimed at identifying areas for protection. This included an inventory of meadows and pastures, funded by the Municipality of Kristianstad and conducted by SEM and the Kristianstads County Museum. Since many of the natural values of the area were linked to human use, SEM saw a possibility to combine the two. A criterion for selecting areas to investigate was selecting sites with a historical continuation of land-use, again using compilations of several maps to identify these target areas. The inventory included a range of habitats within the municipality's jurisdiction and identified several areas with unique flora. However, relatively few of them were within the Ramsar Convention Site and information about the cultivated wet grasslands described their values but not what sustained them. Therefore, in 1989, SEM used the experience from his work at the County Museum to design a special inventory of the wet grasslands and their cultivation status. A member of the Bird Society of Northeastern Scania, who later became involved in EKV, helped design this inventory (see below). It was termed "mapping of land-use practices" (*markhävdkartering*), intentionally avoiding traditional terminology associated with ecological inventories and instead using the language of cultural geographers. The inclusion of an inventory of the cultural landscape in the cultural heritage programme made it financially possible for SEM to produce an inventory that combined natural and cultural aspects and illustrated how ecological values such as biodiversity are linked to the quality of the agricultural practices used for cultivating the wet grasslands.

At the same time, in the mid to late 1980's, SEM met several members of the Bird Society of Northeastern Scania (BSNES), who had observed declining waterfowl populations in the area, especially in species associated with cultivated wet grasslands (Johansson and Cronert 1989). BSNES members have produced continuous inventories of birds since the 1950's (for example Bengtsson 1963) and recorded declining waterfowl populations in Lake Hammarsjön and Lake Araslövssjön. The earlier inventories linked the decline to "active threats" such as the disappearance of wetlands by active lowering of water levels, building of embankments and landfills, as well as draining and dredging. Later inventories, some produced in cooperation with the County Administrative Board, linked declining waterfowl populations to the more passive threat posed by the decreasing use of wet grasslands for grazing and hay-making (Neideman 1979, Helldén 1984, Adolfsson et al. 1985, Johansson and Cronert 1989).

Members of the BSNES also recognized that nationally protected areas of cultivated wet grasslands needed improved management practices to prevent them from becoming overgrown (Johansson and Cronert 1989). Officials at the national and county levels responsible for managing wet grasslands within nature reserves on state owned land were approached by the BSNES in an assertive way. Representatives from the County Administrative Board responsible for producing a management plan of these areas, and the National Forestry Board, responsible for management practices, were brought out to the reserve (*Håslövs Ängar*) and convinced that the mere protection of the wet grasslands was insufficient to maintain healthy bird populations. This led to an almost immediate response and improved management practices. The BSNES also proposed that parts of the RCS be made into a national park but their idea was not met with sympathy. SEM argues that the obstacle was that "they were outside the [political] system and were dependent on others to implement what they wanted to get done".

Hence, two previously parallel lines met; the experience and knowledge of SEM at the County Museum were combined with those of members of the BSNES. In the inventory of breeding birds of Lake Hammarsjön in 1986, Johansson and Cronert (1989) conducted a mapping of land-use practices similar to the one that SEM wanted to produce for the RCS. This provided an opportunity to link cultural-history and continuous use of the wetlands for grazing and haymaking to the ecological qualities for maintaining a rich bird fauna.

The mapping of land-use practices within the RCS that was completed in 1989 (Magnusson et al. 1989) provided information about wet grasslands and their geographical position and size, and whether or not they were used for grazing, hay-making, or both. This included indications of whether the areas were strongly or weakly grazed, when the grass was cut, and whether or not hay-making was followed by grazing. The maps also indicated areas where the exploitation of the land had ceased, and where the wet grasslands were becoming overgrown. The mapping revealed that the area still boasted 1200 ha of wet grasslands used for grazing (800 ha) and hay-making (400 ha including some with post-harvest grazing), which is unique in a northwestern European context. It helped to define and prioritize areas for improving land use practices and estimate the funding needed to maintain and develop these practices, and identified habitats for unique flora and fauna.

SEM had the following reflection on investigations and policy documents for managing wetland ecosystems: “The mapping of local land-use practices generated knowledge that was necessary for producing a detailed policy plan and taking action for improving management practices of wet grasslands of the lower Helgeå River. This is something that national efforts often fail to do because their findings are too general, like the inventory of cultivated wet grasslands by Larsson [1972]. Such reports also tend to end up far from the local context, unavailable for local action. Our mapping project is not instead of such efforts but rather is complementary and linked to them”.

National reports and inventories and scientific articles (for example Larsson 1969, Larsson 1972, Pehrsson 1979, Alexandersson et al. 1986) influenced and informed the mapping of land-use practices (Magnusson et al. 1989) which illustrates how such *coarse grained* information can guide local efforts to produce *fine grained*, context specific knowledge. This combining of different sources of knowledge in the local context to improve practices for ecosystem management is a strategy used in the continuous work of EKV.

