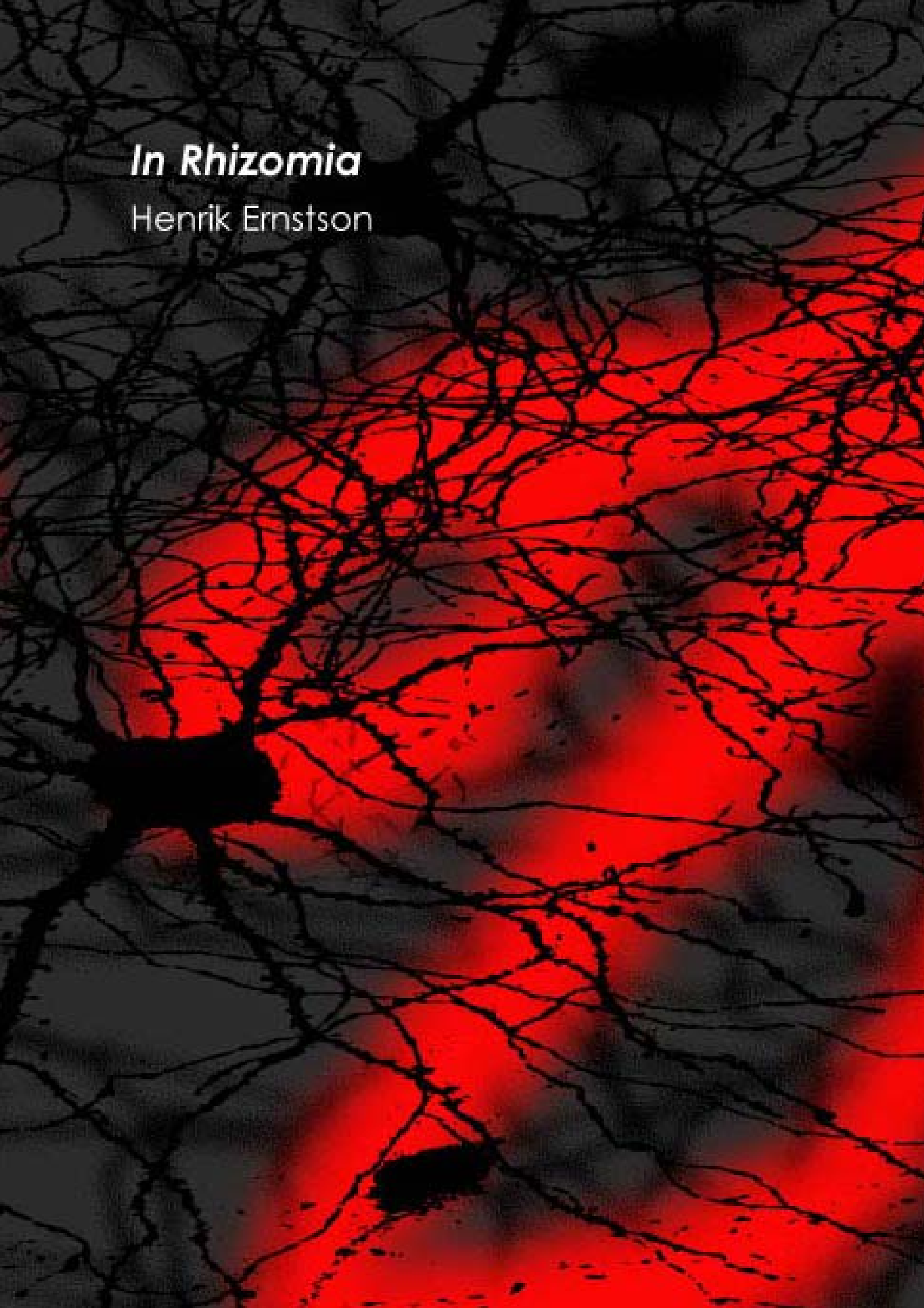
# *In Rhizomia*

Henrik Ernstson



# *In Rhizomia*

## Actors, Networks and Resilience in Urban Landscapes

**Henrik Ernstson**

Academic dissertation for the Degree of Doctor of Philosophy in Natural Resources Management at Stockholm University to be publicly defended on Friday 26 September 2008 at 10:00 in Nordenskiöldsalen, Geovetenskapens hus, Svante Arrhenius väg 8 C.


### Abstract

With accelerating urbanization it is crucial to understand how urban ecosystems play a part in generating ecosystem services for urban dwellers, such as clean water, spaces for recreation, stress relief and improved air quality. An equally important question relate to who gets to enjoy these benefits, i.e. the distribution of ecosystem services, and how issues of power and equity influence the management of ecosystems. Through case studies from the urban landscape of Stockholm, this doctoral thesis engages with these perspectives through combining ecological theory with social theory, including social network analysis, actor-network theory and social movement theory. Strategies for how to improve urban ecosystem management are presented along with frameworks for how to analyze issues of power and equity in relation to natural resource management.

**Paper I** shows that ecosystem management can be studied through analyzing the structure of social networks, i.e. the patterns of relations between agencies, stake-holders and user groups. **Paper II** and **Paper III** analyze, based on a network survey of 62 civil society organizations and in-depth interviews, a transformational process of how an urban local movement managed to protect a large urban green area from exploitation (The Stockholm National Urban Park). **Paper IV** discusses, based on several case studies from Stockholm, a conducive network structure for linking managers and user groups (e.g. allotment gardens, cemetery managers, and urban planners) across spatial ecological scales so as to improve urban green area management. **Paper V** presents a framework to analyze the social-ecological dynamics behind the generation and distribution of ecosystem services in urban landscapes.

The thesis points towards the notion of "a social production of ecosystem services" and argues for deeper engagement with urban political ecology and critical geography to inform governance and collective action in relation to urban ecosystems.



**Keywords:** *urban ecosystem services, green space, social network analysis, social movements, actor-networks, transformation, ecosystem management, scale mismatch, co-management, governance, broker, conservation, Stockholm.*

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Stockholms universitet

# *In Rhizomia* – Actors, Networks and Resilience in Urban Landscapes

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Doctoral dissertation 2008
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# Abstract

The overarching theme of this thesis is the *generation* and *distribution* of urban ecosystem services. Ecosystem services are the benefits humans derive from ecological processes such as food, clean water, stress relief, and improved air quality, which depend upon complex interactions between species and matter. Research in natural resource management has mostly been from a functional management perspective, and less engagement has been from a critical perspective concerning who in society benefit from these services and how issues of equity and power influence ecosystem management. Both perspectives are pursued here.

The bulk of the empirical data has been generated through a case study of an urban social movement that has protected the Stockholm National Urban Park from exploitation, a large and centrally lying green area. In **Paper I**, a theoretical argument is made that ecosystem management can be studied through analyzing the structure of social networks, i.e. the patterns of relations between agencies, stakeholders and user groups. In **Paper II**, a social network analysis of the 62 movement organizations revealed a core-periphery structure effective to ward off exploitation plans, but which also seems to have constrained ecosystem management; user groups with ecological knowledge have been marginalized on collaborative arenas due to their peripheral social network position. Based on in-depth interviews and participatory observations, **Paper III** traces the practice by which activists constructed holistic values and visions for the park. The articulation of values seems to have been conditioned by the access to certain artefacts (historical maps, biodiversity mappings etc.) and social arenas. In **Paper IV**, and based upon other case studies from Stockholm, a conducive network structure is proposed aimed at linking managers and user groups (e.g. allotment gardens, cemetary managers, and urban planners) across spatial ecological scales so as to improve management. Building on the previous papers, **Paper V** presents a framework to analyze the social-ecological dynamics behind the generation and distribution of ecosystem services in urban landscapes.

The thesis argues that urban green areas should be acknowledged as physical sites of social-ecological interaction that can nurture ecological knowledge, value creation processes, and human agency to improve urban ecological processes. The thesis points towards the notion of “a social production of ecosystem services” and argues for deeper engagement with the fields of urban political ecology and critical geography.

# List of Papers

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**I. Social networks in natural resource management: what is there to learn from a structural perspective?**
Örjan Bodin • Beatrice Crona • Henrik Ernstson (2006)
Ecology and Society 11(2):r2
*(NB! All authors participated equally.)*

**II. Social movements and ecosystem services: the role of social network structure in protecting and managing urban green areas in Stockholm**
Henrik Ernstson • Sverker Sörlin • Thomas Elmqvist (2008)
Ecology and Society (*in press*)

**III. Weaving protective stories: connective practices to articulate holistic values in Stockholm National Urban Park**
Henrik Ernstson • Sverker Sörlin (2009)
Environment and Planning A (*in press*)

**IV. Ecological scales and social network structure: management and governance of urban ecosystem services in Stockholm, Sweden**
Henrik Ernstson • Stephan Barthel • Erik Andersson • Sara Borgström (manuscript)
Environmental Management

**V. The social production of ecosystem services: lessons from urban resilience research**
Henrik Ernstson (manuscript)
Human Ecology

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# Abbreviations

| | |
|---|---|
| ANT | Actor-network theory |
| NUP | National Urban Park, *The (Nationalstadsparken)* |
| SES | Social-ecological system |
| SMO | Social movement organization |
| SNA | Social network analysis |

# Introduction

Humans influence ecosystems at scales from local to global (Vitousek et al. 1997) and it has become imperative to understand and better account for the linkages between humans and ecosystems (Berkes and Folke 1998). Research in natural resource management has embraced this notion through stressing a human-in-nature perspective and turning the object of study into "social-ecological systems" (ibid.) seen as complex systems in which humans and their institutions (including organizations, knowledge, and values) become an equal part of analysis with ecological components as water flows and pollination patterns (Gunderson and Holling 2002, Berkes et al. 2003). Tightly linked to this lies the recognition that human activity depend on the goods and services generated from ecosystems (Daily 1997a, Costanza and Farber 2002, MA 2005, Daily and Matson 2008). The clearest difference between social systems and ecological systems lies in that humans are reflective and can consciously manipulate the direction of development, with both intended and unintended consequences for both social and social-ecological systems (cf. Giddens 1984). The focus of natural resource management research then evolves to ask question about how humans, through purposeful actions can act as agents in social-ecological interactions so as to create, sustain and improve the generation of ecosystem services. This should however not be translated as efforts to control 'nature' for the benefit of humans, but in efforts to navigate a complex and continuously changing social-ecological system so as to sustain good human living conditions (Levin 1999, Berkes et al. 2003). Nonetheless, as remnants from an old paradigm, these purposeful actions are often called 'management' or 'protection' of ecosystems, referred to as 'ecosystem-based management' or 'adaptive management', but should be read as an interaction from within an ecosystem rather than as actions from the outside.

Natural resource management literature has traditionally focused on the generative capacity of ecosystems to provide ecosystem services, which I will call a functional analytical perspective. However, a critical perspective that engages with issues of power, equity and the distribution of ecosystem services, i.e. who benefit from ecosystems, has been less developed (Paper V, cf. Ribot and Peluso 2003). For example, while most urban dwellers would agree that living close to green areas can have many benefits (e.g. improved air quality and easy access to space for children to play) less attention in natural resource management literature has been on analyzing the mechanisms behind the uneven patterns of green areas in cities, and the distribution of services from ecosystems more generally.

Based on this, there has been three objectives of this thesis: Firstly, to extend the research agenda of natural resource management to include both the

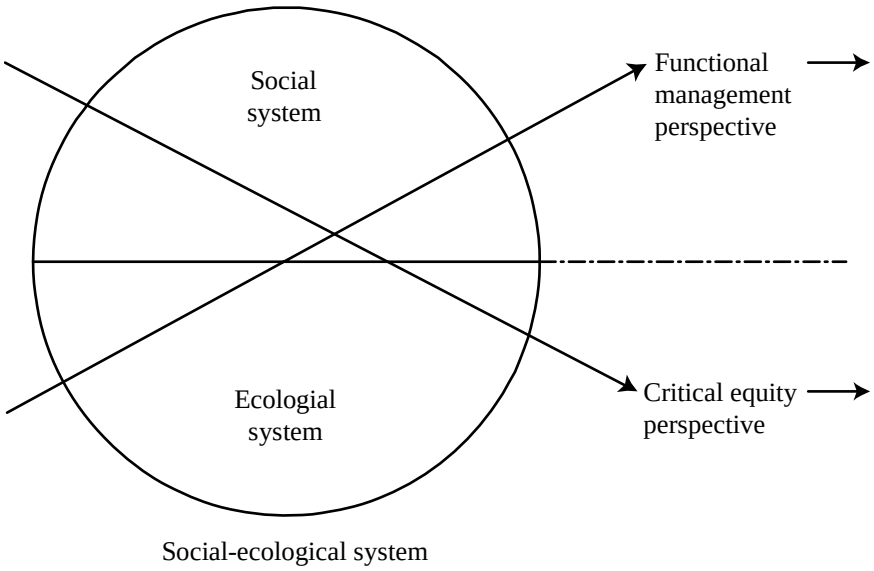
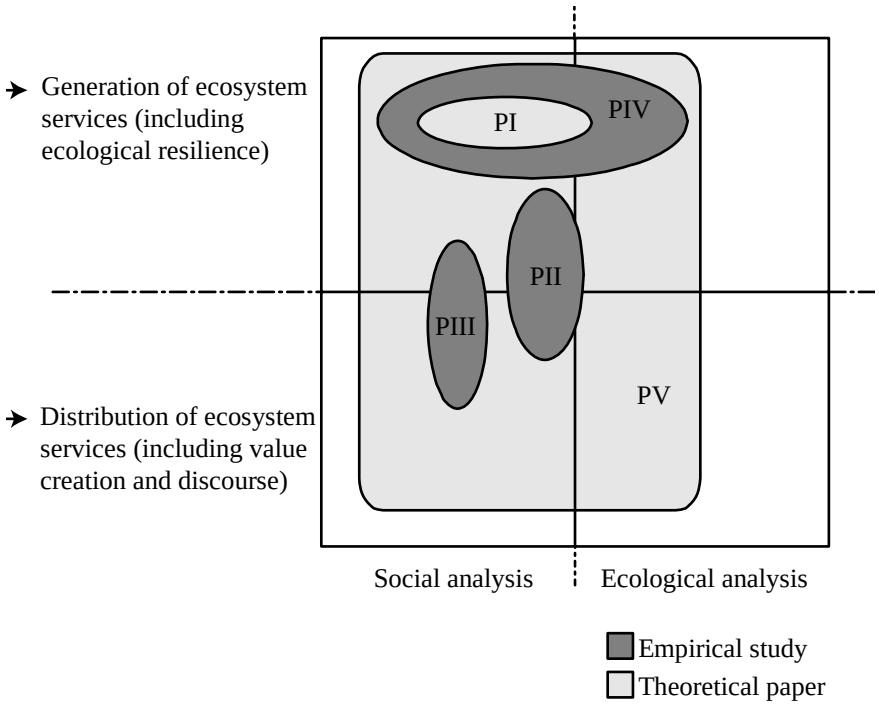



**Figure 1.** The left hand figure displays the overarching framework of the thesis. Two perspectives are used for analyzing complex social-ecological systems; a functional management perspective and a critical equity perspective. The former is needed to analyze the generation of ecosystem services, while the other the distribution of ecosystem services and how discoures and power influence management (right figure). In the right hand figure it is indicated roughly where the three empirical and two theoretical papers are located in the universe of the framework along the two axes of generation/distribution and social/ecological analysis.

generation and distribution of ecosystem services, as outcomes of human interactions with ecosystems. As an overarching assumption I have taken that social-ecological systems both *generate* and *distribute* ecosystem services and that two perspectives are needed to analyze them: a functional perspective seeking the structures and processes underpinning the generation of ecosystem services, but also a critical equity perspective that engages with the distribution of ecosystem services, as depicted in Figure 1. The latter also includes the mechanisms by which certain ecosystem services are prioritized before others, often translated as management prioritizations or in competing land use interests. The second objective has been to contribute to the studies of social-ecological transformations, or transitions towards ecosystem-based management (Olsson et al. 2004b, Olsson et al. 2008). Given Figure 1, this means to account for how such transitions alters both the generation and distribution of ecosystem services. A third objective of this thesis, based on case studies from an urban landscape, has been to contribute to urban theory and policy.




The first two objectives have been pursued by placing different analytical perspectives in focus in different papers (Figure 1). In Paper I and Paper IV the functional management perspective is in focus through studying the patterns of relationships between resource users and stakeholders, i.e. their social networks. Paper I is a theoretical paper, and the ideas pencilled out are taken considerably further in Paper IV when the structure of social networks are combined with empirically identified ecological scales from the management of urban green area ecosystems in Stockholm. Paper II and Paper III use a case study of a local urban movement that managed to protect a large green area in Stockholm. Paper II explores this through a social network analysis, while Paper III, inspired by actor-network theory, focuses on how the movement managed to construct holistic values and visions for the green area, a key factor in the transformational process. Building on these experiences, Paper V is an effort to articulate a framework for how we can understand and analyze the functional management and critical equity perspectives of especially urban social-ecological systems.

The thesis is part of a strong current to combine ecological theory with social theory (e.g. Berkes et al. 2003 and the journal *Ecology and Society*). An original intention with this thesis was to open contemporary discourse of resilience and natural resource management to fields more engaged with the issues of power, equity and service distribution. As in all interdisciplinary work, this comes with a risk. One great risk is to wander out too far in social theory and simplify the complexity of ecosystems, and another to simplify social theory in ways that make it irrelevant. The potential gains, however, lie in building interdisciplinary frameworks that can guide analysis of human-ecosystem interactions in which other fields of research can participate. In pursuit of this goal I have not been hesitant in drawing upon ideas from a diverse set of sources. From sociology I have used social network analysis (Wasserman and Faust 1994), social movement theory (della Porta and Diani 2006), and actor-network theory (Latour 2005), and from historical research, ideas pertaining to social articulation (Sörlin 1998). These have been combined with resilience theory and landscape ecology as used in natural resource management (Holling 1973, Nyström and Folke 2001, Gunderson and Holling 2002, Berkes et al. 2003). This has resulted in a theoretical web that opens the field of natural resource management to especially critical geography and urban political ecology (Harvey 1996, Swyngedouw 1997, Keil 2003, 2005, Walker 2005, Heynen et al. 2006). One can of course question this mixing of theory as an unacceptable eclecticism, but I find support in sociologist Anthony Giddens that once wrote that "[i]f ideas are important and illuminating, what matters much more than their origin is to be able to sharpen them so as to demonstrate their usefulness" (Giddens 1984: xxii). It is of course up to the reader to judge if I have been successful.