Creating the EKV

The idea for the creation of Ecomuseum Kristianstads Vattenrike (EKV) was born during the cultural heritage program. Encouraged by the inventories and inspired by other ecomuseums in Europe, like the French *Musee Camarguais*, SEM decided to realize the idea of an ecomuseum of the lower Helgeå River. Besides the region’s natural and cultural values, which made it a potential tourist attraction, the museum could be easily accessible; Kristianstad is in the middle of the wetlands, a five minute walk from the city center.

SEM was aware of the diversity of actors at different organizational levels involved in on-going activities in the area such as inventories and monitoring programs, restoration projects, and improved land-use and management practices, though they were often not aware of each other. He argues that “it was important to gather [these] activities in one concept. The concept that I thought could be appropriate was *Kristianstads Vattenrike*”. The area’s *water* became the common denominator linking the projects.

The first thing SEM did was to garner support for EKV, focusing on “strong individuals in key organizations”. This focus on establishing a close relationship and trust with key individuals was to become an important strategy for EKV (Magnusson et al., progress report for 2002). His initial contacts included a researcher at the University of Lund who was interested in linking a research project on nutrient loads from agriculture around

Kristianstad and its effects on the Hanö Bay to EKV. Others that supported EKV project and were willing to collaborate in some form included

- an official at the World Wildlife Foundation (WWF) Sweden interested in the project's nature conservation aspects,
- the rector and a senior lecturer at the Kristianstad University interested in EKV's focus on research, education, and pedagogy,
- a hotel director and former president of the Kristianstad Tourism Board intrigued by EKV's potential to attract tourists, and
- the director of the National Museum of Natural History with interest in the ecomuseum.

These individuals represented the main goals identified by EKV: environmental protection, nature conservation, tourism, education and pedagogy, and the creation of an outdoor museum. By this time in early 1988 the term EKV, Ecomuseum Kristianstads Vattenrike, had already come to represent not just a museum project but also an organization working to initiate, improve and build upon ecosystem management of the catchment of the lower Helgeå River. However, the name has been retained.

With the support of these five individuals in hand, SEM prepared the first proposal to charter EKV in late 1988. The purpose of creating EKV, according to the proposal, was to address links between humans and nature, highlight the connection of the wetlands to the surrounding landscape and the sea, and to inform the public about on-going activities and increase the understanding and appreciation of the values of the area. This proposal was aimed at the Municipality, the County Administrative Board, and several other potential collaborators and financiers. The proposal contained different angles of approach for managing wetland ecosystems that SEM used in one on one encounters, lifting out specific parts of the proposal that could interest the person in question. The proposal also included information on values, threats and potential of the wetland area. It pointed out the important role of EKV in conflict resolution, coordinating activities, information sharing, and developing overall goals for managing the wetland ecosystems. SEM notes that “some of these were new strategies that had not yet been tried”. The proposal also showed that there was enough existing knowledge to enable immediate action to start the project.

A crucial meeting occurred in October 1988 between SEM and a senior municipal politician who was presented with the EKV idea. The politician was enthusiastic about the holistic approach and the suggested name “Kristianstads Vattenrike”. The politician notes that “SEM presented the area in a different way than anyone had done before and I became aware of the values. Many considered the wetlands as a problem...SEM presented a nature conservancy plan that didn't close the area but opened it up and made it accessible for the public”. He continues, “I was impressed by the way SEM marketed the idea and the broad support he got. He managed to engage and involve several important groups in the project, even farmers”.

The politician in turn convinced the chair of the municipal executive board to support it. These two persons were instrumental in implementing EKV; according to SEM, “these were the only two at the municipality that were able to get the stone rolling at the time”. The politicians were convinced that the issue of improved management of the wetlands of the lower Helgeå River was pressing. According to SEM, “they realized that the values of these areas were threatened and that the wetland ecosystems could serve humans by providing both recreational opportunities and nitrogen reduction”.

By late 1988 – early 1989, SEM had assembled a broad base of support for EKV from several key individuals within various key organizations at different levels in society. These supporters evolved into a network that involved people and organizations with local

knowledge and experience, such as representatives from the Municipality, the County Administrative Board, local environmental organizations, the Bird Society of Northeastern Scania, and local farmers' associations. Others involved in the project were WWF Sweden, the National Museum of Natural History, and a national research council (FRN). A press release was used to anchor the idea of EKV with the general public and to show the broad support for the project (unpublished press information material from February 1989).

In March 1989, the Municipality of Kristianstad took on the responsibility of running the project Kristianstads Vattenrike and granted funding for a small group of people to further develop the EKV idea. SEM was appointed project leader to identify a suitable location and budget for a wetland center, which was part of the original idea (the center was never realized due to financial constraints). At this point SEM and the EKV project was still associated with the County Museum. However, as indicated in interviews with both SEM and the municipal politician, the idea did not have support from the museum board, which led to the resignation of SEM and a colleague (an exhibition designer) from the County Museum in August 1989. However, the Municipal Executive Board was in favor of the EKV project and its vision, and SEM and his colleague from the County Museum became part of the municipality organization where they started to work September 1, 1989. The Municipality established an EKV office that still functions as a meeting place and workshop for building material for wetland exhibitions. In hindsight SEM argues that “becoming part of the municipality organization was better for the EKV project since the municipality is a major landowner in the [KV] area. The County Museum neither owns land nor has the skills, competencies, or economic resources important for implementing a project like the EKV that a municipality can provide”.

The initial funding for EKV depended on the will of others to contribute to the process. Different parts of the EKV project appealed to different sponsors and all sponsors conditioned their support on the broader participation of other sponsors. Sponsors and other collaborators were approached individually and presented with a part of the project that could be appealing to them and their specific interests. This is also linked to the trust building process and focusing on “strong individuals in key organizations” mentioned above. For example, the Municipality and the County Administrative Board were interested in “putting Kristianstad on the map”, strengthening Kristianstad's image and sense of identity. The municipal politician interviewed notes that “Kristianstad was relatively unknown except from its military base but we did not think that this was appropriate....We needed something else”. WWF was interested in supporting biodiversity within the cultivated wet grasslands. SEM argues that “the key was to avoid a fit-all-proposal that would be so neutral that nobody would be interested. Instead I had to approach each person and listen to what their specific needs and interests might be and emphasize the parts of the [EKV] project proposal that they could identify with and find of interest”.

SEM established an agreement that the Municipality would hire a person to start an EKV project on restoring wet grasslands as part of the EKV if the County Administrative Board would contribute and fund an adviser/administrator for a year. The funding from the County Administrative Board was provided by the sitting County Governor who notes that “we thought it was a good idea to use the environment and tourism to put Kristianstad on the map....we used a regional development fund to finance the project” However, although this financed EKV's administration there were still no funding for actions such as fencing and clearing. WWF, which was part of the emerging network, was willing to fund the remaining part of the project on the condition that the municipality and the County Administrative Board funded the administration.

Ecomuseum Kristianstads Vattenrike

A flexible organizational structure

The structure of EKV at the start in 1989 included five sections: outdoor museum, nature conservancy, environmental protection and production, tourism and recreation, and education and pedagogy. Another section, the cultural-history section, was added later. EKV is structured as a network organization where the sections form the nodes of the network. It encourages people employed in strategic nodes to tie their own capital and projects to the organization's common goals. In this way, the work of EKV is divided up in clearly defined subprojects and utilizes the competencies of experts in its key issue areas while maintaining a flexible, low cost structure.

SEM began searching for individuals to work with the different sections while he was developing the idea of EKV. In particular, three individuals had initiated projects in the area that were included in the initial work of EKV. These individuals are still associated with EKV and play key roles in the organization's work. A biologist who had started a nature school for children in the area headed the section for education and pedagogy, and she also developed the EKV Internet site.

An official at the environmental protection unit at the County Administrative Board, also an active member of the Bird Society of Northeastern Scania, was put in charge of the nature conservation section which includes the production of inventories, creating reserves, and improving management practices for maintaining and restoring cultivated wet grasslands. He helped design the mapping of land-use practices in wet grasslands in mid-1989 and SEM notes, "He seemed thorough and ambitious...it is important to tie oneself to that sort of individual".

In mid 1989 SEM also met an official at the environment and health office at the Municipality of Kristianstad who was leading several projects within the Kristianstad Project (*Kristianstadsprojektet*), which concerned the role of the wetlands for reducing the nitrogen and phosphorus load to the Hanö Bay in the Baltic Sea. These projects were linked to EKV and the municipal official responsible for them became head of EKV's environmental protection and production section. The early proposal included findings from recent research including scientists at the University of Lund that among other things noted the important ecological service to humans provided by the wetlands as water filters. The Kristianstad Project and the participation of this key official provided an opportunity to test various management practices for reducing nitrogen and phosphorus through collaboration among land owners, the University of Lund, the Municipality of Kristianstad, the Kristianstad County Agricultural Board, Önnestads Agricultural and Horticultural College, and a local branch of the Swedish farmers' association (*LRF*). These practices included restoring watercourses, establishing dams, protecting riparian zones, and creating artificially flooded meadows.

The activities in the sections are project based and framed by the availability of a regular funding stream. SEM argues, "this provides a flexibility to try out different things although it makes us constantly hunt for money". The EKV is a dynamic entity; the ideas and plans for EKV have been revised many times since 1989. For example, the wetland center that was part of the original plan has never been realized due to economic constraints. Since the start in 1989 the sections have been more or less active depending on focus, available funding, and the availability of a suitable person to manage the issue.

EKV is dependent on the support from the chair of the Municipal Executive Board. The municipal politician interviewed in this study was chair until 2002 and has continued to support EKV. The new chair has been convinced of the importance of EKV or as the politician puts it "I have convinced my replacement".

Work and achievements

EKV is a dynamic network organization within the Municipality of Kristianstad involved in overall planning, conflict resolution, coordination and administration of conservation and restoration efforts within Kristianstads Vattenrike as well as the production of management plans, agreements, follow-up reports, and updates for specific wetland areas.

EKV has made the wetland landscape area more accessible to the public and has established thirteen information sites in the wetlands. More than 150 000 people visit these sites each year. EKV spreads the results of its monitoring, inventories and mapping efforts to a variety of users and the general public using the sites and the Internet as important tools.