The aim of this pre-chapter, or *kappa*, is to lay the background of the thesis, point out underlying assumptions, summarize the included papers, and draw out wider implications for theory, policy and future research that the thesis has established.

## Urban landscapes and urban ecosystem services

Urban landscapes are extreme among social-ecological systems through the great impact human activities have on ecosystem processes (Collins et al. 2000, Grimm et al. 2000a, Grimm et al. 2008, Pickett et al. 2008). Being centres of economic and industrial activity, cities draw upon resources far away through trading routes, but they also impact on local and regional ecosystems affecting the living environment for a more and more urbanized human population (McGranahan et al. 2005). Currently half of Earth's 6.6 billion humans live in urban areas, while by 2030 another 2 billion are expected, with the highest increase in developing countries (UN 2005). It is therefore of crucial concern to address what constitutes the living environment of these human habitats in which local and regional ecosystems, to-

***Box 1.*** *Four categories of ecosystem services*

In the United Nation's Millennium Ecosystem Assessment (MA 2005: vi) ecosystem services were described as consisting of four main categories:

- *Provisioning services* (products obtained from ecosystems like food and fibre);
- *Regulating services* (benefits obtained from regulation of ecosystem processes like air- and water filtration);
- *Cultural services* (nonmaterial benefits obtained from ecosystems, like spiritual enrichment, cognitive development, recreation, and aesthetic experiences); and finally
- *Supporting services* (ecological functions such as pollination, nutrient cycling and soil formation) seen as necessary for the production of all other ecosystem services.

gether with the built environment of houses, plazas and public space, form important parts.

Three recent developments have been important for this thesis. First, the concept of ecosystem services, or "nature's services" as it was originally coined, defined as the goods and services derived from natural processes that benefit human well-being (Daily 1997a, Daily 1997b, Costanza and Farber 2002, Daily and Matson 2008). Ecosystem services now occupy a central position in policy and research on human-ecosystem interaction, and in the UN-initiated Millennium Ecosystem Assessment in 2005 (MA 2005) four main categories were suggested: provisioning, regulating, cultural, and supporting ecosystem services (Box 1). Second, since the 1990's and through a significant shift within the discipline of ecology (Kingsland 2005), urban nature has been 'discovered', both for its intriguing ecology, and as a policy arena to sustain its productive force to generate urban ecosystem services (Bolund and Hunhammar 1999, Grimm et al. 2000b, Pickett et al. 2001, Alberti 2005, Colding 2007, Pickett and Cadenasso 2008). Thirdly, the development of the theory of resilience, which started as an internal debate within ecology regarding how to interpret the stability of ecosystems (Holling 1973), to now encompass ideas of dynamic change of human-ecosystem interaction through social-ecological system analysis, including adaptive management and governance (Gunderson and Holling 2002, Folke et al. 2005).

By directing attention towards urban green and blue areas such as urban forests, parks, and watersheds, a wide range of services generated by urban ecosystems have been identified (Bolund and Hunhammar 1999, Jackson 2003, McGranahan et al. 2005, Jansson and Colding 2007). Some services

are primarily locally distributed, as when single trees, urban forests and green areas reduce noise and wind, while providing shade, clean the air from pollutants and improve general health (Bolund and Hunhammar 1999). Simultaneously, local green areas can lower the levels of human stress, and strengthen community life (Kuo et al. 1998) through providing space for informal meetings and recreational activities. Urban wetlands can mitigate local flooding events and retain nitrogen at a regional scale (Jansson and Colding 2007). On greater spatial and temporal scales, benefiting a larger but more abstract and even future population, vegetation covered land aid in draining rainwater and sustaining the ground water table (Bolund and Hunhammar 1999), while also absorbing $CO_2$ emissions (Jansson and Nohrstedt 2001). Urban green areas have also been shown to sustain pollination and seed dispersal processes and provide substitute habitat for endangered species (Sukopp and Weiler 1988), which underpin global biodiversity increasing the capacity to adapt to environmental and climatic changes (Folke et al. 1996). Furthermore, in a rapidly urbanizing world green areas within walking distance could prove crucial in enhancing broad-based support for sustainable development (cf. Miller 2005).

## To study urban social-ecological systems

In studying the dynamics of urban social-ecological systems there are at least three characteristics that make them different from non-urban systems. Most studies of social-ecological systems have been on systems with a direct linkage at a local scale between resource users and ecological dynamics, (see e.g. Berkes et al. 2003, Folke et al. 2005). Although such systems are influenced by greater scale linkages (for example through markets etc.), people in such systems depend directly on provisioning services from local ecosystems (e.g. crop or fish) which they either eat or sell. People might even be aware of how supporting services, like pollination and soil formation in the local ecosystem benefit their production and consumption (Berkes et al. 2003), or institutions, norms or taboos have evolved that seem to sustain those services (ibid.). Consequently, there are quite easily identifiable local feedback loops between social and ecological systems, which makes it more straightforward to talk about one (co-evolving) system (Berkes and Folke 1998), and to make these feedback loops the object of study to understand the system (Berkes et al. 2003). However, in urban systems this type of direct and local scale linkage is considerably weaker. Provisioning services are mainly imported through trade (which instead involves linkages at a regional and global scale abstracted through the market (Deutsch et al. 2000)), and the local scale linkages that exist are instead shaped by the desire of cultural services, and to some extent regulating services, as these address more urgent issues of urban life. The less tangible benefits of having space for recreation, improved air quality, an English park to contemplate or a garden to

tend – which are all distributed to urban citizens in the form of spatially constrained green space, parks, urban forests and lakes – are of value in an urban landscape. Although urban farming and allotment gardening could be important for some groups (especially in lower-income countries), citizens depend generally less directly on their local ecosystems. An assumption from this is that the choice of how to use green areas become more a matter of taste and culturally constructed values, which, as investigated in sociology, are often dominated by those with higher economic, cultural and social capital (Bourdieu 1984).

The second and third general characteristics of urban systems pertain to if green and blue areas will exist at all. The spatial pattern of urban landscapes are tightly linked to cities' centrality in contemporary modes of production of goods and services as explored in sociology and geography (Castells 1989, Harvey 1996, Sassen 2006). A variety of functions, from transport and sewage systems, to housing and offices need to find their space, along with urban parks and greenery, in order to produce urban services craved by citizens, industries and commerce, all in a competition of which land use can render highest profit on capital investment, being either private or public capital (Castells 1983, Harvey 1996, Swyngedouw 1997). As described by geographer David Harvey (1996, 2002), the space of the city is a potential space for profit. Consequently, two other interlinked characteristics of urban social-ecological systems, apart from the decoupling of direct need at the local scale, is first that the issue of how to use land becomes to a large extent a matter of human choice (often regulated through urban planning) in which the alternative uses for each patch of land are greater than in non-urban landscapes, which secondly produces an extreme heterogeneity of land use.

Based on these characteristics, an underlying assumption in this thesis is that when analyzing urban social-ecological systems one must engage more explicitly with the politics of the city, the creation of values around urban space and green areas, and how different actors strive to influence the institutions and decisions guiding land use and urban planning.

# Theoretical framework

## Ecosystem management in urban landscapes

My general approach to the functional management perspective of social-ecological systems (Figure 1) has been through social network structure and ecological scales. Here the urban context is challenging and it has been argued that given the extreme heterogeneity of urban landscapes, they have a higher tendency of scale mismatch, i.e. a temporal or spatial mismatch between the scale of ecological processes and the scale of social organization for management (Folke et al. 1998, Cumming et al. 2006).

Ecological scales are context sensitive and difficult to readily define in practice, but are generally viewed as hierarchically and dynamically linked (Gunderson and Holling 2002) where interactions between parts in ecosystems (plants, animals and chemical compounds) are nonlinear and local, and constrained by larger scales, but where local interactions could have emergent effects influencing other scales and the system as a whole (Pickett et al. 2008). One key to finding the relevant scales for management is to understand how different organisms perceive and interact with the landscape, especially those species forming part of functional groups that play complementary roles in facilitating ecological processes (Hostetler and Holling 2001, Farina and Belgrano 2006, Lundberg et al. 2008).

Although studies in urban ecology have embraced cities as social-ecological systems, they have mainly focused on exploring how the heterogeneity of land use patterns and dynamics affect ecosystem function (Alberti 2005, Cadenasso et al. 2006, Grimm et al. 2008, Pickett et al. 2008) with less focus on actual management. In this thesis, focus has been on actors that intentionally interact with urban ecosystems at different scales, from cemetery/park managers, allotment gardeners, and urban social movements at the local scale, to urban planners at greater scales. This approach acknowledges a wider importance of green areas. Besides being parts of green spatial patterns, they also constitute physical sites of social-ecological interaction that can nurture ecological knowledge and open for human agency in manipulating and improving ecological processes (cf. Miller 2005, cf. Berkes et al. 2003).

Green areas represent an opportunity in urban social-ecological systems to establish ecological feedbacks at the local scale, in spite that most activities depend less on these local ecosystems as explained above. This has been used in this thesis as a way to link my research to more general studies (or actually non-urban studies) of adaptive co-management and governance of ecosystems (Gunderson and Holling 2002, Berkes et al. 2003, Folke et al. 2005). This literature argues for a management paradigm based upon collaboration between various actor groups that are active at different scales and with different and often scale-specific knowledge and information about the ecosystem (Bandura 1977, Ashby 2003, Olsson et al. 2007). This is seen to facilitate social learning about ecosystem dynamics and help coordinate management actions so as to decrease scale mismatch. Successful collaboration in turn depends on several social factors such as trust, conflict resolution, and knowledge integration (e.g. Folke et al. 2005, Manring 2007). However, and crucially for this thesis, all these factors depend (in one way or another) on creating and sustaining social networks for information flows (ibid., Bodin et al. 2006a).

## Social network analysis

Just as ecological patches are part of greater scale patterns (Alberti 2005), social actors are part of emergent social network structures (Wasserman and Faust 1994). Social networks consist of actors interlinked through measurable and quantifiable relationships, e.g. friendship, exchange of information, family, co-worker etc. (ibid., Marsden 1990). A presumption is that all relationships in a social network come with an effort (or a cost) for establishing and then sustaining the relationship (Granovetter 1973, Degenne and Forsé 1999). This tends to direct information flows through established patterns of interaction (Diani 2003). "Network theory builds its explanations from [these] patterns of relations" (Burt 1986: 106) and could consequently be used to investigate social processes, including social learning and collective action in relation to natural resource management. Crucially, the patterns of interaction are an outcome of localized interactions, which means that no actor can fully control the emergent structure (Diani 2003). This opens for human agency to change at least parts of the network structure through interacting with new actors (ibid.). However, this also demonstrates the inertia of social network structure (and why we refer to it as 'structures')(Degenne and Forsé 1999).

The field of social network analysis has formalized the analysis of networks, translating actors and their relationships into graphs of nodes and links (Degenne and Forsé 1999). Through mathematical algorithms one can analyze how patterned relationships within a system can *facilitate* and *constrain* both the individual behaviour of actors, as well as system function and collective action (Wasserman and Faust 1994). This makes it possible to bridge the 'micro' scale of interacting individuals, and the 'macro' scale of groups and institutions (Emirbayer and Goodwin 1994).

This thesis used social network analysis to analyze the functional management and the critical equity perspective of social-ecological systems (Figure 1). From a functional approach networks were viewed as a means to link actors across ecological scales to increase ecosystem monitoring and social learning about ecosystem dynamics (Paper I, Paper IV). From a critical approach, the structural network position of actors was used to analyze how some actors can enhance the impact of their agenda, while others are constrained (Diani and McAdam 2003), be that in social movements (Paper II), or in collaborative management and governance (Paper I and Paper IV).

Many authors use the notion of social capital together with social networks, but since there exist various definitions and usages of social capital (Portes 1998), I have in my analyses quite consistently referred to the more unambiguous analytical categories of actors/nodes, ties/links and network positions to explain social mechanisms.

## Social movement theory

Analyzing transformational processes towards ecosystem-based management in urban landscapes needs to acknowledge urban politics and urban planning. This thesis engaged this notion by using social movement theory in analyzing a local urban movement that played a key role in protecting and changing the governance structure of a large green area in Stockholm (Paper II, Paper III).

Social movement research is a field that *par excellence* has studied transformational change (della Porta and Diani 2006). Within this field urban movements have been viewed as a social mechanism that can transform urban politics (Pruijt 2006 with reference to Castells 1972/1977). Tied together through informal social networks, civil-society organizations opposing dominating city-politics have played crucial roles before in pointing out injustices, lifting non-forgotten issues, and placing novel ones on the city-agenda (Ballard et al. 2006, della Porta and Diani 2006). Through engaging in what Manuel Castells (1983) referred to as struggles over collective consumption – which could be any urban service from access to medical care, schools, or green areas – "social movements […] have contributed to major shifts in the goals and values of societies" and through this shaped policy and public perception of reality (Melucci 1995, Boström 2004).

Three central aspects of social movements have been identified: the structure of opportunities, mobilization processes, and cultural framing processes (Ballard et al. 2006: 3). Structuralist and institutionalist discussions of political opportunity structures seek to understand the context within which mobilisation is more or less likely (Tarrow 1994, McAdam et al. 1996). Resource mobilization theory focuses on social movement organizations and the (often formal) resources such as money and labour that these aggregate to carry out strategies (McCarthy and Zald 1977, Diani 2003: 304). Mobilization processes have investigated how new members are attracted, often using social network analysis (della Porta and Diani 2006: 117). Cultural theory focuses on collective identity and framing processes (Eyerman and Jamison 1991, Melucci 1995) in which social movements are viewed as occupying "cultural roles" in society as they "interpret tensions in contemporary societies, demonstrate inequalities, and suggest alternatives to existing conditions" (Boström 2004 with references to (Eyerman and Jamison 1991, Melucci 1995). Through novel framing of reality they can be seen as knowledge producers while they "open up new conceptual spaces and in this way contribute to social change" (Boström 2004), while in parallel it helps them mobilizing new members (della Porta and Diani 2006:127).

Given the above, social movement theory served as a guide to analyze transformational processes, especially through an analysis of the movement's social network (Paper II) and how it framed the values of the National Urban Park (Paper III).

## Framing, value creation processes, and actor-networks

Framing processes were in this thesis analyzed through the practices by which movement actors created values around green areas. Historical research holds that in order for something to be seen as having a value, there needs to be actors that can explain that it has a value (Sörlin 1998). This is often carried out through the use of artefacts produced by other actors, for example artist's paintings or scientific reports. A scientific report of red-listed species can be an asset for environmentalists, but an obstacle for developers. With inspiration from actor-network theory (ANT; Callon and Latour 1981, Callon 1986, Castree and MacMillan 2001, Latour 2005) processes that "create value" can be seen as a *political programme* that gains power as actors "pick up" artefacts produced by other actors and fit them with the programme to give it "weight" (cf. Forsemalm 2007). This produces what can be referred to as actor-networks, viewed as assemblages of humans and non-humans that should not be seen as a structure of relationships (as in social network analysis), but rather as a set of transformations or associations (Latour 2005). Callon (1986) refers to a "sociology of translation", which I interpret as an urge to recognize in analysis that humans are dependent on non-humans to translate different meanings, ideas and values, and that these non-humans (e.g. a construction plan for a building) can come to change social processes "on its own".[1] Although such actor-networks do not possess power in any formal sense, they can (if successful) make a change, i.e. gain power, both as a "community of practice" wielding power and knowledge (Fox 2000, Wenger 1998, Foucault 1980), and through the framings, narratives and visions emanating from them which could mobilize yet more actors and artefacts into action (Callon 1986, Forsemalm 2007). In social movement theory, Snow and Benford (1988) have referred to this as "frame resonance", but without acknowledging the ANT-"twist" that artefacts, such as maps of species dispersal corridors, can become "immutable mobiles" (Latour 1987) as they are reproduced by journalists and other actors on various social arenas, to expand the actor-network and gain (if successful) more supporters.

[1] Also non-humans could consequently be regarded as actors, as they change things and "act". This has made scholars of ANT to use the word "actant" and "actant-network" instead to avoid the humanistic connotations of actor. However, in this thesis, actors are human actors. Although some scholars of ANT (including Bruno Latour himself) would disagree with my usage of actor, it relates better with social network analysis. Critics of ANT, see for example Vandenberghe (2002), would probably be sympathetic to my usage as it reinstates a more stratified view of social reality, than what is usually acknowledged in the "flat ontology" of ANT. As developed a bit further in the Discussion section, but at length elsewhere (Ernstson et al. forthcoming), I believe there is a chance to merge structural social network analysis with "ANT-inspired" thinking, i.e. to recognizes that also non-humans participate in creating what we often refer to as the 'social' (Latour 2005).

# Method and study area

## Stockholm and the National Urban Park

The Stockholm metropolitan area (Figure 2) is situated at the boundary between the northern hemisphere boreal zone and the mid-European nemoral zone, and at the outlet of the freshwater lake Mälaren into the brackish Baltic Sea. The physical landscape is to a large extent shaped by the last glacial period 10.000 years ago and consists of fissured bedrock and clay covered valleys. The resulting small scale rough terrain and the climatic conditions convey a relatively high biodiversity (CAB 2007). An isostatic rebound from the latest glacial period has constantly increased the land available for human use (Bratt 1998). As a consequence, most of the ecosystems in Stockholm are remnants from cultural usage and shaped by humans over the millennia. Ecosystem services generated today have emerged from this long-term cultural-ecological interaction (Barthel et al. 2005). Stockholm, founded as early as mid 1200s has a long history of more or less planned urbanization with early land use plans.

Stockholm is the capital of Sweden and the county hosts a current population of 1.9 million people, with 0.8 million in the most central areas (SCB 2007). It is the country's most densely populated region with 2500 inhabitants/km$^2$ (SCB 2002), and current green area management and planning is challenged by rapid population growth, estimated at approximately 20.000 new inhabitants per year (RTK 2001). The struggle over different land use and consequently the generation and distribution of urban ecosystem services will be a growing issue.