EKV has been involved in numerous inventories since its inception. These inventories are part of generating new ecosystem knowledge for the local collaboration process. It is also part of the follow-up and progress of various projects. A mapping of land-use practices conducted in 1996 revealed that the area of wet grasslands used for hay-making and grazing had increased by 200 ha compared to 1989 (Wendt-Rasch and Cronert 1996). Also, a higher share of well cultivated areas was found. Other inventories concern reserves (Wallsten and Cronert 2000, Svensson 2002). By 1991, 170 ha within the Ramsar Convention Site were protected in nature reserves (Cronert, 1991) and by 2002 this figure was 480 ha⁵. An inventory of bird populations of cultivated wet grasslands within KV in 1997 (Cronert and Lindblad 1998) indicated that several European bird species, some of which were threatened, had increased their population since EKV was established in 1989. These inventories are initiated and designed by the EKV, often in collaboration with WWF, the County Administrative Board, the Municipality of Kristianstad, Bird Societies, and the Swedish EPA. Often, scientists or consultants are hired to conduct these inventories.

SEM sees conflict resolution as a key process for sustainable management of KV. In the beginning of the 1990's a reference group was formed by EKV within the section for nature conservancy. This group included individuals representing various organizations and interests from the local and regional levels. SEM says that "the purpose was to gather representatives involved in activities that had links to the water of the Kristianstads Vattenrike and who had not met earlier in a common forum. It was often so earlier that the only time they were in contact with each other was during a conflict that often took place on the letters page of the local newspapers". He notes that EKV led the process of "identifying common interests and discussing differences of opinion in a constructive way". This also built trust among the representatives, essential to the success of the collaboration process. As SEM argues, "to start to discuss collaboration during a conflict situation is not a good strategy". This strategy is a way to forestall conflict and is further addressed and investigated in Hahn et al (in manus). Formal agreements and action programs emerge from these collaborative processes. These in turn lead to a change in behavior and practices in order to improve management of wetland ecosystems. This has been referred to as "open institutions" (Shannon and Antypas 1997). SEM argues that "this is a faster and more long-lasting way to achieve our goals than making authorities change rules that force people to change behavior".

The work of EKV has developed into an adaptive co-management approach (Table 1) that includes stakeholders at several levels in society, from local to international, for managing the ecosystems of KV (Table 2). The geographic area defined as Kristianstads Vattenrike provides the arena for collaboration where different interests are represented. SEM states "collaboration is a necessary process to reach the set goals for the KV and to achieve sustainable results". SEM believes that "not being an authority is a prerequisite for gaining enough trust among local stakeholders to lead local collaboration processes". However, there

⁵ <http://www.vattenriket.kristianstad.se>

have been proposals to make the EKV into a municipal authority rather than a municipal organization.

EKV combines and incorporates the local skills and knowledge of a variety of stakeholders who have been observing and interacting with the ecosystems of the KV. EKV maintains a close collaborative relationship with the farmers, utilizing their knowledge and understanding of agricultural practices that often has been developed and passed on from generation to generation. An example is the adjustment of grazing pressure on wet grasslands in relation to biodiversity. If only grazed by cattle the ground takes on a tussocky surface; if grazed by horses it develops a smooth even surface (instead of grazing by horses, the wet grassland can be mowed to acquire the same result). Some bird species are dependent on a mixture of the two types of surfaces. The use of horses is returning in the landscape after declining till the 1970's (Larsson 1972, Helldén 1984). EKV uses inventories (for example von Proschwitz 2001, Ljungberg 1995) to increase farmers' awareness of the unique values of their land in a larger context. The inventories are important for continuously "tuning" management practices to secure goals.

SEM notes, "our view at EKV is that protecting and maintaining values should be as interesting to the land owners as it is to the municipality or the state. Many farmers possess the knowledge for cultivating the wet grasslands but not the economic incentive to do so". Therefore, the collaboration with farmers also includes keeping abreast of technological improvements, finding funds (including EU funds) that they can apply for to develop new ideas and compensate them for their conservation efforts, and finding markets for their products.

An adaptive agenda

Ecomuseum Kristianstads Vattenrike has demonstrated an ability to respond to environmental feedback and to develop new knowledge and understanding about ecosystem management needs. Although the initial work of EKV was concentrated to wet grasslands it has gradually expanded its management focus and has initiated new projects. Examples of such projects include reintroducing the white stork (*Ciconia ciconia*) and the European catfish (*Silurus glanis*), solving the problem of increasing numbers of cranes (*Grus grus*) and geese (*Anser anser*) and the damage they cause to standing crops, protecting and restoring tributaries of the Helgeå River, and managing floods. Since these projects include international associations, national, regional and local authorities, non-profit associations and landowners, the network of collaborators has also expanded.

EKV is currently broadening its response to change in ecosystems outside the RCS. Although KV is a well-defined area (see Figure 1) there is confusion between the KV and the RCS. Many of the EKV activities have focused on the areas within the RCS since it is a well-defined area for which it has been easier to obtain project funding. It has been more difficult for the EKV to implement projects outside of the RCS wetlands, though project leaders have identified a need to focus on links between the wetlands and the surrounding landscape. The KV is in the final stages of becoming a Man and Biosphere (MAB) reserve, currently wrestling with the zoning issues. SEM believes that making KV a MAB reserve will help expand the focus of activities to the surrounding areas including the sandy grasslands, which is even more unique an ecosystem than the wet grassland from a European perspective. Within the MAB reserve it will be possible to connect landscape elements that are linked through ecological and hydrological processes and that have been historically and culturally linked through agricultural practices, such as the cultivated wet grasslands of Helgeå River and the outlying grazing areas (*enefäläd*) on the Linderödsåsen ridge (Magnusson 1995).

Conditions for adaptive co-management

We have earlier described how conditions can be created to facilitate the emergence of adaptive co-management arrangements (Olsson et al. in manus). The requirements include vision, leadership and trust, enabling legislation that creates social space for ecosystem management, providing funds for responding to environmental change and for remedial action, monitoring and responding to environmental feedback, facilitating information flow through social networks, combining various sources of information and knowledge, sense-making, and establishing arenas for collaborative learning of ecosystem management. In Table 1 we describe how each of these conditions was reflected in our case study.

EKV operates within existing polycentric governance structures (McGinnis 2000) involving different levels in society. Hence, the establishment of the adaptive co-management system did not involve crafting new institutions but rather a reorganization within existing institutional frameworks, connecting and coordinating on-going activities. Incorporating EKV as a network organization within the Municipality of Kristianstad created space for ecosystem management. The legitimacy of municipal support made it possible to coordinate information and start collaborative processes that we argue are necessary for ecosystem management while maintaining the flexibility of a semiautonomous organization.

Financing was provided throughout the process to fund inventories and planning in order to address ecological and social processes. The main financial contributors to the initiation of EKV were the County Administrative Board, the Municipality of Kristianstad, World Wildlife Foundation Sweden, and The National Cultural Advisory Board (*Statens Kulturråd*). This support provided fertile soil for the self-organization process and the organizational change. Although EKV is constantly under pressure to find funding, the project based financing provides flexibility and opportunities to test new ideas and projects. However, it also makes EKV vulnerable to external factors that affect funding, like a new chair of the Municipality Executive Board. SEM's central strategy has been to encourage local actors to tailor the production of material planned within their own organizations such that it may be used as an input to EKV analyses. This allows EKV to benefit from existing funding sources. For instance, the county administration board has supported several inventories conducted and published by EKV.

The mapping of cultivated wet grasslands provided information necessary for quantifying ecosystem change and evincing the imminent ecological crisis. This information was also crucial for responding to ecosystem change, particularly by preventing wetland ecosystems from entering undesirable states. The response to the threat of the wet grasslands becoming overgrown was to create social structures and processes to secure their continued cultivation. This was also important for enhancing the decreasing bird populations that depend on cultivated wet grasslands. In response to the increased nutrient loads to the Hanö Bay and increased levels of nitrates in the groundwater, the response was to reduce nitrogen by experimenting with various ways of using wetlands as filters. EKV continuously conducts inventories to increase ecosystem knowledge in order to tune management practices and associated institutional and organizational structures to the ecosystem dynamics.

The capacity to address the range of issues involved with ecosystem management is dispersed over a range of actors at different levels in society. Therefore, rather than trying to develop expertise in all issue areas himself, SEM developed social networks to coordinate activities and exchange information about managing the wetland ecosystems of the lower Helgeå River catchment. Knowledge for ecosystem management is mobilized through the networks and complements and refines local practice for ecosystem management. The network was first developed to produce the mapping of land-use practices in order to show ecosystem change. The network later expanded to establish EKV and the knowledge that exists within the network was used to change municipal policy in for managing wetland

ecosystems. It has continued to develop in response to new problems and challenges emerging in KV. The networks connect institutions and organizations across levels and scales. They facilitate information flows, identify knowledge gaps, and create nodes of expertise of significance for ecosystem management.

SEM played a key role in combining several sources of information and knowledge systems in a local context. At the County Museum SEM combined information and knowledge of ecology, geology and cultural history of the landscape used in exhibitions and outdoor museums to help people interpret the landscape around them. In mapping the wet grasslands used for grazing and haymaking, SEM combined his own local knowledge and experience and that of the Bird Society of NE Scania with more general information such as scientific articles, EPA reports and other writings on the management of wet grasslands for bird fauna. In the project proposals SEM combined information of ongoing projects in the area. All these steps were necessary to address the complex social-ecological interactions of the lower Helgeå River catchment.

SEM plays a key role in compiling knowledge and information from various sources and interpreting and making sense of it. He interpreted ecosystem changes and created a meaningful order and strong vision, which was captured in the project proposals used as a call to action. SEM provided skills and leadership, which are essential components in the sense-making process for the management of complex social-ecological systems (Westley 2002). With a clear and convincing vision, compelling arguments and good social links with stakeholders with whom he had established mutual trust, he mobilized several interest groups including land owners to start a self-organizing process toward adaptive co-management of the wetland ecosystems.