The National Urban Park is a 27 km$^2$ mixed woodland area close to the city centre of Stockholm (Figure 2). Barthel et al. (2005) showed that the area's high biodiversity and its capacity to generate ecosystem services is tightly linked to the long-term use of the park by various user groups such as allotment gardens and by royal management stretching back hundreds of years. The park is also an important node in the city's ecological network (Löfvenhaft 2002, Elmqvist et al. 2004, Mörtberg and Ihse 2006). However, the proximity to Sweden's political, administrative and business centre have resulted in a huge exploitation pressure from municipalities, state and building companies that has accelerated since the 1950's. Although voices for protection had been heard earlier, it was not until 1990, as a reaction to a new set of heavy exploitations plans, that the Ecopark movement emerged, originally forming part of a city-wide protest cycle opposing new motorways and other planned exploitation (Stahre 2004, Ernstson and Sörlin 2009, details in Ernstson 2007).

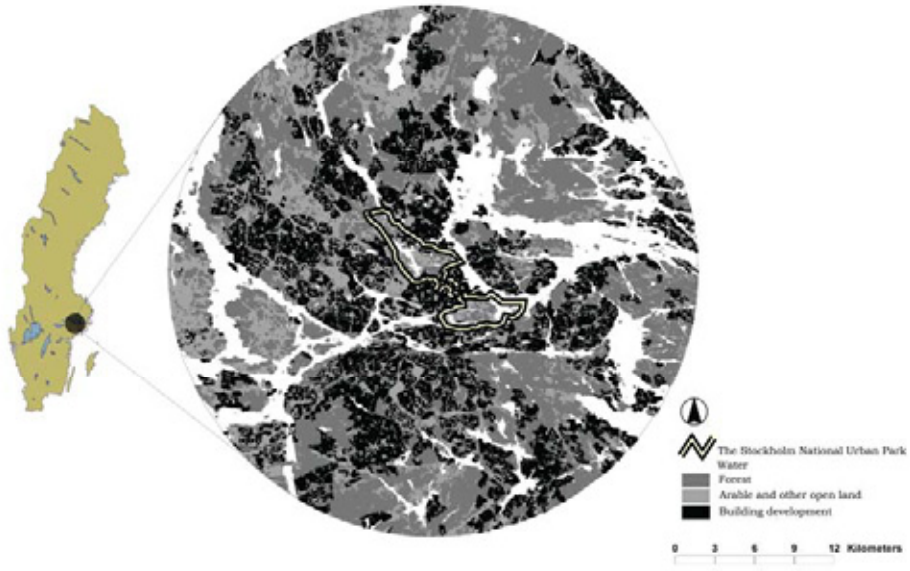



**Figure 2.** The map shows Stockholm metropolitan area lying in the south east part of Sweden (59º20'N, 18º05'E). Marked in the figure is also the Stockholm National Urban Park (Swedish: *Nationalstadsparken*), which is situtated close to the city center. It stretches mainly into Stockholm and Solna municipalities, with a small part into Lidingö.

## Case study approach

This thesis has used a case study approach (especially Paper II, Paper III and Paper IV). Instead of seeking cases in which some variables can be said to be constant and a single one varied, a case-study can have hundreds of variables (Yin 1994), and the task is to select a case study that can be considered "purposeful" for communicating and challenging already established theories (ibid.), and consequently not for generalizing to other cases. This type of research stress the dialectical relationship between theory and empirical data, and the iterative process of how interpretations emerge as the researcher moves back and forth between the field and the theories (Bryman 2002: 254).

The case of the National Urban Park is valuable for various reasons: A large-scale structural change occurred as the green area became protected,

which opens for discussing transformational processes in social-ecological systems. Furthermore, the movement has been heavily engaged in land use struggles and urban planning; and furthermore, the collective action rested upon informal social networks between a diverse set of civil-society organizations representing various interests, which opens towards discussing collaborative management more general, and in urban landscapes more specifically.

In total I worked with the case for three years (2003-2006), with various intensity. I made a concentrated pre-study to aid the design of the questionnaire for the social network study (Paper II), in formulating general research questions (cf. Bryman 2002: 252, Kvale 1997), and in writing the context and history of the Ecopark movement. The social network was generated through a questionnaire sent out to sixty official leaders of movement organisations. Through a recall list (Marsden 1990) respondents marked organisations they interacted with and their answers were combined into a social network consisting of those organizations perceived as active in the protection of the National Urban Park by at least two others. Among other attributes, the user intensity of the park was measured for each organization, along with the number of political contacts to authorities (further details in Paper II, Paper III).

Through working with the social network analysis, insights were gained into how movement members framed the park and articulated its values, which were presented in Paper III. Interview theme-sheets were prepared as described in Bryman (2001) with questions concerning the emergence of the movement, how activists had acted to protect the park, what resources they used, and the values they perceived the park had. Interviewees were selected based on a list of most-cited activists generated from the social network survey above, which had asked all respondents to name those persons they felt most engaged in protecting the park. This consequently made sure that the interviewees were considered important in protecting the park by the field itself, and thus supposedly heavily involved in the articulation process of its values. Interviews followed an un-structured fashion in which interviewees were allowed to develop their answers (Bryman 2002: 301). Most interviews were recorded and transcribed (see Paper III). I also visited highly profiled events organized by movement organizations or by authorities. These were visited since they represented important arenas for movement organizations and activists to articulate the values of the park (Paper II). With inspiration from actor-network-theory, I went back to some of the data and identified artefacts used by activists for articulating values. Although many field documents had been read before, it was with this insight that more documents were collected and analyzed in order to deepen the understanding on how artefacts were put into use to articulate values. Newspaper articles were searched in which activists had been interviewed, along with letters that had been sent to authorities. Also organizational homepages and books published

by movement organizations, activists, or by people standing close to the movement were analyzed, along with documents from authorities. Through these qualitative data, along with interview data, the interpretation of how values and which values were articulated could be iterated.

The network analysis, although being more linear since it relies heavily on a questionnaire that was sent out once, also had its iterative steps. Especially the construction of the attributes of political contacts and user intensity was developed after having gotten to "know" the data set better (cf. Bryman 2002).

Paper IV is based on a synthesis of seven individual case studies (including studies carried out by my colleagues), from the urban landscape of Stockholm and published in separate papers (see Paper IV). The individual studies focused on different aspects of ecosystem management in Stockholm and generated both social and ecological data in order to capture the dynamics of social-ecological processes. Ecological data focused on functional groups of ecosystems (especially pollinators, seed dispersers, and insectivores) and were generated through field surveys of birds and bumblebees, complemented with ecological landscape analysis based on land cover structure from satellite images. Social data were generated through engaging with different actors at different scales using different methodological tools such as text analyses, questionnaires and interviews. Actors included were regional and municipal agencies, cemetery and park managers employed by the public or private sector, and civil society groups such as allotment gardens, outdoor life associations, boating clubs and cultural-history and nature conservation groups.

In the Appendix of this thesis, complementary data not found in the individual papers are given for the case study of the Ecopark movement.

## Summary of Papers

### Paper I

Paper I was written to clarify how social network structure enters as a variable to effect various features such as learning, leadership, and trust, which have been identified as important in adaptive collaborative ecosystem management. While others have suggested that the ability to cope with change will increase through a dynamic balance between bridging/weak and bonding/strong links (i.e. links stretching outside the community are needed to access diverse resources and internal links are needed to absorb these benefits (Granovetter 1973, Newman and Dale 2005)), this paper focuses on the structure within the 'community' or collaborative network. Several network measures are presented and it is shown that there might be inherent

juxtapositions among these measures. A high degree centrality (the tendency in a network for a few actors to have many links, e.g. wheel-star structures) could facilitate coordination in times of rapid change, but could also in the longer-term undermine social learning because it reduces the access of individual actors to multiple sources of information (Leavitt 1951, Weimann 1982, Abrahamson and Rosenkopf 1997). High density (that most actors are directly linked to each other) might strengthen trust to reduce transaction cost for collaboration and promote mutual norms (and compliance) in relation to resource use and extraction (Granovetter 1985, Ostrom 1990, Pretty and Ward 2001). However, high density might also result in homogenization of experiences which undermines social learning and innovation (Oh et al. 2004, Crona and Bodin 2006). Furthermore, while studies based on ethnographic methods often result in the characterization of different 'social roles' in collaborative management (Folke et al. 2003), network analysis seeks to explain social roles based on network position (Borgatti and Foster 2003). One of the most important position is held by brokers that have many exclusive links to groups that would otherwise not be in contact (Burt 2003, 2005). Merely by its position in-between many others, the broker gains access to group-specific information and an advantage in knowing which groups or individuals to connect (or not to connect), how to connect them and when. As is pursued further in Paper II and Paper IV, this enhances the broker's ability to navigate a continuously changing social landscape and an increased ability to coordinate the actions of a network through finding new collaborative solutions for different and upcoming problems. The broker seems gifted with creativity, but also has a greater potential to influence the network, i.e. power.

## Paper II

This paper analyzed the social network structure of the Ecopark movement that was found to consist of 62 civil-society organizations – from user groups such as boating clubs and allotment gardens, to culture and nature conservation groups – that all were engaged, to larger or smaller extent in protecting the Stockholm National Urban Park. The results revealed a core-periphery structure where six core and semi-core organizations had deliberately built political connections to authorities, whereas the periphery gathered all user groups involved in day-to-day activities in the park. On one hand it was shown how the structure facilitated social mechanisms underpinning protective capacity. Core and semi-core organizations had, facilitated by the many links between each other developed a set of methods to influence large-scale land exploitation plans. However, since they also had weaker links to user groups that were active in the landscape, also smaller-scale exploitations could be monitored and acted upon. This demonstrates the importance of network diversity for adaptive response and protective

capacity (cf. Cash et al. 2006). However, it also shows that diversity in itself is not enough, but that it is the structure of social networks (especially the upholding of cross-scale linkages) that bring out purposeful collective action. On the other hand, the study showed that the same social network structure could have constrained collaborative ecosystem management. Especially user groups with valuable local ecological knowledge had not been included in collaborative arenas, which exemplifies the inherent double-nature of social networks as they can facilitate certain collective actions, while constraining other (Diani 2003, cf. Giddens 1984).

## Paper III

While Paper II is a study of an urban movement based upon resource mobilization and social network structure, Paper III analyzes framing processes as emergent actor-networks. The paper shows that activists, by interlacing artefacts and discourses from cultural history and conservation biology managed to link spatially separated green areas, while they simultaneously articulated the interrelatedness between the cultural and natural history of the area. This *connective practice* was effective in that it constructed holistic values of a unified park, a protective story, but also in that it stretched the identity of the movement to facilitate the mobilization of organizations active in different parts of the park. The framing, which rested on both existing and newly produced artefacts, heavily influenced the official framing of the park's values and actually came to define and create the National Urban Park as it was inscribed in the statute book. There was consequently, in this transformational process, a tight linkage between the spatial emergence of the social network structure and the framing process (Ernstson and Sörlin in prep., Miller 2000). The paper also argues that in contrast to historically top-down led designation of natural reserves, the involvement of civil society in protecting nature (and culture) is on the rise. This nonetheless begs the question concerning who can participate in these value creating processes, and if certain green areas have an advantage over others. Four structural factors seem to mould actor-networks constructing values for urban green areas: (i) the number and type *of artefacts* linked to an area; (ii) the capabilities and numbers of *actors* involved; (iii) their access to *social arenas*; and (iv) the *social network position* of actors.

## Paper IV

This article advances the theoretical insights from Paper I to present a framework that combines a structural social network perspective with that of ecological scales. Of concern is how knowledgeable actor groups that interact with green areas at different spatial scales in Stockholm can be linked through social networks so as to overcome scale mismatches between man-

agement processes and ecological dynamics. Based on the framework and empirical data, an alternative management system is suggested for Stockholm organized around three ecological scales (local green areas, city-green networks and the regional green infrastructure). New actors are proposed for the management of the unattended mid-scale, along with scale-crossing brokers. One contribution of this study lies in theorizing how a social network structure would look like that increases the sensitivity of city governance to ecosystem dynamics. A strategy based on purposeful networking to accomplish this is spelled out, along with the recommendation to acknowledge that green areas are not only ecological entities, or green space, but also important physical sites of social-ecological interaction that nurture the generation of ecological knowledge.

## Paper V

Building on the previous papers, Paper V explores the presumption that social-ecological systems both generate and distribute ecosystem services. The aim was to articulate, by setting social theory in communication with especially landscape ecology, a framework for analyzing both the functional and critical perspective of urban social-ecological systems. My first notion of the framework originated out of the case study of the National Urban Park. While the analysis of the Ecopark movement could explain the high protective capacity for this particular green area, I lacked a framework to analyze the effects of this protection on a larger landscape and city-wide scale. One hypothesis was that the movement, through developing new conceptual tools by which the values of green areas could be articulated, might have helped accomplished a paradigm shift in urban planning and increased the general value of green areas in relation to other land use interests. However, a parallel hypothesis was that other neighbourhoods were losing “their” green areas as a result of the strong protective capacity of the National Urban Park; exploitation pressure will seek out green areas for which a strong enough voice for resistance does not exist, or can not be created. Further, such an effect could relate to the city’s ecological resilience (Alberti and Marzluff 2004, Andersson 2006, Colding 2006, Colding et al. 2006), while if lost green areas are crucial in city-spanning ecological networks, the overall capacity in maintaining functioning ecosystems might decrease drastically (cf. Andersson and Bodin, accepted). The generation and distribution of urban ecosystem services seem to be linked in complex ways, and with this in mind I set out to write Paper V. The ideas that emerged are followed up in the discussion section below.

# Discussion

I had three overarching objectives with my thesis.

I Develop ideas and frameworks on how to analyze social-ecological systems from a functional management perspective and a social equity perspective.

II Contribute to the understanding of transformational processes towards ecosystem-based management.

III Contribute to urban theory and policy regarding the generation and distribution of urban ecosystem services.

These objectives will be discussed here to draw out some of the wider implications for research and policy that the thesis has established.

## Social network structure and natural resource management

Analyzing social network structures can give both a functional and critical perspective on natural resource management. Social networks are seen as a prerequisite for collaborative management (Carpenter et al. 2001, Olsson et al. 2004a). However, my case study of the Stockholm National Urban Park demonstrates that although a social network existed, connecting stakeholders, user groups and authorities, it was not obvious if and how this entailed an advantage. Instead the analysis pointed to the inherent double-nature of social networks and the importance of analyzing social network structure (Diani 2003).

The same structure that helped protect the park and sustain ecosystem functioning, could simultaneously have constrained collaborative ecosystem management (Paper II). User groups with ecological knowledge were marginalized on collaborative arenas partly due to their peripheral structural position in the movement's social network that constrained participation directly, but also in more subtle forms when the values of the park was articulated; user values was deemed less important than values held by more central organizations focusing on cultural-history and biodiversity conservation (Paper II).

The structure of social networks also relates to studies of adaptive capacity. In their review of research on adaptive governance, Folke et al. (2005) identified social memory – defined as the arena to capture experience of ecosystem change actualized through community debate and decision-making – as a source of resilience that "key persons" can use to guide and frame collective action in times of crisis and re-organization (cf. Barthel et al. in prep.). A more critical stance would wonder how this social memory gets constituted, who constructs it, and who uses it (Halbwachs 1952/1992). As was shown in Paper II and Paper III, core and semi-core actors in the

Ecopark movement – sometimes in alliance with authorities – have been central in decision-making and in constructing the identity of the park, which hinges more on conservation biology and cultural history, than on active use by allotment gardens and others. This indicates that social memory is contested and should be treated as an outcome of power relations. Consequently, if it is in time of crisis that social memory gets activated to frame activity, this turns the whole issue of adaptive capacity into a political issue where certain actors could shape the unfolding collective action possibly towards benefitting them more than others (Halbwachs 1952/1992, Melucci 1996, Boström 2004). From a functional perspective, the domination of some actors – state agencies and/or civil-society organizations – can come to work as a conservative force through locking certain landscapes into a certain identity that could hinder experimentation and decrease adaptive capacity (Gunderson and Holling 2002).

Studies of adaptive co-management and governance of ecosystems (Gunderson and Holling 2002, Berkes et al. 2003, Folke et al. 2005) have hitherto been less applied in urban landscapes. There is consequently less said about how to take into account the great heterogeneity and the spatial patterns of urban green areas, which to large extent conditions urban ecosystem functioning (Alberti 2005, but see Colding 2007). From Paper IV it was learnt that this requires a more spatially explicit analysis of management and governance systems than what current theory has proposed (e.g. polycentric structures, collaborative or adaptive governance, learning networks as in: Ostrom 1998, Folke et al. 2005, Manring 2007, Pahl-Wostl et al. 2007). Paper IV showed that by combining the analytical perspective of social network structure with empirical analyses of ecological scales, scale mismatches between ecological processes and the scales of management can better be analyzed as attention is directed towards actor groups in the landscape, how they are linked to each other, and if there are actor groups on all relevant ecological scales. Such analysis also helps to uncover strategies for how to build purposeful social networks for ecosystem management. One suggestion from Paper IV, which extends ideas regarding “bridging organizations” (Hahn et al. 2006, Olsson et al. 2007) and “net brokers” (Manring 2007), was the position of a scale-crossing broker, which could be filled by actors focusing on nurturing links between actor groups across ecological scales, either through meeting with them directly, initiating collaborative management arenas or meeting forums as “connection arenas” to generate weak links between actor groups. Such actors should operate as agents to sustain a conducive network structure to better handle slow, rapid and unexpected changes.

## Studying transformational processes

Building on my thesis, a model for transformational processes in social-ecological systems can be constructed that aims to merge value creation processes (based on actor-netorks) and social network analysis (Ernstson and Sörlin in prep., see also footnote 1). The idea draws upon framing and resource mobilization theory from social movement research, but greater attention towards ecological and social-ecological complexity needs to be maintained.