EKV provided an arena for collaboration. It was based on SEM's conviction that the complexity of the issues of managing the wetland ecosystems of the lower Helgeå River required a coordinated effort involving a range of stakeholders at different levels in society and representing a variety of interests. Regular meetings of a reference group established within the nature conservancy section of EKV are meant to forestall conflict and in this way produce mechanisms for conflict management. For each problem arising in Kristianstads Vattenrike stakeholders are gathered by EKV to be part of the process of solving the problem. EKV acts as a facilitator on this arena. The stakeholders are part of the planning, implementing, monitoring and evaluating phases of the learning process and management practices emerge and are revised through this process.

Social-ecological transformations for ecosystem management

The new management of wetland ecosystems seems to meet the conditions defined by Olsson et al. (in manus) for the development of adaptive co-management of ecosystems. However, this case also provides insights into social processes that *create* those conditions. Our study concludes that four factors are important for creating the conditions for adaptive co-management: the *perception of a crisis* in the resource which opens up space for action, a *steward* providing leadership, strategies, vision and trust, the presence of a social and political *window of opportunity*, and *broad support* for change among a range of actors at different levels in society. To further understand these factors we use Kingdon (1995) on policy windows and policy entrepreneurs.

The policy change by the Municipality of Kristianstad to adopt a flexible and collaborative approach for managing the catchment was accompanied by organizational change with the inclusion of EKV into the municipality's organization. Support from the municipal executive board was absolutely necessary for the establishment of EKV and the adoption of an adaptive co-management approach. SEM believes that the window of opportunity was open during a very short period in the late 1980's; "if we had not taken the

chance then, we would still be knocking on the door today”. By emphasizing the values of the area and the threats to these values SEM convinced key politicians that the issue of managing the wetlands of KV was pressing. Kingdon (1995) refers to such an event as a policy-driven window.

We have identified four circumstances that were helpful in opening such a window of opportunity and putting the management of KV on the municipal political agenda. First, local politicians were keen to find a profile for the municipality, “to put Kristianstad on the map”. Second, the politician interviewed in this study had, like SEM, been working at the County Museum in 1975-76. Through his contact there he knew of SEM as a reputable entrepreneur. Third, the proposed ecomuseum was a novel device with good potential for local recreation and eco-tourism. Fourth, environmental questions had been particularly emphasized during the national Swedish election in September 1988. No other question had received as much attention in Sweden, with 46% of the population stressing environmental issues as the most important political issue (Bennulf 1994). One-on-one dialogue with individuals representing various organizations has been mentioned earlier as a strategy of SEM to secure the participation of collaborators. Such dialogues with municipal politician may also have been important in helping SEM identify the policy window.

Key stewards like SEM have been referred to as *policy entrepreneurs* in the literature on policy change (e.g. Shannon 1991, Kingdon 1995). Kingdon (1995) identifies key roles for the policy entrepreneur in combining three streams: *policy proposals*, *problem perception*, and *political momentum* to achieve policy change. According to Kingdon (1995), “the [policy] window opens because of some factor beyond the realm of the individual entrepreneur, but the individual takes advantage of the opportunity”. Further he states that policy entrepreneurs “develop their proposals and then wait for problems to come along to which they can attach their solutions or for a development in the political stream like a change of administration that makes their proposals more likely to be adopted”.

SEM took advantage of the policy window for pushing the EKV project proposal. The proposals contained a compilation of knowledge to convince decision-makers of the need for improved management of the wetland ecosystems based on a holistic approach and sees humans as part of ecosystems, addressing the complex interactions across spatial and temporal scale in such social-ecological systems. This proposal was the basis for the municipality’s policy change.

The proposal was used to increase problem perception among a wider array of people and organizations at different levels in society. This made people aware not only of the ecological problems in the area but also of the lack of coordination of on-going activities. Broad support was important for securing funding for the project, since the commitment of each financier was contingent on the commitment of others. The proposals and the engagement and support of a wide range of individuals and organizations at an early stage in the development of the EKV ideas helped gain political momentum when the policy window opened.

Leaders like SEM often initiate key processes that are required in ecosystem management (Pinkerton 1998, Westley 2002). Individual actors serve as key players in institution building and organizational change in relation to ecosystem dynamics and facilitate horizontal and vertical linkages in the adaptive co-management process (Folke et al. 2003, Olsson et al. in manus). The work of SEM to link people and activities was part of the strategy to create social networks to draw on several sources of knowledge, solve complex problems and stimulate engagement in adaptive co-management of the wetland ecosystems. The proposals and the trust building process were important for mobilizing people in these networks and creating vertical and horizontal linkages. 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. Social networks are fundamental for ecosystem management and dealing with uncertainty and change (Shannon 1998, Wilson 2002).

This case also supports the argument of Olsson et al. (in manus) that it is difficult for one person to have all relevant knowledge for ecosystem management. Instead of attempting to provide all necessary knowledge, SEM plays the role as the sense maker and knowledge manager. He is responsible for the strategies used to form and operate EKV. These involve press and public relations, marketing the area, and maintaining a dialogue with key actors to identify interests, build trust, facilitate collaboration and forestall conflict.

Ecosystem management requires a multi-scale approach. The problem of the mismatch of scales between social and ecological structures and processes has been addressed by Lee (1993a) and has been referred to as the problem of fit by Folke et al. (1998). In the case presented here, scale-matching involved defining an area for ecosystem management, coordinating information flow and initiating collaborative processes. SEM is important in the process of expanding management structures to meet new challenges of matching social and ecological dynamics. Such expansion is needed when prevailing management structures become insufficient to address functional links in the landscape, for example between sandy grasslands and wet grasslands. The first step in this process was the creation of EKV. Although the aim was to manage the lower Helgeå River catchment, much of the focus has been on the Ramsar Convention Site. The next step will be the establishment of a MAB reserve which could provide an opportunity to address social-ecological dynamics at other scales. The preparation for implementing a MAB area has started with knowledge accumulation through thorough inventories of for example the sandy grasslands. These steps are examples of how knowledge generation of ecosystem dynamics is explicitly integrated and evolves with the institutional and organizational structures and processes for ecosystem management.

Conclusions

We have provided insights into social processes that create conditions for adaptive co-management and have illustrated how organizational and institutional arrangements can emerge through self-organization processes, initiated by key stewards, to fit context specific problems and needs. The perception of a crisis in the resource triggered action, a key steward provided leadership, vision and trust, a brief social and political window of opportunity at a critical time, and there was broad support for a new management approach among a range of actors at different levels in society.

The whole system was transformed into a new configuration, a new social-ecological stability domain. This makes this case a good example of transformative capacity. The self-organizing process that followed the rapid transformation in 1988-1989 developed into an adaptive co-management system with numerous social linkages across scales. The knowledge generation, creating functional feedback loops, social network building, and collaborative learning processes initiated by the key steward helped widen the social-ecological stability domain for ecosystem management.

The study illustrates that social and ecological systems are linked, which implies that losing key structuring social variables could affect the ecosystem state as much as losing key structuring ecological variables. Hence, the erosion or loss of a key social variable like trust (e.g. Shannon 1998, Pretty and Ward 2001) not only jeopardizes collaboration processes (Baland and Plateau 1996) but also the ability to develop desirable ecosystem states and to store and enhance adaptive and transformative capacity. Systems that rely on one or a few key

stewards might be vulnerable to change (Olsson and Folke 2001). This is exemplified by Peterson (2002) who describes the management of the long-leaf pine forest in Florida and how the desirable state or the stability domain of the forest is maintained by fire as a main structuring variable. Fire frequency has decreased in the area and long-leaf pine forest ecosystems therefore risk entering into other less desirable ecosystem states. The forest is within a military base and an air force general has been a key steward for maintaining the forest through active burning. When the general left his position, a new general that did not share the interests and convictions of his predecessor replaced him. However, some of the personnel who had taken active part in ecosystem management had developed knowledge and affection for the long-leaf pine forests. They also used a scientist's model of forest dynamics (Hardesty et al. 2000) to successfully convince the new general of the importance of fire management for maintaining the desirable stability domain of a long-leaf pine forest ecosystem. This example shows how structures and processes can provide a social memory (McIntosh 2000) of ecosystem management that sustains adaptive capacity in times of change.

The development of the adaptive co-management system of Kristianstads Vattenrike was probably most vulnerable during the initial phase of its existence, when the transformation into another configuration of the social-ecological systems took place. If the key steward had moved or for some other reason disappeared at this point, the direction of management would have been highly uncertain and the transformation may have taken another pathways. However, the change of policy by the Municipality of Kristianstad initiated social learning (Lee 1993b) and collective action for ecosystem management. In this process knowledge of ecosystem dynamics developed as a collaborative effort and became part of the organizational and institutional structures of the adaptive co-management system. Such structures include the network organization of EKV and the wider social network of individuals and organizations that have participated in various projects over the years. Over time, the ability to deal with change and uncertainty seems to have improved, which increases the capacity to deal with future change (Folke et al. 2003). In this way, one may speculate that the development of the adaptive co-management system in Kristianstad has reached a state of social-ecological resilience through widening of the social-ecological stability domain. It may have become robust to changes that previously would have threatened its existence. In light of this study, we suggest that the existence of transformative capacity is essential in order to create social-ecological systems with the capability to manage ecosystems sustainably for human wellbeing. Adaptive capacity will be needed to strengthen and sustain such systems in the face of external drivers and events.

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Table 1. Social conditions essential to the adaptive co-management process as reflected in Ecomuseum Kristianstads Vattenrike

Social Conditions ^a	EKV structures and processes
Enabling legislation that creates space for ecosystem management	EKV operates as a network organization within the Municipality of Kristianstad. It has the flexibility of a semiautonomous organization, and the legitimacy of municipal support allow EKV to coordinate information and start collaborative processes.
Funds for responding to environmental change and for remedial action	<ul style="list-style-type: none"> • financing from public and private organizations funds inventories and planning to address ecological and social processes. • almost all financing is project based, which provides flexibility and supports the creation of new ideas and projects, but also makes EKV vulnerable to external factors that affect funding. • EKV benefits from existing funding sources, using material planned within EKV network organizations in EKV analyses
Monitoring and responding to environmental feedback	<p><i>Monitoring:</i> mapping cultivated wet grasslands to quantify wetland ecosystem change and the threat of them entering undesirable states. continuous inventories to increase ecosystem knowledge and tune management practices and institutional structures to ecosystem dynamics.</p> <p><i>Responses to environmental feedback:</i> threat of the wet grasslands becoming overgrown and subsequently declining bird populations: creation of social structures and processes to secure their continued cultivation. increased groundwater nitrate levels and nutrient loads to the Hanö Bay: reduction of nitrogen by using wetlands as filters.</p>
Information flow and social networks for ecosystem management	<p>EKV coordinates activities and exchanges information about managing the wetland ecosystems. A network first developed to map land-use practices, later expanded to establish EKV and change municipal policy. It continues to develop in response to new problems and challenges. The networks</p> <ul style="list-style-type: none"> • connect institutions and organizations across levels and scales • facilitate information flows • identify knowledge gaps • create nodes of expertise