First, by using the approach of value creation and actor-networks, a deeper analysis of transition dynamics and collective action can be reached. Especially the analytical categories of leaders, key stewards, and visions, which are often used in explaining social dynamics, can be taken further (Folke et al. 2003, Olsson et al. 2004b, Olsson et al. 2008). Both actors *and* artefacts are important. It is the continuous assembling of humans and non-humans into actor-networks that give shape to values and visions, which in turn could change what has been refered to as stakeholder's "mental models" (Walker et al. 2002). As stressed in social movement theory (Boström 2004), informal networks are self-organized and collective action is not controlled by a single leader or key steward, but narratives that explain "the right course of action" emerges out of the interaction between humans and non-humans as Paper III showed. Through tracing the actors in their course of action (Latour, 2005), important social arenas can be encountered on which these values and narratives are articulated. As argued by Latour (2005), political programmes gain power as they are set in a constant state of "becoming" on various social arenas, for instance in a debate forum directing a large audience, in a newspaper, in a scientific meeting, an exhibition, or a lecture room. Guided by these remarks one could start asking: What is the nature of artefacts that seem to facilitate transitions towards ecosystem based management? Who produces these and who can use them? How do such actor-networks sustain narratives that can translate the complexity of ecosystems and foster preparedness towards unpredicted changes?

Second, and building on my findings from structural social network analyses, an emergent hypothesis is that actors with great network centrality have an increased potential to be active in assembling actor-networks (Paper III, Ernstson and Sörlin in prep.). Especially brokers that sit on network paths between many actors (Burt 2003, 2005) have a greater potential to navigate a continuously changing social landscape and coordinate the actions of a network. Reminiscent of Callon's (1986) "obligatory passage points", their network position could render them greater abilities to dominate processes of finding, picking-up and translating artefacts to assemble actor-networks that build certain visions and values (and not other)(see also (Fox 2000). This relates to research made around bridging organizations and net brokers (Hahn et al. 2006, Manring 2007, Olsson et al. 2007).

The above underlines one general finding from my studies: natural resource management is not just about knowledge, but also about values (Paper II, Paper III, Paper V). Both transformational processes and collaborative arenas should be analyzed not just for their ability to synthesize knowledge about ecosystems, but also as processes and arenas that construct values influencing land use and management prioritizations. Through this, two fallacies of contemporary thinking on natural resource management can be addressed: first an objectivist stance that ecosystem services exist "out there" in the landscape (independent of humans and social articulation); and secondly that the process of "finding the right trade off" between different ecosystem services is often simplified into a consensual process or as a rational choice game between actors with fixed interests that can be steered/guided by economic incentives (Folke et al. 2005, Ostrom 2005, Goldman et al. 2007). These fallacies are serious since the analyses that follow from them will miss the processual and relational dynamics captured in actor-networks and also the value formation as a social process involving social groups, knowledge, and power. Closely associated with this, models of adaptive management and governance of ecosystems can also be interrogated (Gunderson 1999, Folke et al. 2005). In these models, knowledge about specific ecosystems, as held by different actors and users, are predominantly seen as merely useful, or "functional", for building more complete understanding of ecosystem dynamics. This tends to neglect the situatedness of knowledge as a product of social class and cultural processes (Berger and Luckmann 1966, Bourdieu 1984, Shapin 1995: pp. 303). A richer understanding could be achieved through Foucault's conception of knowledge as indiscernible from power (expressed as 'power/knowledge'), along with his concern of 'concrete practice' (what actors *do*)(Law 1986). Both these can adequately be explored through an actor-network perspective to better (Foucault 1980, Fox 2000, Adger et al. 2005)) and open analytical pathways to better come to grips with how different stakeholders can bias management towards certain ecosystem services (instead of other) as I have tried to do (Ernstson et al. 2008, Ernstson and Sörlin 2009).

## Towards new urban theory

Social-ecological system analysis stresses that systems should be characterized by their feedbacks, i.e. their reinforcing mechanisms that tie the social and ecological system together in patterns of co-evolution (Berkes and Folke 1998, Gunderson and Holling 2002). From this horizon, and as established in the Introduction, urban systems are different from non-urban systems in that their direct dependence on tangible products from local ecosystems are weaker, that the range of choices of how to use land is greater (producing heterogeneity), and that the spatial patterns of localized urban ecosys-

tems (green and blue areas) are moderated through intense political land use struggles.

As the concept of ecosystem services is moved to the urban landscape, it becomes inscribed in intense political land use struggles. Green areas, vacant lots, and brown-fields, all can be turned to different land use, from housing, offices, motorways or through replantation to urban parks, which will affect the overall generation of ecosystem services (Alberti 2005, Colding 2007), as well as their distribution at different scales (Heynen 2003, Paper V). Ecosystem services is therefore tightly linked to capital investment, either through private or public capital, or through the "investment" by civil society in engaging time, effort and skills in managing and protecting urban green and blue areas. The above comprises the foundation upon which we can talk about a "social production of ecosystem services" as argued for in Paper V, since the human choices (and all the social, cultural, technical and political processes that impinge on these) will moderate both the generation and distribution of urban ecosystem services.

In Paper V, and building on the other papers, a framework for analyzing the social production of urban ecosystem services was proposed based on two interlinked modes of analysis: spatial social-ecological networks, and value-creation processes around ecosystem services. The first mode is based upon a spatial social-ecological network in which each node in the network – a green or blue area – have different levels of management or protective capacity, i.e. the level of resistance to disappear or ecologically degrade (through exploitation), and the level of capacity to sustain landscape ecological flows (through management practices), respectively. Ecological dynamics are accounted for through an ecological network approach where green areas are seen as connected through functional ecological links representing species movement or other vital ecological flows as developed by others (Bodin et al. 2006b, Bodin and Norberg 2007, Andersson and Bodin accepted, Zetterberg et al. in prep.). The second mode of analysis examines the decisions regarding trade-offs between ecosystem services as a value creation process. Different actors, with different and unequal abilities and resources, are seen as participating in creating values around different and sometimes opposing ecosystem services (cf. Wilson and Howarth 2002). By interlinking the second mode of analysis with the first mode, effects at the local scale (for instance that a green area gets built upon) can be translated to systemic effects at the city-wide scale. The changes in the social-ecological network, through the different levels of management and protective capacities, becomes a way to understand the effect of how socio-political processes moderate biophysical processes at different scales, which parallels how cities are conceptualized by critical geography and urban political ecology (Harvey 1996, Swyngedouw 1997, Heynen et al. 2006). Civil society groups, say an allotment garden or organizations resisting exploitation, enter as agents that could change the different levels of protective and management capacity, eit-

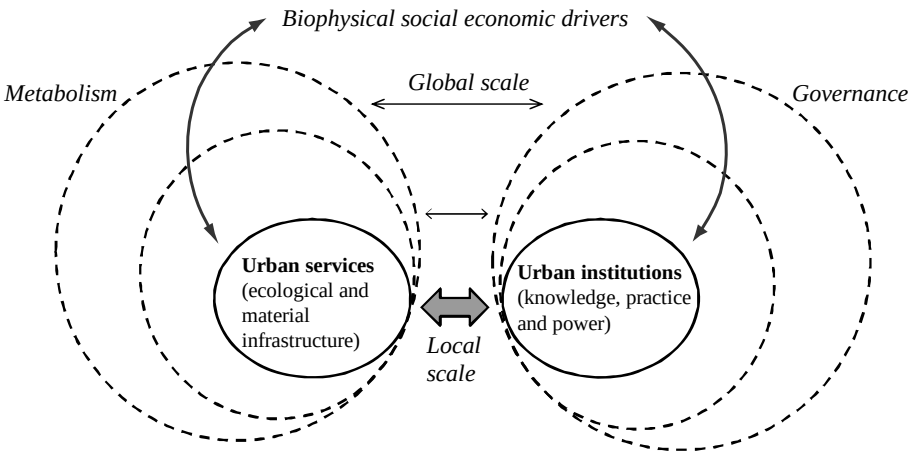



**Figure 3.** A suggestion for an overall framework for the study of urban systems. Local institutions and governance moderate global drivers to generate and (unevenly) distribute urban services, which includes transport services, electricity, medical care, broadband, and urban ecosystem services.

her directly through their own practices, or through interfering with urban planning processes (Paper II, Paper III, Paper IV).

When the critical dimension of social-ecological systems is stressed, current usage and definitions of resilience in natural resource management can be questioned and extended (Holling 1973, Berkes et al. 2003, Carpenter and Folke 2006). Resilience is though of, as described by Berkes et al. (2003: 13), as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity and feedbacks. This could be translated to the normative goal that resilience is the capacity to maintain the generation of ecosystem services. However, these definitions could implicate that resilience is maintained through a very unjust social system, i.e. in which the distribution of ecosystem services falls unevenly among the population. In regard, I extend the definition to offer a more critically formulated definition of resilience:

> Resilience is the capacity of a social-ecological system to sustain a certain set of ecosystem services, in face of uncertainty and change, for a certain set of humans.

Applying this definition to practical research begs the researcher to analyze not just how ecosystems are managed (as in most natural resource management literature), but also which ecosystem services that are prioritized (as in recent literature on trade offs (Daily and Matson 2008)) — but, and on top of that, who benefit from these services. This opens the social-ecological system and the concept of ecosystem services for political and critical analy-

sis, without loosing the analysis of how to manage and interact with complex ecosystems in uncertainty and change. This definition is useful for analyzing the question of "resilience for whom and for what" (Armitage and Johnson 2006 and references therein).

Finally, if urban ecosystem services are viewed as socially produced, an important and far-reaching possibility opens to integrate urban ecology in the wider field of urban theory and critical geography. As depicted in Figure 3, ecosystem services could be treated as part of a broader category of *urban services* that also includes services like transport, fresh water, electricity, broadband, medical care and education. All urban services require space in the city so the generation and (uneven) distribution of them can be linked to analyses of the institutions guiding land use and urban decision-making, including social movements and policy processes striving to effect these (Paper II, Paper III). With such a model of the urban landscape, political and normative goals for urban governance can be formulated as visions towards sustaining a good living environment for all citizens and increase the adaptive capacity of the city to sustain these services in face of change and uncertainty. This model of the city, could furthermore help to politicize urban ecosystem services as part of a whole bundle of urban services and help link diverse struggles for social justice (Castells 1983, Harvey 1996). This would probably also challenge – and hopefully renew – current collective identities within the environmental movement more based on habitat and biodiversity conservation.

# Conclusion

In this thesis I have analyzed social-ecological systems and what underpins the generation of ecosystem services, seen as the benefits humans derive from ecological processes, but also who in society that can benefit from them, i.e. the distribution of ecosystem services. My particular focus has been on urban landscapes with the empirical base from a case study of a local urban movement that protected a large green space in Stockholm. My writings aimed at opening the discourse of resilience and natural resource management towards social sciences, on one hand towards sociology to uncover important social mechanisms behind collective action for transformation and ecosystem management, and on the other, towards critical geography and urban political ecology to engage with issues of social equity and power.

Important challenges for future research have emerged from my work. One is to more explicitly engage with critical-equity perspectives and issues of power. One the one hand it is important to find models and frameworks that makes it possible to analyze and increase understanding of the dynamics of both the distribution and generation of ecosystem services (Paper V).

Here, the structure of social networks enters as an interesting approach (Paper I, II and IV): What types of structures exist in empirical settings? What is a good structure to facilitate ecosystem-based management? How do network structures change over time? One the other hand, and as similarly argued by Adger et al. (2005), it is important to analyze more critically the concept of adaptive capacity, social memory and knowledge in relation to ecosystem management (Paper II). If issues of power and social equity is left outside analysis, then, in times of crises (which seems to increase in a world of climatic and environmental change), patterns of injustice could come to be sustained or even strengthened as those with economic, social and cultural resources would impose their framing of what is the "best" course of action to re-organize and secure future resilience (Paper III, V). How do we make the discourses of resilience and ecosystem services more sensitive (and therefore also us researchers more observant) to the voice of the now disempowered and disadvantaged? Could these discourses even be made to work in their favour? Or should other discourses be employed instead?

Another set of future challenges emerge in relation to studies of transformational change in social-ecological systems, or transitions towards ecosystem-based management (Olsson et al. 2004b, Olsson et al. 2006, Olsson et al. 2008). Especially the analytical categories of leaders, key stewards, and visions can be understood better by also searching for the artefacts and social arenas that underpin this type of collective action (Paper III). Actor-network theory here presents a compelling framework which could be linked to social network analysis to also pose questions regarding who can participate in these processes and whose values are represented (Ernstson and Sörlin in prep.). This could enrich our understanding of these important transition processes.

When it comes to policy and urban planning, the most general implications that one could draw from this thesis is that in a world of rapid urbanization, urban green areas should be appreciated not only as ecological entities part of larger green structures that generate and distribute ecosystem services (Alberti 2005), but also as physical sites of social-ecological interaction (Paper IV and references therein). The latter acknowledges that green areas are sites that mutually nurture urban ecological knowledge (Paper IV) and collective action to articulate values of urban green areas (Paper II, Paper III). Following from this, and in order to secure the generation of ecosystem services, one is dependent not only on ecosystem knowledge held by different actors in the landscape, but also – and in order to cope with slow, rapid and uncertain change – on the structure of the social networks that link different actor groups across the landscape (Paper I, Paper IV). For policy this would mean to (i) devote attention to find suitable ecological scales for management, which in Stockholm were proposed to be local green areas, city-green networks, and the regional green infrastructure (ibid.); (ii) invest in identifying existing management capacities in the urban landscape (e.g. allotment

gardens and cemetery managers); and (iii) develop networking strategies to facilitate the emergence of scale-crossing brokers that can link between actor groups and facilitate social learning around urban ecological processes on which ecosystem management can be based. Such a management network would, in spite that cities are generally less directly dependent on their local ecosystems (see above), increase the sensitivity and responsiveness towards urban ecosystem dynamics and their inherent complexity (Paper IV).

In face of other land use interests, it will become increasingly important to argue for investments in urban ecosystems and protect urban green areas. This thesis has uncovered a connective practice of value creation of green areas built upon active citizens and useful artefacts such as historical maps and biodiversity dispersal corridors. New type of artefacts are probably needed, developed by state agencies and/or by social movements, to explain urban ecosystem services and where in the urban landscape they are generated and distributed.

The critical resilience definition above, combined with the framework for analyzing generation and distribution of ecosystem services at different scales, is designed to invite for systemic critique of current social order, while maintaining ecological sensitivity (Paper V). Hopefully it can also aid in working out material political practices towards democratizing urban change and increase social justice.

# Afterword *[In Rhizomia]*

For a long time I have been living with the word ”rhizomia” derived from ”rhizome”, which is the horizontally growing underground stem of a ginger, potato and other plants that sends out shoots and roots from its nodes. The connection points are where things happen; if you cut it in half, shoots and roots can still grow from remaining connection points; a quite resilient life-form. As a metaphor rhizome has been used in contemporary philosophy, especially by Gilles Deleueze and Félix Guatarri (1987). But, and in closer connection to my text, the word as also been used by Bruno Latour. In re-calling the development and use of actor-network theory (ANT), Latour (1999) refers to Mike Lynch that once said that “ANT should really be called ‘actant-rhizome ontology’” since it better describes what ANT does (and tries to do) both with me as a researcher and what I am researching. Latour explains:

> It was never a theory of what the social is made of [, or] one more school trying to explain the behaviour of social actors [… ;] it always was, and this from its inception (Callon and Latour 1981), a very crude method to learn from the actors without imposing on them an *a priori* definition of their world-building capacities.

I have not been faithful to ANT, but have “applied” traditional scientific concepts like “context” and “scales” over the worlds of the actors (both humans and non-humans) to explain – as best as I can to other researchers – the behaviour of social actors and social-ecological systems. But, I have been inspired by ANT and especially its motto to “follow the actor” and search for all the actors – the human and non-human *actants* – that are assembled to translate complex social-ecological processes into ideas, values and visions that can open up the minds of others to join in the translation process and change the world and its development. ANT expanded my awareness as a researcher, and as a citizen, to also strive to take in social actors (the activist, the scientist or somebody else), and their artefacts (maps, reports etc.) [which in turn are products from the interaction between social actors, plants, animals, measuring technology, or the brush of an artist] together with the social arenas on which these translations, ideas, values and visions can be expressed, articulated, ‘performed’ and kept alive. When I started to recognize this whole dynamic heterogeneous network (or *rhizome*) of humans and non-humans, my awareness of the world, and how it works had been changed. Bit for bit, I was, I might say, entering *rhizomia*.

# Sammanfattning på svenska

Det övergripande temat för denna doktorsavhandling är *generering* och *distribuering* av ekosystemtjänster, vilket har analyseras genom social nätverksanalys och social rörelseteori. Ekologiska processer skapar nytta för människor genom mat, rent vatten och förbättrad luftkvalitet. Dessa så kallade ekosystemtjänster beror på komplexa interaktioner mellan arter och materia. Studier inom naturresurshushållning har företrädesvis använt sig av ett funktionellt förvaltningsperspektiv för att undersöka hur människan bör interagera med ekosystem så att ekosystemtjänster kan upprätthållas trots förändringar och stora osäkerheter. Färre studier har utförts från ett kritiskt perspektiv där frågorna istället blir *vem* i samhället som drar nytta av dessa ekosystemtjänster, och *hur* makt- och rättviseaspekter påverkar en effektiv ekosystemförvaltning. Denna avhandling har arbetat utifrån föreställningen att båda perspektiv är nödvändiga för att fördjupa vår förståelse av länkade social-ekologiska system, speciellt för urbana landskap.