Social Conditions ^a	EKV structures and processes
Combining information and knowledge for ecosystem management	<p>SEM combined several sources of information and knowledge systems to address complex social-ecological interactions of the lower Helgeå River catchment.</p> <ul style="list-style-type: none"> • At the County Museum, he combined information and knowledge of the ecology, geology and cultural history of the landscape used in exhibitions and outdoor museums to help people interpret the landscape. • In mapping the wet grasslands used for grazing and haymaking, he combined local knowledge and experience with general information from scientific articles, EPA reports and other writings on the management of wet grasslands for bird fauna. • In the project proposals he combined information about ongoing projects in the area.
Sense-making for ecosystem management	<p>SEM plays a key role in compiling and interpreting knowledge and information from various sources. This includes:</p> <ul style="list-style-type: none"> • interpreting ecosystem changes • providing a clear and convincing vision • providing skills and leadership • creating social links and building trust among stakeholders • mobilizing interest groups and land owners to start a self-organizing process toward adaptive co-management
Arenas of collaborative learning for ecosystem management	<p>EKV provides an arena for collaboration. The complexity of managing these wetland ecosystems requires a coordinated effort involving stakeholders representing a variety of interests. For each problem arising in Kristianstads Vattenrike, EKV acts as a facilitator, gathering stakeholders to help find a solution. This includes planning, implementing, monitoring and evaluating phases of the learning process by which management practices emerge and are revised.</p>

^a Source: Olsson et al. (in manus)

Table 2. Stakeholders at different levels involved in various collaboration projects in Kristianstads Vattenrike

Level	Organizations and Institutions
International	ICOM International Council of Museums Ramsar Convention on Wetlands EU commission - Natura 2000 Directive UNESCO - Man and the Biosphere Programme
National	Environmental Protection Agency The National Cultural Advisory Board Research Council (<i>Forskningsrådsnämnden</i>) Central Board of National Antiquities Fishery Department Agricultural Department World Wildlife Fund Ornithological Society of Sweden
Regional	Scania County Administrative Board Scania Region (<i>Region Skåne</i>) Kristianstad University Rural Economic and Agricultural Association in Kristianstad (<i>Hushållningssällskapet</i>) Other universities
Local	<i>Municipality administrations</i> School, Trade and Tourism, Environment and Health, Technical, Labor Market <i>Associations and organizations</i> NSF, Bird Society, lower Helgeå River Fishing Association, Boating Club, private landowners, farmer's associations, community and village associations <i>Trade and Industry</i> SEB (a bank), OLW (potato chips manufacturer), River Boat (sightseeing in KV), Viby Gårdsbutik (farmers' market), Helgeå River camping, other agricultural businesses

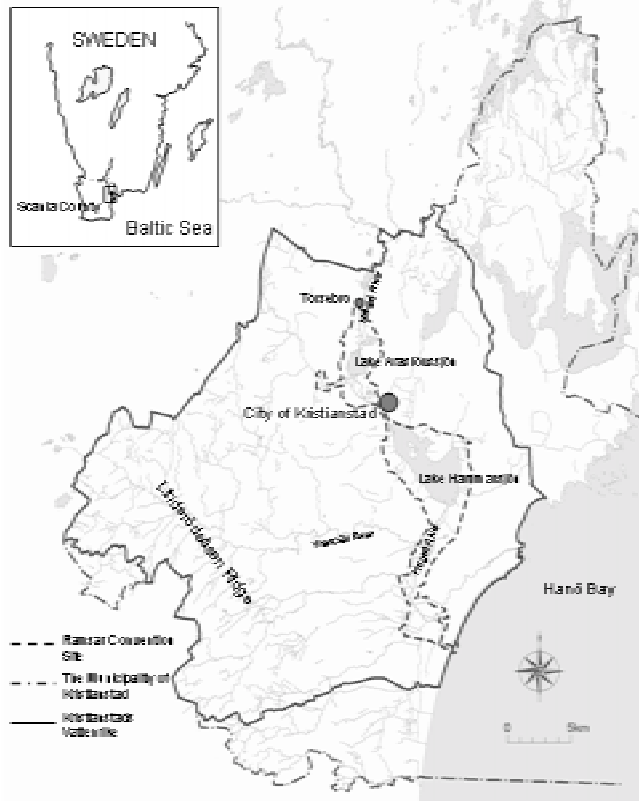


Figure 1. The lower Helgå River catchment with the Ramsar Convention Site, Kristianstads Vattenrike, and the Municipality of Kristianstad.