Huvuddelen av det empiriska materialet har genererats genom en fallstudie av en urban social rörelse som har skyddat Nationalstadsparken i Stockholm, som är ett stort och centralt beläget grönområde. I första artikeln (**Paper I**) framförs en rad teoretiska argument för varför man kan studera ekosystemförvaltning genom att analysera strukturen hos sociala nätverk, vilka definieras som de mönster av relationer som uppstår mellan aktörer länkade till ett visst resurs- eller ekosystem (t.ex. fiskare och myndigheter kring en kust eller sjö; jordbrukare, fågelskådare och friluftsföreningar kring en skog). I den andra artikeln (**Paper II**) görs en nätverksanalys av de 62 organisationer som deltar i den urbana sociala rörelsen vilket påvisar en stjärnformad struktur med en liten kärngrupp och många perifera organisationer. Denna struktur har visat sig främja effektiva skyddsmekanismer mot exploatering, men den verkar samtidigt ha begränsat ekosystemförvaltning baserad på samarbete mellan olika grupper. Användargrupper som spenderar mycket tid i parken, speciellt kolonilottsägare, har blivit marginaliserade på samförvaltnings- och beslutsarenor, och artikeln visar att detta kan härröras från deras perifera nätverksposition vilket ger dem mindre inflytande. I tredje artikeln (**Paper III**), och baserat på deltagande observationer och djupintervjuer med aktivister, spåras den praktik som aktivister använt sig av för att förklara och konstruera holistiska värden och visioner för parkområdet. Denna förmåga att ”skapa” värden var direkt avgörande för att parkområdet skulle skyddas som den första urbana nationalparken. Generellt kan sägas att artikuleringen av värden för specifika grönområden verkar villkorade, dels genom tillgången på användbara artefakter (t.ex. historiska kartor, kartor över biologisk mångfald), men också genom tillgången till sociala arenor där värden kan förklaras för en större publik så att fler supportrar kan vinnas. Artikel fyra (**Paper IV**) är baserad på även andra fallstudier från Stockholm (utförda av kollegor). Genom att kombinera ett strukturellt nätverksperspek-

tiv med empiriskt belagda ekologiska skalor (t.ex. det område över vilken en humla rör sig), föreslås en nätverksstrategi för hur förvaltningen av Stockholms ekosystem kan förbättras. Bland annat diskuteras en så kallad *scale-crossing broker*, en skalöverskridande medlare som ska föra samman aktörsgrupper från olika skalor (t.ex. kolonilottsföreningar, park- och kyrkogårdsskötare på en lokal skala, med stadsplanerare på en högre). Den skalöverskridande medlaren kan liknas vid en nätverksagent som strävar efter att upprätthålla ett socialt nätverk som underlättar för socialt lärande och ökar förvaltningens anpassningsförmåga till överraskningar och ständiga förändringar i ekosystem och det urbana landskapet. Baserat på erfarenheterna från de andra artiklarna, presenterar artikel fem (**Paper V**) ett ramverk för hur man rumsligt kan analysera genereringen och distribueringen av ekosystemtjänster i urbana landskap.

Denna avhandling argumenterar för en kompletterande syn på grönområden. De är inte bara komponenter i ett större ekologiskt nätverk som kan generera ekosystemtjänster, inte heller enbart ett socialt eller offentligt rum i staden. Utöver detta måste de också ses som fysiska platser för social-ekologisk interaktion som kan skapa och upprätthålla lokal ekologisk kunskap och arenor för värdeskapande processer kring urban natur. Dessutom utgör de platser för att manipulera och förbättra ekologiska processer i det urbana landskapet. Avhandlingen menar också att eftersom människan och samhället i så stor utsträckning villkorar både genereringen och distributionen av urbana ekosystemtjänster (genom urban planering, daglig skötsel etc.) så pekar avhandlingen mot en begreppsmässig förståelse av en ”social produktion av ekosystemtjänster”. Detta formuleras också som ett argument mot att fördjupa utbytet med urbanpolitisk ekologi och kritisk geografi, vilket påbörjats i denna avhandling.

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# References


Abrahamson, E., and L. Rosenkopf. 1997. Social network effects on the extent of innovation diffusion: A computer simulation. Organization Science **8**:289-309.

Adger, N. W., K. Brown, and E. L. Tompkins. 2005. The political economy of cross-scale networks in resource co-management. Ecology and Society **10**:9.

Alberti, M. 2005. The effects of urban patterns on ecosystem function. International regional science review **28**:168-192.

Alberti, M., and J. M. Marzluff. 2004. Ecological resilience in urban ecosystems: Linking urban patterns to human and ecological functions. Urban Ecosystems **7**:241-265.

Andersson, E. 2006. Urban landscapes and sustainable cities. Ecology and Society **11**:34.

Andersson, E., and Ö. Bodin. accepted. Testing network based models of habitat fragmentation in complex landscapes - implications for management. Ecography.

Ashby, J. 2003. Introduction: Uniting science and participation in the process of innovation: Research for development. Pages 1-19 *in* B. Pound, S. Snapp, C. McDougall, and A. Braun, editors. Managing Natural resources for sustainable livelihoods: Uniting Science and Participation. Earthscan Publications Ltd, London.

Ballard, R., A. Habib, and I. Valodia, editors. 2006. Voices of Protest: Social Movements in Post-Apartheid South-Africa. University of KwaZulu-Natal Press, Pietermaritzburg.

Bandura, A. 1977. Social Learning Theory. Prentice Hall, Englewood Cliffs, NJ.

Barthel, S., J. Colding, T. Elmqvist, and C. Folke. 2005. History and Local Management of a Biodiversity-rich, Urban, Cultural Landscape. Ecology and Society **10**:10..

Barthel, S., J. Colding, and C. Folke. in prep. Social-ecological memory for management of ecosystem servcies. Human Ecology.

Berger, P., and T. Luckmann. 1966. The Social Construction of Reality - A Treatise in the Sociology of Knowledge. Penguin Books, London.

Berkes, F., and C. Folke, editors. 1998. Linking Social and Ecological Systems. Cambridge University Press, Cambridge.

Berkes, F., C. Folke, and J. Colding, editors. 2003. Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press, Cambridge.

Bodin, Ö., B. Crona, and H. Ernstson. 2006a. Social networks in natural resource management: What is there to learn from a structural perspective? Ecology and Society **11**:r2.

Bodin, Ö., and J. Norberg. 2007. A network approach for analyzing spatially structured populations in fragmented landscape. Landscape Ecology **22**:31-44.

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

Bolund, P., and S. Hunhammar. 1999. Ecosystem services in urban areas. Ecological Economics **29**:293-301.

Borgatti, S. P., and P. C. Foster. 2003. The Network Paradigm in Organizational Reserach: A Review and Typology. Journal of Management **29**:991-1013.

Boström, M. 2004. Cognitive Practices and Collective Indenties within a Heterogenous Social Movement: the Swedish environmental movement. Social Movement Studies **3**:73-88.

Bourdieu, P. 1984. Distinction: A Social Critique of the Judgement of Taste. Harvard University Press, Cambridge.
Bratt, P. 1998. Forntid i ny dager. Arkeologi i Stockholmstrakten. (Prehistoric age in new guise. Archeology around Stockholm). Raster förlag, Stockholm.
Bryman, A. 2001. Social Research Methods. Oxford University Press, Oxford.
Bryman, A. 2002. Samhällsvetenskapliga metoder (Social Research Methods, 2001, Oxford University Press, Oxford; translated to Swedish by B Nilsson). Liber AB, Malmö.
Burt, R. S. 2003. The Social Capital of Structural Holes. Pages 148-189 *in* M. F. Guillen, R. Collins, P. England, and M. Meyer, editors. The New Economic Sociology: Developments in an Emerging Field. Russell Sage Foundation, New York.
Burt, R. S. 2005. Brokerage and Closure: An Introduction to Social Capital. Oxford University Press, Oxford.
CAB. 2007. Länsstyrelesen i Stockholm län. (The Stockholm County Adminstrative Board's webpage) URL: http://www.ab.lst.se, 2007-04-20, 14:30.
Cadenasso, M., S. Pickett, and J. Grove. 2006. Dimensions of ecosystem complexity: Heterogeneity, connectivity, and history. Ecological Complexity **3**:1-12.
Callon, M. 1986. Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. Pages 196-223 *in* J. Law, editor. Power, action and belief: a new sociology of knowledge. Routledge, London.
Callon, M., and B. Latour. 1981. Unscrewing the Big Leviathan: how actors macrostructure reality and how sociologists help them to do so. *in* K. Knorr Cetina and A. Cicourel, editors. Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro-Sociologies. Routledge & Kegan Paul, London.
Carpenter, S., B. Walker, J. M. Anderies, and N. Abel. 2001. From Metaphor to Measurement: Resilience of What to What? Ecosystems **4**:765-781.
Carpenter, S. R., and C. Folke. 2006. Ecology for transformation. Trends in Ecology & Evolution **21**:309-315.
Cash, D. W., N. W. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. Young. 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. Ecology and Society **11**:8.
Castells, M. 1972/1977. The Urban Question: A Marxist Approach. E. Arnold, London (First published 1972 in French, "La question urbaine", Maspero, Paris).
Castells, M. 1983. The City and the Grassroots. E. Arnold, London.
Castells, M. 1989. The Informational City. Blackwell, Oxford.
Castree, N., and T. MacMillan. 2001. Dissolving Dualisms: Actor-networks and the Reimagnitation of Nature. Pages 208-224 *in* N. Castree and B. Braun, editors. Social Nature: Theory, Practice, and Politics. Blackwell, Oxford.
Colding, J. 2006. 'Ecological land-use complementation' for building resilience in urban ecosystems. Landscape and Urban Planning.
Colding, J. 2007. 'Ecological land-use complementation' for building resilience in urban ecosystems. Landscape and Urban Planning **81**:46-55.
Colding, J., J. Lundberg, and C. Folke. 2006. Incorporating Green-area User Groups in Urban Ecosystem Management. Ambio **35**:237-244.
Collins, J. P., A. P. Kinzig, N. B. Grimm, W. F. Fagan, D. Hope, J. Wu, and E. T. Borer. 2000. A New Urban Ecology - Modeling human communities as integral parts of ecosystems poses special problems for the development and testing of ecological theory. American Scientist **88**:416-425.
Costanza, R., and S. Farber. 2002. Introduction to the special issue on the dynamics and value of ecosystem services: integrating economic and ecological perspectives. Ecological Economics **41**:367-373.

Crona, B., and Ö. Bodin. 2006. WHAT you know is WHO you know? Communication patterns among resource users as a prerequisite for co-management. Ecology and Society **11**:7.
Cumming, G. S., D. H. M. Cumming, and C. L. Redman. 2006. Scale mismatches in social-ecological systems: causes, consequences, and solutions. Ecology and Society **11**:14.
Daily, G. 1997a. What are ecosystem services? *in* G. Daily, editor. Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington D.C.
Daily, G. C., editor. 1997b. Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington D.C.
Daily, G. C., and P. A. Matson. 2008. Ecosystem services: From theory to implementation. PNAS **105**:9455-9456.
Degenne, A., and M. Forsé. 1999. Introducing Social Networks. Sage Publications, London.
Deleuze, G., and F. Guattari. 1987. A Thousand Plateaus: Capitalism and Schizophrenia. University of Minnesota Press, Minneapolis.
della Porta, D., and M. Diani. 2006. Social Movements: An Introduction. Blackwell Publishing, Oxford.
Deutsch, L., A. Jansson, M. Troell, P. Ronnback, C. Folke, and N. Kautsky. 2000. The 'ecological footprint': communicating human dependence on nature's work. Ecological Economics **32**:351-355.
Diani, M. 2003. Networks and Social Movements: A Reserach Programme. Pages 299-319 *in* M. Diani and D. McAdam, editors. Social Movements and Networks: Relational Approaches to Collective Action. Oxford University Press, Oxford.
Elmqvist, T., J. Colding, S. Barthel, S. Borgström, A. Duit, J. Lundberg, E. Andersson, K. Ahrné, H. Ernstson, C. Folke, and J. Bengtsson. 2004. The Dynamics of Social-Ecological Systems in Urban Landscapes: Stockholm and the National Urban Park, Sweden. Annual New York Academy of Science **1023**:308-322.
Emirbayer, M., and J. Goodwin. 1994. Network analysis, culture and the problem of agency. American Journal of Sociology **99**:1411-1454.
Ernstson, H. 2007. The Drama of Urban Greens and Regimes: Social Movements and Ecosystem Services in Stockholm National Urban Park. Licentiate in Philosophy Thesis. Stockholm University, Stockholm.
Ernstson, H., and S. Sörlin. 2009. Weaving protective stories: Connective practices to articulate holistic values in Stockholm National Urban Park. Environment and Planning A **in press**.
Ernstson, H., and S. Sörlin. in prep. A framework for studying transformative capacity in sustaining urban ecosystems linking social network structure and actor-network framings. Environment and Planning A.
Ernstson, H., S. Sörlin, and T. Elmqvist. 2008. Social Movements and Ecosystem Services - The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm. Ecology and Society **(in press)**.
Eyerman, R., and A. Jamison. 1991. Social Movements. A Cognitive Approach. Polity Press, Cambridge.
Farina, A., and A. Belgrano. 2006. The eco-field hypothesis: Toward a cognitive landscape. Landscape Ecology **21**:5-17.
Folke, C., J. Colding, and F. Berkes. 2003. Synthesis: Building Resilience and Adaptive Capacity in Social-Ecological Systems. Pages 352-387 *in* F. Berkes, C. Folke, and J. Colding, editors. Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive Governance of Social-Ecological Systems. Annu. Rev. Environ. Resour. **30**:441–473.

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

Folke, C., L. Pritchard, F. Berkes, J. Colding, and U. Svedin. 1998. The problem of fit between ecosystems and institutions. IHDP working papers. International Human Dimensions Programme on Global Environmental Change, Bonn.

Forsemalm, J. 2007. Bodies, Bricks and Black Boxes: Power Practices in City Conversion. PhD dissertation in European Ethnology. Gothenburg University, Gothenburg.

Foucault, M. 1980. Power/Knowledge: Selected Interviews and Other Writings 1972-1977. Harvester, Hempsted.

Fox, S. 2000. Communties of Practice, Foucault and Actor-Network Theory. Journal of Management Studies **37**:853-867.

Giddens, A. 1984. The Constitution of Society: Outline of the Theory of Structuration. Polity Press, Cambridge.

Goldman, R. A., B. H. Thompson, and G. C. Daily. 2007. Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. Ecological Economics **64**:333-343.

Granovetter, M. 1973. The Strength of Weak Ties. American Journal of Sociology **76**:1360-1380.

Granovetter, M. 1985. Economic action and social structure: The problem of embeddedness. American Journal of Sociology **91**:481-510.

Grimm, N. B., S. H. Faeth, N. E. Golubiewski, C. L. Redman, J. Wu, X. Bai, and J. M. Briggs. 2008. Global Change and the Ecology of Cities. Science **319**:756-760.

Grimm, N. B., J. M. Grove, S. T. A. Picket, and C. L. Redman. 2000a. Integrated approaches to long-term studies of urban ecological systems. Bioscience **50**:571-583.

Grimm, N. B., J. M. Grove, S. T. A. Pickett, and C. L. Redman. 2000b. Integrated approaches to long-term studies of urban ecological systems. Bioscience **50**:571-583.

Gunderson, L. H. 1999. Resilience, flexibility and adaptive management - Antidotes for spurious certitude? Conservation Ecology **3**:7.

Gunderson, L. H., and C. S. Holling, editors. 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Island Press, Washington D.C.

Hahn, T., P. Olsson, C. Folke, and K. Johansson. 2006. Trust-building, Knowledge Generation and Organizational Innovations: The Role of a Bridging Organization for Adaptive Comanagement of a Wetland Landscape around Kristianstad, Sweden. Human Ecology **34**:573-592.

Halbwachs, M. 1952/1992. On Collective Memory. University of Chicago Press, Chicago.

Harvey, D. 1996. Justice, Nature and the Geography of Difference. Blackwell, Oxford.

Harvey, D. 2002. Spaces of Capital: Towards a Critical Geography. Routledge, New York.

Heynen, N. C. 2003. The Scalar Production of Injustice within the Urban Forest. Antipode:980-998.

Heynen, N. C., M. Kaika, and E. Swyngedouw, editors. 2006. In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism. Routledge, Oxford.

Holling, C. S. 1973. Resilience and stability of ecological systems. Annual Review of Ecological Systems **4**:1-23.
Hostetler, M., and C. S. Holling. 2001. Detecting the scales at which birds respond to structures in urban landscapes. Urban Ecosystems **4**:25-54.
Jackson, L. E. 2003. The relationship of urban design to human health and condition. Landscape and Urban Planning **64**:191-200.
Jansson, Å., and J. Colding. 2007. Urban Development: The Case of Nitrogen Load from the Stockholm County to the Baltic Sea. Ambio **36**:650-656.
Jansson, Å., and P. Nohrstedt. 2001. Carbon sinks and human freshwater dependence in Stockholm County. Ecological Economics **39**:361-370.
Keil, R. 2003. Progress Report: Urban Political Ecology. Urban Geography **24**:723-738.
Keil, R. 2005. Progress Report: Urban Political Ecology. Urban Geography **26**:640-651.
Kingsland, S. E. 2005. The Evolution of American Ecology. The John's Hopkins University Press, Baltimore.
Kuo, F. E., W. C. Sullivan, R. Levine Coley, and L. Brunson. 1998. Fertile Ground for Community: Inner-City Neighborhood Common Spaces. American Journal of Community Psychology **26**:823-851.
Kvale, S. 1997. Den kvalitativa forskningsintervjun. Studentlitteratur, Lund.
Latour, B. 1987. Science In Action: How to Follow Scientists and Engineers Through Society. Harvard University Press, Cambridge.
Latour, B. 1999. On recalling ANT. *in* J. Law and J. Hassard, editors. Actor Network Theory and After. Blackwell Publishing.
Latour, B. 2005. Reassembling the Social: An Introduction to Actor-Network Theory. Oxford University Press, Oxford.
Law, J. 1986. Editor's introduction: power/knowledge and the dissolution of the sociology of knowledge. *in* J. Law, editor. Power, Action and Belief: A New Sociology of Knowledge. Routledge & Kegan Paul, London.
Leavitt, H. 1951. Some effects of certain communication patterns on group performance. Journal of Abnormal and Social Psychology **46**:38-50.
Levin, S. A. 1999. Fragile Dominion: Complexity and the Commons. Perseus Books, Reading.
Lundberg, J., E. Andersson, G. Cleary, and T. Elmqvist. 2008. Linkages beyond borders: targeting spatial processes in fragmented urban landscapes. Landscape Ecology **23**:717-726.
Löfvenhaft, K. 2002. Biologisk mångfald i urban miljö (Biological diversity in urban environments). *in* L. Holm and P. Schantz, editors. Nationalstadsparken - ett experiment i hållbar utveckling (The National Urban Park - An experiment in sustainable development). Formas, Stockholm.
MA. 2005. Millenium Ecosystem Assessment: Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.
Manring, S. L. 2007. Creating and maintaining interorganizational learning networks to achieve sustainable ecosystem management. Organization and Environment **20**:325-346.
Marsden, P. V. 1990. Network Data and Measurement. Annual Review of Sociology **16**:435-463.
McAdam, D., J. D. McCarthy, and M. N. Zald, editors. 1996. Comparative Perspectives on Social Movements. Political Opportunities, Mobilizing Structures, and Cultural Framings. Cambridge University Press, Cambridge.
McCarthy, J. D., and M. N. Zald. 1977. Resource mobilization and social movements: A partial theory. American Journal of Sociology **82**:1212-1241.

McGranahan, G., P. Marcotullio, X. Bai, D. Balk, T. Braga, I. Douglas, T. Elmqvist, W. Rees, D. Satterthwaite, J. Songsore, H. Zlotnick, J. Eades, E. Ezcurra, and A. Whyte. 2005. Urban systems. Pages 795-825 *in* Millennium ecosystem assessment: Conditions and trends assessment. Island Press, Washington, DC, USA.

Melucci, A. 1995. The process of collective identity. Pages 41-63 *in* H. Johnston and B. Klandermans, editors. Social Movements and Culture. University of Minnesota Press, Minneapolis.

Melucci, A. 1996. Challenging Codes. Collective Action in the Information Age. Cambridge University Press, Cambridge.

Miller, B. 2000. Geography and social movements. University of Minnesota Press, Minneapolis.

Miller, J. R. 2005. Biodiversity conservation and the extinction of experience. Trends in Ecology & Evolution **20**:430–434.

Mörtberg, U., and M. Ihse. 2006. Rapport 2006:13 - Landskapsekologisk analys av Nationalstadsparken (Landscape ecological analysis of the National Urban Park). Länsstyrelsen i Stockholms Län (The County Administrative Board of Stockholm), Stockholm.

Newman, L., and A. Dale. 2005. Network Structure, Diversity, and Proactive Resilience Builiding: a Response to Tompkins and Adger. Ecology and Society **10(1)**:r2.

Nyström, M., and C. Folke. 2001. Spatial Resilience of Coral Reefs. Ecosystems **4**:406-417.

Oh, H., M. H. Chung, and G. Labianca. 2004. Group social capital and group effectiveness: the role of informal socializing ties. Academy of Management Journal **47**:860-875.

Olsson, P., C. Folke, and F. Berkes. 2004a. Adaptive comanagement for building resilience in social-ecological systems. Environmental Management **34**:75–90.

Olsson, P., C. Folke, V. Galaz, T. Hahn, and L. Schultz. 2007. Enhancing the Fit through Adaptive Co-management: Creating and Maintaining Bridging Functions for Matching Scales in the Kristianstads Vattenrike Biosphere Reserve, Sweden. Ecology and Society **12**:28.

Olsson, P., C. Folke, and T. Hahn. 2004b. Social-Ecological Transformation for Ecosystem Management: the Development of Adaptive Co-management of a Wetland Landscape in Southern Sweden. Ecology and Society **9**:(4): 2.

Olsson, P., C. Folke, and T. P. Hughes. 2008. Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. PNAS **105**:9489-9494.

Olsson, P., L. H. Gunderson, S. R. Carpenter, P. Ryan, L. Lebel, C. Folke, and C. S. Holling. 2006. Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems. Ecology and Society **11**:18.

Ostrom, E. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press.

Ostrom, E. 1998. Scales, polycentricity, and incentives: designing complexity to govern complexity. Pages 149-167 *in* L. D. Guruswarmy and J. A. McNeely, editors. Protection of global diversity: converging strategies. Duke University Press, Durham, NC.

Ostrom, E. 2005. Understanding Insitutional Diversity. Princeton University Press.

Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tabara, and T. Taillieu. 2007. Social learning and water resources management. Ecology and Society **12**:5.

Pickett, S. T. A., and M. L. Cadenasso. 2008. Linking ecological and built components of urban mosaics: an open cycle of ecological design. Journal of Ecology **96**:8-12.

Pickett, S. T. A., M. L. Cadenasso, J. M. Grove, P. M. Groffman, L. E. Band, C. G. Boone, W. R. Burch, C. S. B. Grimmond, J. Hom, J. C. Jenkins, N. L. Law, C. H. Nilon, R. V. Pouyat, K. Szlavecz, P. S. Warren, and M. A. Wilson. 2008. Beyond urban legends: An emerging framework of urban ecology, as illustrated by the Baltimore Ecosystem Study. Bioscience **58**:139-150.

Pickett, S. T. A., M. L. Cadenasso, J. M. Grove, C. H. Nilon, R. V. Pouyat, W. C. Zipperer, and R. Costanza. 2001. Urban Ecological Systems: Linking Terrestrial Ecological, Physical, and Socioeconomic Components of Metropolitan Areas. Annual Review of Ecology and Systematics **32**:127-157.

Portes, A. 1998. Social Capital: Its Origins and Applications in Modern Sociology. Annual Review of Sociology **24**:1-24.

Pretty, J., and H. Ward. 2001. Social Capital and the Environment. World Development **29**:209-227.

Pruijt, H. 2006. Urban Movements. *in* G. Ritzer, editor. Blackwell Encyclopedia of Sociology. Blackwell, Malden.

RTK. 2001. Regional utvecklingsplan 2001 för Stockholms regionen (Regional development plan 2001 for the Stockholm region). Regionplane- och trafikkontoret (RTK; Office of Regional Planning and Urban Transportation), Stockholm.

Ribot, J. C., and N. L. Peluso. 2003. A Theory of Access. Rural Sociology **68**:153-181.

Sassen, S. 2006. Cities in a World Economy. Pine Forge Press, London.

SCB. 2007. Folkmängd i riket, län och kommuner 31/12/2007 (Population in the nation, county and municipalities). Statistiska Centralbyrån (Sweden statistics).

Shapin, S. 1995. Here and Everywhere: Sociology of Scientific Knowledge. Annual Review of Sociology **21**:289-321.

Snow, D., and R. Benford. 1988. Ideology, Frame Resonance, and Participation Mobilization. Pages 197-218 *in* B. Klandermans, H. Kriesi, and S. Tarrow, editors. From Structure to Action: Comparing Social Movement Reserach across Culture. JAI Press, Greenwhich, CT.

Stahre, U. 2004. Den gröna staden (The Green City). Atlas, Stockholm.

Sukopp, H., and S. Weiler. 1988. Biotope mapping and nature conservation strategies in urban areas of the Federal Republic of Germany. Landscape and Urban Planning **15**:39-58.

Swyngedouw, E. 1997. Power, nature, and the city. The conquest of water and the political ecology of urbanization in Guayaquil, Ecuador: 1880 - 1990. Environment and Planning A **29**:311-332.

Sörlin, S. 1998. Monument and Memory: Landscape Imagery and the Articulation of Territory. Worldviews: Environment, Culture, Religion **2**:269-279.

Tarrow, S., editor. 1994. Power in Movements: Social Movements, Collective Action and Politics. Cambridge Press, New York.

UN. 2005. World Urbanization Prospects: The 2005 Revision. United Nations Population Division, New York.

Vandenberghe, F. 2002. Reconstructing Humants: A Humanist Critique of Actant-Network Theory .2002; 19: 51-67. Theory Culture Society **2002**:51-67.

Walker, B., S. Carpenter, J. M. Anderies, N. Abel, G. Cumming, M. A. Janssen, L. Lebel, J. Norberg, G. Peterson, and R. Pritchard. 2002. Resilience Management in Social-ecological Systems: a Working Hypothesis for a Participatory Approach. Conservation Ecology **6**.

Walker, P. 2005. Political ecology: where is the ecology? Progress in Human Geography **29**:73-83.

Wasserman, S., and K. Faust. 1994. Social Network Analysis - Methods and applications. Cambride University Press, Cambridge.

Weimann, G. 1982. On the importance of marginality: One more step into the two-step flow of communication. American Sociological Review **47(6)**:764-773.

Wilson, M. A., and R. B. Howarth. 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. Ecological Economics **41**:431-443.

Vitousek, P. M., H. A. Mooney, J. Lubchenco, and J. M. Melillo. 1997. Human domination of the earth's ecosystems. Science **277**:494-499.

Yin, R. K. 1994. Case Study Reserach - Design and Methods. Sage Publications, Newbury Park.

Zetterberg, A., U. Mörtberg, and B. Balfors. in prep. Ecological Network Graphs: Linking Graph Theory to Spatially Explicit Maps in Ecological Assessments, Planning and Design.

PAPER I

Copyright © 2006 by the author(s). Published here under license by the Resilience Alliance.
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Response to Newman and Dale. 2005. "Network Structure, Diversity, and Proactive Resilience Building: a Response to Tompkins and Adger"

# Social Networks in Natural Resource Management: What Is There to Learn from a Structural Perspective?

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ABSTRACT. Social networks among actors and stakeholders are gaining attention in studies of natural resource management, particularly those of adaptive management based on different forms of participation and co-management. In this sense, social networks have primarily been envisioned as enabling different actors to collaborate and coordinate management efforts. Here, we continue the discussion initiated by Newman and Dale (2005), which highlighted the fact that not all social networks are created equal. We discuss the relation between some structural characteristics and functions of social networks with respect to natural resource management, thus focusing on structural implications that are often overlooked when studying social networks within the context of natural resource management. We present several network measures used to quantify structural characteristics of social networks and link them to a number of features such as learning, leadership, and trust, which are identified as important in natural resource management. We show schematically that there may be inherent juxtapositions among different structural characteristics that need to be balanced in what we envision as social network structures conducive to adaptive co-management of natural resources. We argue that it is essential to develop an understanding of the effects that different structural characteristics of social networks have on natural resource management.

Key Words: *adaptive management; co-management; natural resource management; social networks; structure*

## INTRODUCTION

Social networks are gaining attention in discussions of adaptive natural resource management based on different forms of participation and co-management (Holling 1978, Schneider et al. 2003, Anderies et al. 2004, Olsson et al. 2004, Ostrom 2005). This is a response to Tompkins and Adger (2004) and Newman and Dale (2005). Tompkins and Adger (2004) argued that social networks between stakeholders and actors can build community resilience and increase the adaptive capacity for environmental change. Newman and Dale (2005) extended this idea and noted that "not all social networks are created equal," and that a dynamic balance between bonding and bridging links is needed. Bridging links extend outside the community and provide access to a diverse set of resources, whereas bonding links within the community are necessary to absorb these benefits. Newan and Dale (2005) thus point out that social networks are more than just binary variables that either exist or do not exist. Here, we further unravel the social network variable to show its multidimensional nature when the structure of the social network is taken into account.

Thus, we address social networks as real observable phenomena that can be measured using quantitative techniques (Marsden 1990) and analyzed using social network analysis (Degenne and Forsé 1999, Scott 2000). The social networks primarily in focus are those that contain different stakeholders within a fairly well-defined management area and can be used to mobilize and maintain the co-management of common-pool resources.

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We begin by explicitly examining the relation between the structures and functions of social networks. We ask the question: How does the structure of a social network affect the ability to manage natural resources adaptively? We take our standpoint from a number of features identified in the literature as important for adaptive natural resource management and discuss how these are linked to network structure based on a review of social network literature. Secondly, we present some network measures that can be used to quantify network structure. Finally, we discuss how social roles and leadership in co-management can be understood based on their structural positions. Because most research on social roles in adaptive management lacks a structural perspective, we hereby hope to add to the understanding of these roles.

## ROLE OF SOCIAL NETWORK STRUCTURE FOR NATURAL RESOURCE MANAGEMENT

Research has identified a number of features that are seemingly important for the adaptive management of ecosystems. We have chosen six of these as examples to be discussed further: social memory, heterogeneity, redundancy, learning, adaptive capacity, and trust (Table 1). In Table 1, we describe how each of the features is linked to social network structure and provide examples of measures (Table 2) that can be used to assess how each feature is affected by the network structure. Neither the list of features nor the linked structural characteristics should be viewed as exhaustive. They serve merely to illustrate the interaction between function and network structure within the framework of resource management.

It is evident that a network structure that enhances one feature may simultaneously inhibit another; an example is centrality (Table 1). A high degree of centrality may in some respects be very good for facilitating the process of solving simple tasks because relevant information can be relayed and synthesized to a few actors who can make a decision and take action (Leavitt 1951). For the same reason, high centrality might also be good in times of change when effective coordination of actors and resources may be needed. On the other hand, social networks in which a few individuals have a high degree of centrality may lead to increasingly centralized decision making, which in turn may have negative effects on, for instance, learning because it reduces the access of individual actors to multiple sources of information (Weimann 1982, Abrahamson and Rosenkopf 1997).

Density is another network measure that may have different effects depending on the feature in focus. For example, high density may contribute to the strengthening of trust between individuals and groups and thereby also increase the possibility for social control (Granovetter 1985, Coleman 1990, Pretty and Ward 2001). This is important in two ways; first, it decreases the risk and cost of collaborating with others, which is an essential prerequisite for collective action and collaboration (Ostrom 1990, Cohen et al. 2001, Burt 2003). Second, it promotes the development of and compliance with mutual norms in relation to what is considered acceptable with respect to resource use and extraction (Coleman 1990). High density may also benefit the spread of information through increased accessibility to information (Weimann 1982, Abrahamson and Rosenkopf 1997). However, very high density of relations among actors can result in homogenization of experiences and knowledge (Oh et al. 2004, Bodin and Norberg 2005, Crona and Bodin 2006). This occurs, for example, through a high density of interaction among individuals that leads to a situation in which all individuals tend to adopt similar perceptions of issues at hand.

A final example of a relevant network measurement is betweenness (Freeman 1979). This is a measure that can be used to describe the degree of modularity in a network. Modularity is the tendency to form multiple groups; a network with high modularity consists of several internally dense groups that are either isolated or relatively loosely connected to each other, i.e., clusters or cliques. High modularity increases the ability of the different groups to develop partly distinct knowledge systems such as local ecological knowledge (see Ghimire et al. 2004, Crona and Bodin 2006) about the same ecological system, which in turn bestows the ability to perceive different changes in the ecosystem that may be conveyed to others. High modularity thereby opens the network to a potentially large number of feedback possibilities from the ecosystem to the management system, i.e., it enhances monitoring, provided that the groups of actors in the network are not completely isolated. Because of high density within separate groups of actors, a very high degree of modularity can, however, foster a mind-set of “us

**Table 1.** Features identified as important for the adaptive management of natural resources and the ways in which they are linked to social network structure.

| Feature | Link to social network structure |
|---|---|
| **Social memory** | |
| Collective memory/experiences to be used in times of change and uncertainty (e.g., McIntosh 2000, Folke et al. 2003). | Reachability: access to many individuals<br><br>Density: many links to others in the network. |
| **Heterogeneity** | |
| A diversity of many types of actors or actors with differing knowledge will broaden the collective knowledge base and increase the capacity for innovation and maintenance of different knowledge systems and frameworks for interpretation (Folke et al. 2005). | Betweenness/modularity: A certain degree of separation of groups in the network is needed to maintain heterogeneity.<br><br>Density: High density may have a negative effect on heterogeneity because it promotes homogeneity of experience and attitudes among actors and reduces the potential for innovation (e.g., Reagans and McEvily 2003, Oh et al. 2004). |
| **Redundancy** | |
| Provides buffering capacity in case of loss, i.e., if one or more actors are weakened or lost, others can fill the position and continue to perform the management function (Janssen et al. 2006). | Density: Many links makes the loss of single actors less disruptive, with a lesser effect on the average distance in the network.<br><br>Betweenness/modularity: A high degree of betweenness of single actors makes the network vulnerable to fragmentation should these actors disappear (Borgatti 2003). |
| **Learning** | |
| Knowledge about ecosystems can be continuously increased and improved, and thereby governance and management can be updated and adapted to changing conditions (Holling 1978). | Betweenness/modularity: Maintenance of strong links within a group to some extent requires high modularity (Granovetter 1973), and strong links are needed to transfer tacit knowledge (e.g., Reagans and McEvily 2003 and references therein) and complex knowledge, i.e., knowledge that involves interpretation of a number of nonlinear and noncausal variables.<br><br>Reachability: access to many actors from whom knowledge and information can be amassed or to whom it can be distributed (e.g., Oh et al. 2004).<br><br>Centrality: A high degree of centrality may give rise to centralized management and thereby fewer experiments and experiential learning (Leavitt 1951, Shaw 1981). |

(con'd)

| | |
|---|---|
| **Adaptive capacity** | |
| New knowledge and/or changing conditions require adaptive capacity and innovation to meet new needs (e.g., Gunderson 1999, Walker et al. 2004 for a discussion on adaptive capacity, resilience, reorganization, and novelty). | Reachability: Collective action requires multiple actors to collaborate, but too much decentralization may have negative effects on the potential for collective action (Steel and Weber 2001).<br><br>Centrality: Coordination ability, which is important in times of change and rapid response, increases with centrality (Leavitt 1951).<br><br>Density: Too many links to others may lock an actor into a political position because of, e.g., peer-pressure, thereby limiting his/her ability to innovate and act (e.g., Frank and Yasumoto 1998). |
| **Trust** | |
| Co-management is facilitated by trust among actors (e.g., Olsson 2003). | Density: Many links foster feelings of belonging and group identity (Coleman 1990).<br><br>Betweenness/modularity: A high degree of separation among groups can undermine the development of trust (Borgatti and Foster 2003). |

vs. them," which consequently contributes to locking actors in fixed political positions and limiting their common ability to act and seek consensus (Borgatti and Foster 2003). The network measurement of betweenness can also be used to identify individual actors occupying bridging positions, that is, contributing to the linking of otherwise isolated groups (Freeman 1979, Gould and Fernandez 1989).

## ROLES AND STRUCTURAL POSITIONS IN NATURAL RESOURCE MANAGEMENT

In addition to the abovementioned features, the importance of leadership and other social roles in adaptive natural resource management has been discussed (e.g., Folke et al. 2003). Many of these roles coincide with what Frances Westley describes as social entrepreneurship (F. R. Westley, *personal communication*; see also Westley and Vredenburg 1997). In social network theory, scholars have often sought to explain roles based on structural position (e.g., Scott 2000, Borgatti and Foster 2003). Here, we highlight the structural position that, in our view, seems to be one of the most important for social and institutional entrepreneurship: the broker.

Brokers are individual or organizational actors who carry many exclusive links, that is, links to groups that would otherwise not be in direct contact with each other (Burt 2003). In relation to Newman and Dale's (2005) discussion, we can view the broker as the actor who embodies the bridging links of the community. Consequently, and in relation to our discussion on different network measures, the broker acquires a high score of betweenness (Table 2) while also linking otherwise disconnected groups. Thus, a broker, merely by its structural position, gains access to many pieces of group-specific information captured inside the different groups, which allows the broker to synthesize a large knowledge pool. In addition, through its structural position, the broker learns about the inner life of many of the different groups and therefore achieves, through the position, an advantage in knowing which groups or individuals to connect and not to connect, how to connect them, and when (Burt 2003). In times of crisis, this is critical knowledge. Burt (2003) calls this capacity acquired by the broker adaptive implementation, i.e., the ability to navigate in a continuously changing social landscape and coordinate the actions of a network. The broker, which in a real setting could be an individual, a group of individuals, or an organization, can thus find new collaborative

**Table 2.** Examples of quantitative network measures and how they are related to different network characteristics.

| Characteristic | Measure |
|---|---|
| Density | Number of links divided by the number of nodes in the network. |
| Reachability | Diameter, i.e., the number of steps maximally needed to reach from one node to any other node in the network. |
| | Number of components. A component is an independent network within the larger network in which all nodes are directly or indirectly in contact with each other. If a network consists of more than one component, it is considered fragmented; the degree of fragmentation is quantified by measuring the number of components. |
| Betweenness | A measure that quantifies the degree of betweenness (Freeman 1979), i.e., how much each node contributes to minimizing the distance between nodes in the network (compare with reachability above). This measure can be applied to individual nodes, and can then be used to identify the actors that contribute most to linking the network. The measure can also be applied to the network as a whole to quantify the degree of modularity, i.e., separation into smaller groups or modules. |
| Centrality | The degree of centrality indicates how many links a node has (Freeman 1979). This measure can be applied to individual nodes or the whole network. A high degree of centrality for an individual node indicates that it has many links compared to other nodes. Centrality for the whole network indicates the tendency in the network for a few actors to have many links, e.g., a wheel-star structure. |

solutions for different situations at different points in time. It is also clear from this description that brokers are powerful actors in the sense that they can control the behavior of social groups and the information flow between groups in the network to a higher extent than can other actors. Burt (2003) further points out that brokers, with early access to critical information, often create new understandings and see new opportunities that other actors never recognize. The broker seems gifted with creativity and could be critical for the innovative and adaptive capacities of communities that Newman and Dale (2005) search for (see also Westley and Vredenburg 1997).

The broker is thus an important position and plays a critical social role in adaptive natural resource management. Other social roles important for such management have been identified (see, for example, Folke et al. 2003). Although a discussion of these roles lies outside the scope of this reply, we believe that an understanding of their importance can be further improved through discussions similar to the one presented here for brokers.

## CONCLUDING REMARKS

We have discussed the relation between social network structure and function in natural resource management. We have furthermore highlighted network measures used to quantify structures in social networks and linked these to features identified as important in enhancing adaptive management of ecosystems. As in Janssen et al. (2006), our discussion deals with structural characteristics of networks, but with a stronger focus on the interplay between social structures and actors. We have shown, if only schematically, that there may be inherent juxtapositions between different structural characteristics that need to be balanced in what we envision as social network structures conducive for co-management of natural resources. One beneficial structure for this appears to be a network containing separate groups with internal trust and with some degree of trust among them, linked together by motivated brokers who are interested in using their structural positions to initiate and maintain adaptive co-management. This structure could be seen as supporting the dynamic balance between bonding and bridging links

envisioned in the reply by Newman and Dale (2005), in which the broker embodies the critical bridging links. It also resembles the advantages of intermediate modularity as discussed by Webb and Levin (2005), who took a mainly ecological perspective. However, there are several issues we have not addressed. These issues relate to (1) problems of scale matching, i.e., how network structures match the different scales of ecosystem processes, both temporal and spatial; (2) temporal dynamics, i.e., how different structures can provide different benefits at given phases of the management process (compare with adaptive cycle phases as described by Gunderson and Holling 2002); (3) the role of leadership in organizational change (Danter et al. 2000); (4) the dynamics of structures, i.e., how and why network structures change and the effects on management; and (5) the social effects of structure on the distribution of power and influence. To increase our knowledge of the structures that serve adaptive natural resource management, we think that more emphasis should be placed on developing an understanding of the effect of different structures on co-management (compare Carlsson and Berkes 2005 and Crona and Bodin 2006). This line of research should be based on empirical studies of social networks in which we can use many of the methods and techniques already available and under constant development by a growing group of transdisciplinary-oriented researchers that has been partly assembled in the International Network of Social Network Analysis (see http://www.insna.org). In our current projects, we are generating empirical data on the networks of existing management structures, and we know that other researchers of natural resource management are using similar approaches. We look forward to the results of this ongoing effort and a continued discussion on the role played by social networks in the management of ecosystems.

*Responses to this article can be read online at:*
*http://www.ecologyandsociety.org/vol11/iss2/resp2/responses/*

**Acknowledgments:**

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## LITERATURE CITED

**Abrahamson, E., and L. Rosenkopf.** 1997. Social network effects on the extent of innovation diffusion: a computer simulation. *Organization Science* **8**(3):289-309.

**Anderies, J. M., M. A. Janssen, and E. Ostrom.** 2004. A framework to analyze the robustness of social–ecological systems from an institutional perspective. *Ecology and Society* **9**(1): 18. [online] URL: http://www.ecologyandsociety.org/vol9/iss1/art18/.

**Bodin, Ö., and J. Norberg.** 2005. Information network topologies for enhanced local adaptive management. *Environmental Management* **35** (2):175-193.

**Borgatti, S. P.** 2003. The key player problem. Pages 241-252 *in* R. Breiger, K. Carley, and P. Pattison, editors. *Dynamic social network modeling and analysis: workshop summary and papers.* National Academies Press, Washington, D.C., USA. [online] URL: http://darwin.nap.edu/books/0309089522/html/.

**Borgatti, S. P., and P. C. Foster.** 2003. The network paradigm in organizational research: a review and typology. *Journal of Management* **29**(6):991-1013.

**Burt, R.** 2003. The social capital of structural holes. Pages 148-189 *in* M. F. Guillen, R. Collins, P. England, and M. Meyer, editors. *The new economic sociology: developments in an emerging field.* Russell Sage Foundation, New York, New York, USA.

**Carlsson, L., and F. Berkes.** 2005. Co-management: concepts and methodological implications. *Journal of Environmental Management* **75**:65-76.

**Cohen, M. D., R. L. Riolo, and R. Axelrod.** 2001. The role of social structure in the maintenance of cooperative regimes. *Rationality and Society* **13** (1):5-32.

**Coleman, J. S.** 1990. *Foundations of social theory*. Harvard University Press, Cambridge, Massachusetts, USA.

**Crona, B. I., and Ö. Bodin.** 2006. WHAT you know is WHO you know? Communication patterns

among resource users as a prerequisite for co-management. *Ecology and Society* **11**(2):7. [online] URL: http://www.ecologyandsociety.org/vol11/iss2/art7/.

**Danter, K. J., D. L. Griest, G. W. Mullins, and E. Norland.** 2000. Organizational change as a component of ecosystem management. *Society and Natural Resources* **13**:537-547.

**Degenne, A., and M. Forsé.** 1999. *Introducing social networks.* Sage Publications, London, UK.

**Folke, C., J. Colding, and F. Berkes.** 2003. Synthesis: building resilience and adaptive capacity in social–ecological systems. Pages 352-387 *in* F. Berkes, J. Colding, and C. Folke, editors. *Navigating social–ecological systems: building resilience for complexity and change.* Cambridge University Press, Cambridge, UK.

**Folke, C., T. Hahn, P. Olsson, and J. Norberg.** 2005. Adaptive governance of social–ecological systems. *Annual Review of Environment and Resources* **30**:441-473.

**Frank, K. A., and J. Y. Yasumoto.** 1998. Linking action to social structure within a system: social capital within and between subgroups. *American Journal of Sociology* **104**(3):642-686.

**Freeman, L.** 1979. Centrality in social networks. Conceptual clarifications. *Social Networks* **1**:215-239.

**Ghimire, S. K., D. McKey, and Y. Aumeeruddy-Thomas.** 2004. Heterogeneity in ethnoecological knowledge and management of medicinal plants in the Himalayas of Nepal: implications for conservation. *Ecology and Society* **9**(3): 6. [online] URL: http://www.ecologyandsociety.org/vol9/iss3/art6/.

**Gould, R. V., and R. M. Fernandez.** 1989. Structures of mediation: a formal approach to brokerage in transactions networks. *Sociological Methodology* **19**:89-126.

**Granovetter, M.** 1973. The strength of weak ties. *American Journal of Sociology* **76**(6):1360-1380.

**Granovetter, M.** 1985. Economic action and social structure: the problem of embeddedness. *American Journal of Sociology* **91**:481-510.

**Gunderson, L. H.** 1999. Resilience, flexibility and adaptive management - - antidotes for spurious certitude? *Conservation Ecology* **3**(1): 7. [online] URL: http://www.consecol.org/vol3/iss1/art7/.

**Gunderson, L. H., and C. S. Holling.** 2002. *Panarchy: understanding transformations in human and natural systems.* Island Press, Washington D. C., USA.

**Holling, C. S.** 1978. *Adaptive environmental assessment and management.* John Wiley, New York, New York, USA.

**Janssen, M. A., Ö. Bodin, J. M. Anderies, T. Elmqvist, H. Ernstson, R. R. J. McAllister, P. Olsson, and P. Ryan.** 2006. A network perspective on the resilience of social–ecological systems. *Ecology and Society* **11**(1): 15. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art15/.

**Leavitt, H.** 1951. Some effects of certain communication patterns on group performance. *Journal of Abnormal and Social Psychology* **46**:38-50.

**Marsden, P. V.** 1990. Network data and measurement. *Annual Review of Sociology* **16**:435-463.

**McIntosh, R. J.** 2000. Social memory in Mande. Pages 141-180 *in* R. J. McIntosh, J. A. Tainter, and S. K. McIntosh, editors. *The way the wind blows: climate, history, and human action.* Columbia University Press, New York, New York, USA.

**Newman, L., and A. Dale.** 2005. Network structure, diversity, and proactive resilience building: a response to Tompkins and Adger. *Ecology and Society* **10**(1): r2. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/resp2/.

**Oh, H., M.-H. Chung, and G. Labianca.** 2004. Group social capital and group effectiveness: the role of informal socializing ties. *Academy of Management Journal* **47**(6):860-875.

**Olsson, P.** 2003. *Building capacity for resilience in social–ecological systems.* Dissertation. Stockholm University, Stockholm, Sweden.

**Olsson, P., C. Folke, and T. Hahn.** 2004. Social–ecological transformation for ecosystem management: the development of adaptive co-management of a

wetland landscape in southern Sweden. *Ecology and Society* **9**(4): 2. [online] URL: http://www.ecologyandsociety.org/vol9/iss4/art2/.

**Ostrom, E.** 1990. *Governing the commons: the evolution of institutions for collective action.* Cambridge University Press, Cambridge, UK.

**Ostrom, E.** 2005. *Understanding institutional diversity.* Princeton University Press, Princeton, New Jersey, USA.

**Pretty, J., and H. Ward.** 2001. Social capital and the environment. *World Development* **29**(2):209-227.

**Reagans, R., and B. McEvily.** 2003. Network structure and knowledge transfer: the effects of cohesion and range. *Administrative Science Quarterly* **48**(2):240-267.

**Schneider, M., J. Scholz, M. Lubell, D. Mindruta, and M. Edwardsen.** 2003. Building consensual institutions: networks and the National Estuary Program. *American Journal of Political Science* **47** (1):143-158.

**Scott, J.** 2000. *Social network analysis: a handbook.* Second edition. Sage Publications, Newberry Park, California, USA.

**Shaw, M. E.** 1981. *Group dynamics : the psychology of small group behavior.* Third edition. McGraw-Hill, New York, New York, USA.

**Steel, B. S., and E. Weber.** 2001. Ecosystem management, decentralization, and public opinion. *Global Environmental Change* **11**:119-131.

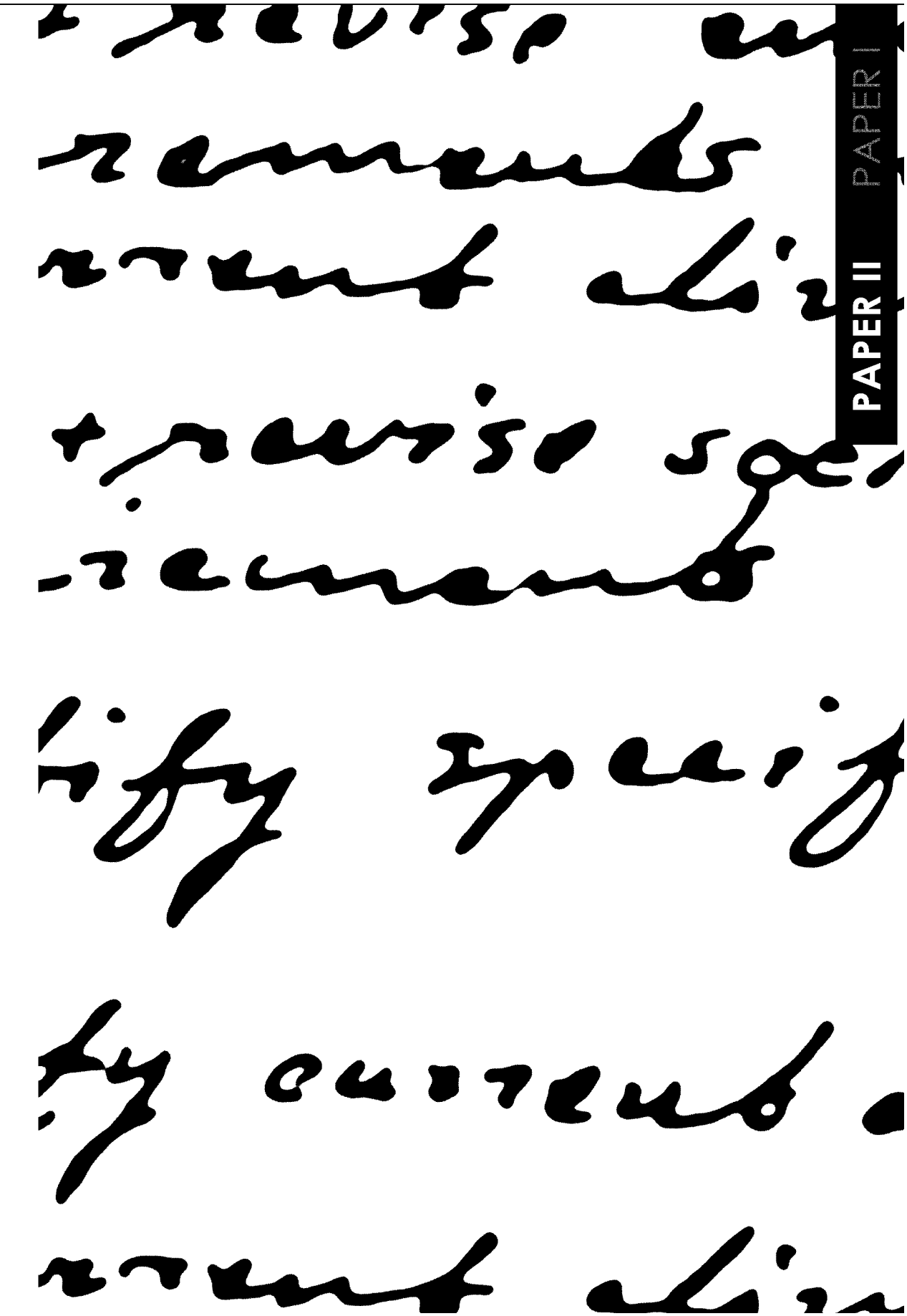
**Tompkins, E. L., and W. N. Adger.** 2004. Does adaptive management of natural resources enhance resilience to climatic change? *Ecology and Society* **9**(2): 10. [online] URL: http://www.ecologyandsociety.org/vol9/iss2/art10/.

**Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig.** 2004. Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society* **9**(2): 5. [online] URL: http://www.ecologyandsociety.org/vol9/iss2/art5/.

**Webb, C. T., and S. A. Levin.** 2005. Cross-system perspectives on the ecology and evolution of resilience. Pages 151-172 *in* E. Jen, editor. *Robust design: a repertoire of biological, ecological, and engineering case studies.* Oxford University Press, New York, New York, USA.

**Weimann, G.** 1982. On the importance of marginality: one more step into the two-step flow of communication. *American Sociological Review* **47**(6):764-773.

**Westley, F., and H. Vredenburg.** 1997. Interorganizational collaboration and the preservation of global biodiversity. *Organization Science* **8** (4):381-403.



PAPER II PAPER I

Ernstson, H., S. Sörlin and T. Elmqvist. 2008. Social Movements and Ecosystem Services – The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm. *Ecology and Society*, in press.

# Social Movements and Ecosystem Services – The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm

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ABSTRACT. Exploitation and degradation of urban green areas reduce their capacity to sustain ecosystem services. In protecting and managing these areas, research has increasingly focused on actors in civil society. Here we analyzed an urban movement of 62 civil-society organizations – from user groups such as boating clubs and allotment gardens, to culture and nature conservation groups – that has protected the Stockholm National Urban Park. We particularly focused on the social network structure of the movement, i.e. the patterns of interaction between movement organizations. The results reveal a core-periphery structure where core and semi-core organizations have deliberately built political connections to authorities, whereas the periphery gathers all user groups involved in day-to-day activities in the park. We show how the core-periphery structure has facilitated collective action to protect the park, but we also suggest that the same social network structure might simultaneously have constrained collaborative ecosystem management. Especially user groups with valuable local ecological knowledge have not been included in collaborative arenas. Our case points out the inherent double-nature of all social networks as they facilitate some collective actions, while constraining other. The paper argues for incorporating social network structure in theories and applications of adaptive governance and co-management.

Key words: *Urban ecosystem services; social network analysis; social movements; core-periphery structure; ecosystem management; adaptive governance*

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## INTRODUCTION

Urban ecosystems are increasingly regarded as critical in providing ecosystem services of value for human health and well-being (sensu Daily 1997, MA 2005) such as mitigation of air pollution, noise and heat, and provision of space for recreation and education (Bolund and Hunhammar 1999, McGranahan et al. 2005). Although it is accepted that fragmentation and isolation of green spaces leads to a loss of ecosystem services (e.g. Schwartz 1997, Young and Jarvis 2001, Stenhouse 2004), there is a need to better understand how social factors interact with urban landscapes and ecosystems to produce social-ecological dynamics (Grimm et al. 2000, Alberti and Marzluff 2004, Redman et al.

2004), especially (i) why certain green areas, in the contested space of the city, remain, and other perish, and (ii) why some green areas hold higher ecological qualities due to differences in management practices.

Most research on urban green areas has focused on the formal planning process and their protection and management (Drayton and Primack 1996, Chiesura 2004, Borgström et al. 2006, Sandström et al. 2006). Increasing attention, however, has turned towards how groups in civil society and their respective management practices influence the spatial arrangements and quality of urban ecosystems, including for instance private gardens, golf courses, and allotment gardens (Barthel et al. 2005, Colding 2006, Colding et al. 2006, Andersson et al. 2007). Our study reinforces that 'civic turn' and focuses on the Ecopark movement, an urban movement (cf. Castells 1983) that has protected the National Urban Park in Stockholm, Sweden. The movement, consisiting of some 60 civil society organizations with approximately 10 000 members, exemplifies that the protection of urban green areas rests upon an active and organized civil society rather than on legislative powers. Actually, and as we have previously shown (Ernstson and Sörlin 2009), it was the political actions of the movement that gave identity to the area and shaped the transformational change leading to its legal protection in 1995.

The movement, and similar forms of collective action, highlight crucial processes in civil society in both creating and providing protection of urban green areas (for other examples, see Diani 1995, Ansell 2003). As such we can see them as partaking in social-ecological processes through shaping the city's ecological infrastructure and its capacity to generate ecosystem services. Our study therefore focuses on how and why it has been possible for the movement to generate protective capacity for this green area and how this in turn has influenced its management. As we will show however, social mechanisms that underpin protection of urban greens, might not always be favourable for their management.

In this paper we employ social network theory (Wasserman and Faust 1994, Degenne and Forsé 1999) as it has been used in social movement theory (Diani 1992, 1995, Diani and McAdam 2003). These schools of thought and their methodologies can advance research on social-ecological systems, especially approaches that tries to understand the role of social networks and social capital in adaptive forms of governance and co-management (Berkes et al. 2003, Adger et al. 2005, Dale and Onyx 2005, Bodin et al. 2006, Armitage 2007). Central to our study is an empirical investigation of the social network structure of the movement, i.e. the sustained pattern of interactions between movement organizations, and a guiding thought is that such structures can simultaneously both facilitate and constrain collective action (Diani 2003a). Our paper offers insights as to how social networks may be studied and, more specifically, how such underlying structures facilitate or constrain collaborative ecosystem management and the protection of urban green areas. We also speculate on how they might influence the adaptive capacity of social-ecological systems (Folke et al. 2005).

Network analysis builds it explanations from patterns of relations between actors, and its greatest strenght lies in the ability of analyzing both the behavior of individual actors, and the behaviour of the whole network (Emirbayer and Goodwin 1994). The actors in our research were social movement organizations (SMOs), defined as organizations that recognize each other as part of the same movement (Diani 2003a). A presumption is that all relations of an SMO come with a cost, first for

establishing it and then to sustain it, which tends to direct information and resource flows following these patterns of established relations (Diani 2003b). In network language this is translated as links between nodes in a graph, and as a basis for our study we used four idealized network models shown in Fig. 1. Diani (2003a) explains that each model exhibits different characteristics. A *clique* movement requires all actors to invest a lot of time in networking with each other, thus drawing resources from interaction with outside actors, possibly leading to more closed communities with strong ideological/cultural affinities. The *wheel/star*, or *core-periphery* structure, exhibits the contrary, where most actors can invest little time in networking but still remain close to others through the core actor. *Policephalous* structures suggest efforts to engage in collective action without delegating important tasks to a few centrally positioned actors, and *segmented-decentralized* structures reject any leaders to coordinate action on broader overarching concerns.

In relation to the whole network and the broader discussion on solving collective action problems (Leavitt 1951, Weimann 1982, Abrahamson and Rosenkopf 1997, Burt 2003, Reagans and McEvily 2003, Bodin and Norberg 2005), a core-periphery movement seems better suited for simple and easily identifiable tasks since information can be gathered to a set of few actors that can coordinate and take action (Leavitt 1951). More segmented networks would better solve complex tasks (ibid.) while subgroups can generate independent knowledge for different parts and scales of the problem (Bodin et al. 2006). However, and in relation to the behaviour of individual actors, it is important to remember that social movements, and also more generally 'communities', should be seen as heterogeneous entities with internal power-struggles (Melucci 1996, Boström 2004). This means that the shape of the collective action that unfolds is more influenced by some actors than by others. In network analysis this can be accounted for by recognizing that different network positions either facilitate or constrain actors (Diani 2003a:303), which can be measured by their degree and betweeness centralities (Freeman 1979). Actors with high betweeness centrality, i.e. with a tendency of sitting on network paths between many others, have greater possibility to control the flow of resources. In Fig. 1 this is illustrated by actor A (and B) in the policephalous model. A high degree centrality (ibid.), the amount of in and out-going links, is crucial since it measures how involved an actor is in the network and thus how known the actor is to others. This could increase the potential to locate and gain resources from the network but also increase direct influence – for example in face-to-face meetings – and consequently the ability to shape actions and priorities (Diani 2003c). Actor a4 in the policephalous model of Fig. 1, has in this sense greater potential to influence the movement than b4. To determine if this potential of influence is also translated to real power in the network, we will in our study draw upon data from interviews and participatory observations.

Essential to our study are the user groups that participate in the movement. These are for instance allotment gardens, riding and boating clubs, scouts, ornithological associations, and sporting clubs, all with day-to-day activity in the park of various degrees. Although several studies point out their crucial role in collaborative ecosystem management, mainly through their potential possession of local ecological knowledge and attenuated abilities to monitor ecosystem change (Olsson and Folke 2001, Gadgil et al. 2003), few studies have accounted for how they are structurally embedded in social networks (but see Crona and Bodin 2006, Prell et al. forthcoming). This misses those important aspects of how and why user groups can participate or get excluded in deliberative processes, governance and collaborative management, which we will analyze here.

Based on a social network survey, complemented with qualitative data, we address the following questions:

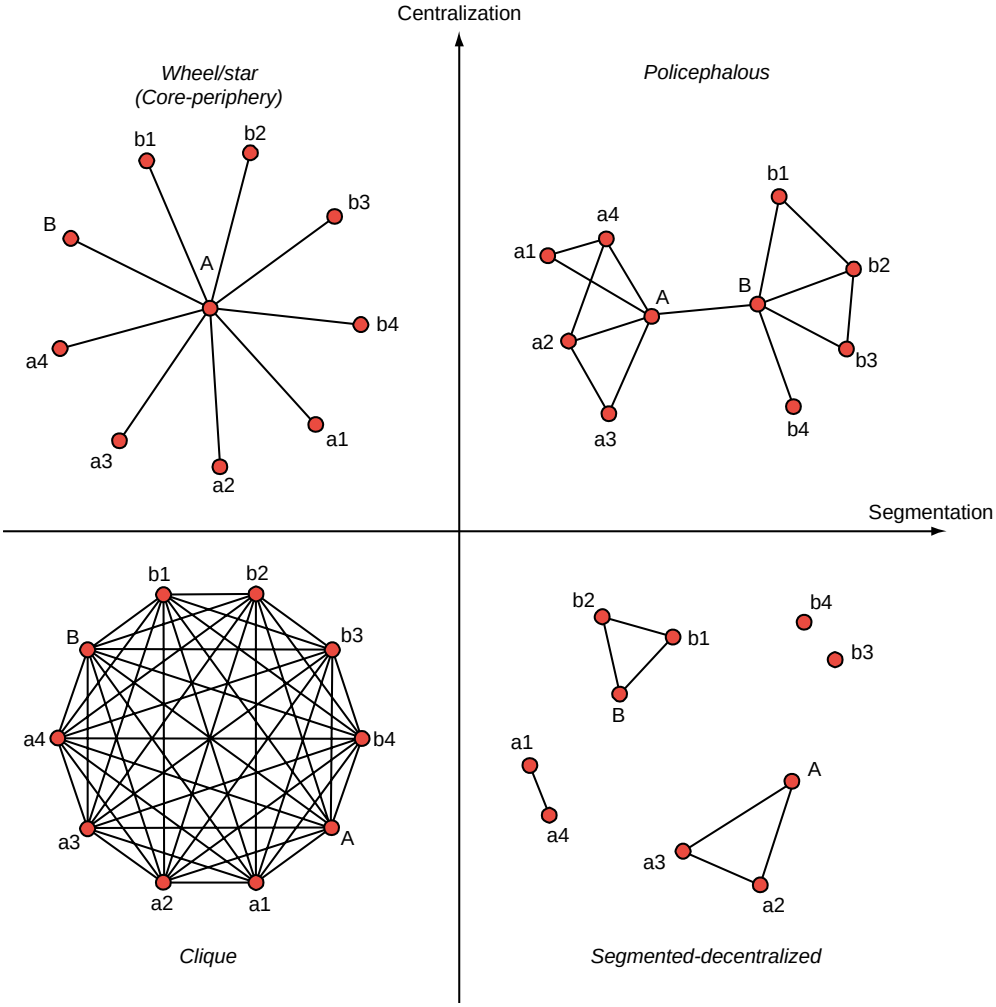
- What is the structure of the social network of the Ecopark movement and which of the typological network models from Fig. 1 provide best fit of our data?
- How does the structure affect the movement's ability to protect the park from exploitation?
- What accounts for the emergence of the observed social network structure? This is crucial in understanding the emergence of the area's protective capacity.
- Finally, how might the structure of the movement's network affect arenas for collaborative ecosystem management?

## BACKGROUND AND CONTEXT: TRANSFORMATIONAL CHANGE THROUGH A LOCAL URBAN MOVEMENT

The National Urban Park (NUP) is a 27 $km^2$ mixed woodland area close to the city center of Stockholm, Sweden (Fig. 2). Barthel et al. (2005) showed that the area's high biodiverstiy and its capacity to generate ecosystem services is tightly linked to the long-term use of the park by various user groups such as allotment gardens and by royal management stretching back hundreds of years. The park is also an important node in the city's ecological network (Löfvenhaft 2002, Elmqvist et al. 2004 and references therein). However, the proximity to Sweden's political, administrative and business center, results in a huge exploitation pressure from both municipalities, state and building companies that has accelerated since the 1950's. Although voices for protection had been heard earlier, it was not until 1990, as a reaction to a new set of heavy exploitations plans, that the Ecopark movement emerged, originally forming part of a city-wide protest cycle opposing new motorways and other planned exploitation (Stahre 2004, Ernstson and Sörlin 2009, details in Ernstson 2007).

In spite the movement's success in protecting the park through the law in 1995, exploitation plans continued to be issued and the movement have continued to mobilize protection until present date. This give evidence to the extreme levels of vested interests and conflicts characterizing urban landscapes, but also of social movement dynamics in that this set of individual organizations have come to link, across space and time, episodes of collective action into a longer-lasting effort (Diani 2003b, della Porta and Diani 2006:23). Based on our pre-study and previous study (Ernstson and Sörlin 2009), we report on two important feats of the Ecopark movement in its early stage. Firstly, it constructed a novel vision for the area. Newly created organizations managed to frame a set of park areas in a novel way, baptizing them The Ecopark (Sw. Ekoparken) and created a narrative able to explain that areas that prior to 1990 were viewed as unrelated, could be seen as connected (Ernstson and Sörlin 2009). In constructing arguments, activists were facilitated by the abundance of artifacts associated with the area, largely due to its royal history. Both cultural historical artifacts (planned English parks, sculptures, castles, burial sites, runestones etc.) and scientific artifacts from conservation biology (e.g. reports on core/buffer zones and species dispersal corridors) were employed to create a "protective story" (ibid.) that articulated the area's holistic values in which history and biology were seen as interlaced (ibid.). This framing process (Snow et al. 1986, Melucci

**Fig. 1.** The figure shows four idealized network models for social movements (Diani 2003a:306ff.). These arise from different levels of centralization and segmentation in the network and are described in the main text. Nodes are actors and links are resource exchanges of some kind. Note that all actors in social movements have mutually recognized each other as part of the same movement. Figure adapted from Diani (ibid.).



1995, Boström 2004) stretched the movement's identity over a greater spatial area, which importantly helped mobilize a diverse set of organizations active in different parts of the Ecopark (e.g. culture and nature conservation organizations, user groups, theatre groups). In 1992, 22 organizations created an umbrella organization, The Alliance of the Ecopark, that today gathers some 50 members. This organization became a focal point for movement activities, although some central organizations never became explicit members. Secondly, it achieved, building on the protective story and using its repertoire of developed methods (e.g. artist galas, exhibitions, lobbying) to 'jump scales' (Miller 2000) and move the political issue of the park from the local level of the municipalities to the national level, thus overriding the strong powers of the municipalities. In 1995 the protective law for the National Urban Park was passed (National Parliament 1994/95).

Through its crucial role in establishing the law (Ernstson and Sörlin 2009), the Ecopark movement not only defined and constructed the identity of these green areas in Stockholm, but it also transformed the governance structure of the park. Firstly, municipalities were forced to collaborate across borders, which opened for ecosystem management over an extensive landscape scale (cf. Nyström and Folke 2001). Secondly, the County Administrative Board was given the right to override the strong Swedish planning monopoly for municipalities, which opened a new option to influence the politics of the park. The latter shows how the movement, through its own actions, increased its political oppportunity structure (cf. McAdam et al. 1996). Nonetheless, decision-making on land-cover change is still highly centralized to the municipalities.

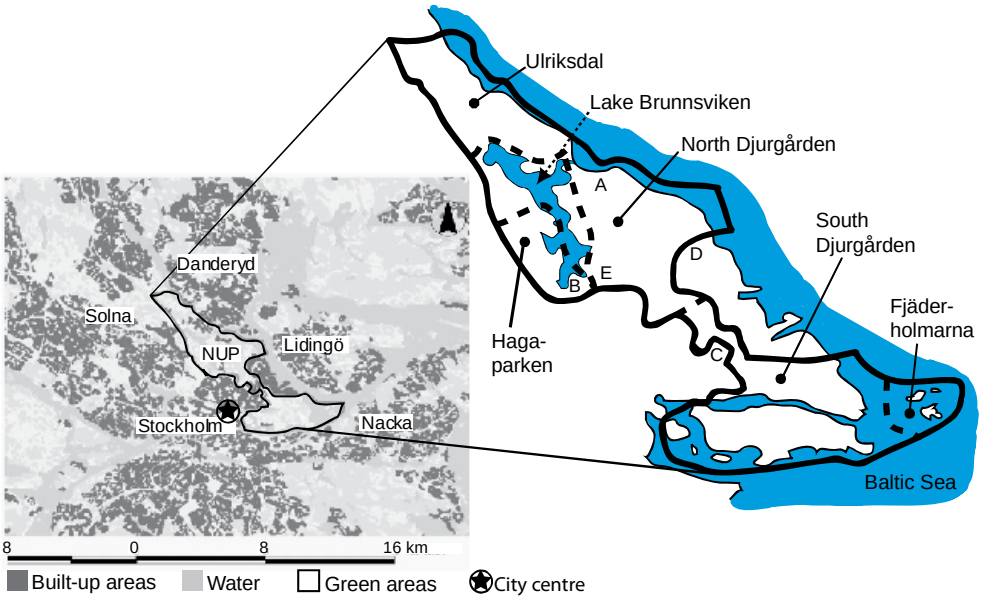
The Ecopark movement has clearly been engaged in a transformational change of a specific governance structure. Part of this rests upon their vision-building and up-scaling, which are factors identified in other studies of similar processes in the field of ecosystem management (Gunderson 1999, Olsson et al. 2004b). However, in contrast to these we will in this study aim to uncover those social network mechanisms that underpin this type of collective action.

## METHODS

In this study we viewed social networks as real observable phenomena (Marsden 1990, White and Houseman 2002). We denoted organizations within the Ecopark movement as nodes and measured the links between them by having respondents mark out their relations to other organizations. Importantly, empirical studies have shown that self-reported ties are biased toward routine, typical interactions (Marsden 1990:447 and references therein), which implies that social networks should not be seen as snap-shots in time, but instead as reflecting long-term stable patterns of social interaction (ibid.). This serves us well as our interest lies in capturing the dominant social processes involved in protecting the park. Below follows a description of our method, for details we refer to Appendix 1.

A robust method for generating self-reported ties is to use recall lists (ibid.), a list of all organizations in the field with adjoining empty columns in which respondents can mark their different relations to others (Diani 1992, 2003b). We created a recall list of all 92 organizations we found to have connections to the park and sent it to the official leader or other knowledgeable person in those 60 organizations that seemed active in protecting the park, according to our pre-study (Appendix 1). Many organizations were members of the umbrella organization. Ansell (2003) used a similar approach, and although greater reliability could have been achieved by asking several activists per org-

**Fig. 2.** The Stockholm National Urban Park (NUP; Sw. Nationalstadsparken) lies close to the city center as shown in the left map. It stretches mainly into Stockholm and Solna municipalities, with a small part into Lidingö. The right map shows the different historical areas of the park that were conceptually linked by the Ecopark movement (Ernstson and Sörlin 2009). Capital letters A-E marks sites for major planned exploitations where the movement has been successful in stopping or altering them (see Table A2.1). For more information on the park's ecosystems and management, see Barthel et al. (2005) and Borgström et al. (2006).




anization (as in Diani 1995), time and resource constraints made this unfeasible. In defining the boundary of the movement, we asked all respondents to mark those organizations that he/she affirmed as active in the protection of the park. Organizations receiving at least two affirmations (mean 8.6, std.dev. 6.4, max 32) were selected as belonging to the movement thus basing the boundary of the network on mutual recognition (Diani 2003b:10). This secured both a minimum notion of a shared identity (ibid.), but also had the advantage of allowing surveys to be sent to active organizations missed in the first set of 60 respondents. This happened for seven organizations (Table A1.2). However, of these all had just two affirmations, except one with three, and all received very few links from others (five were among the isolates with no links at all). We therefore decided not to send the survey to these organizations as their impact on the analysis of the overall movement structure was deemed low. Our final set consisted of 62 social movement organizations (SMOs).

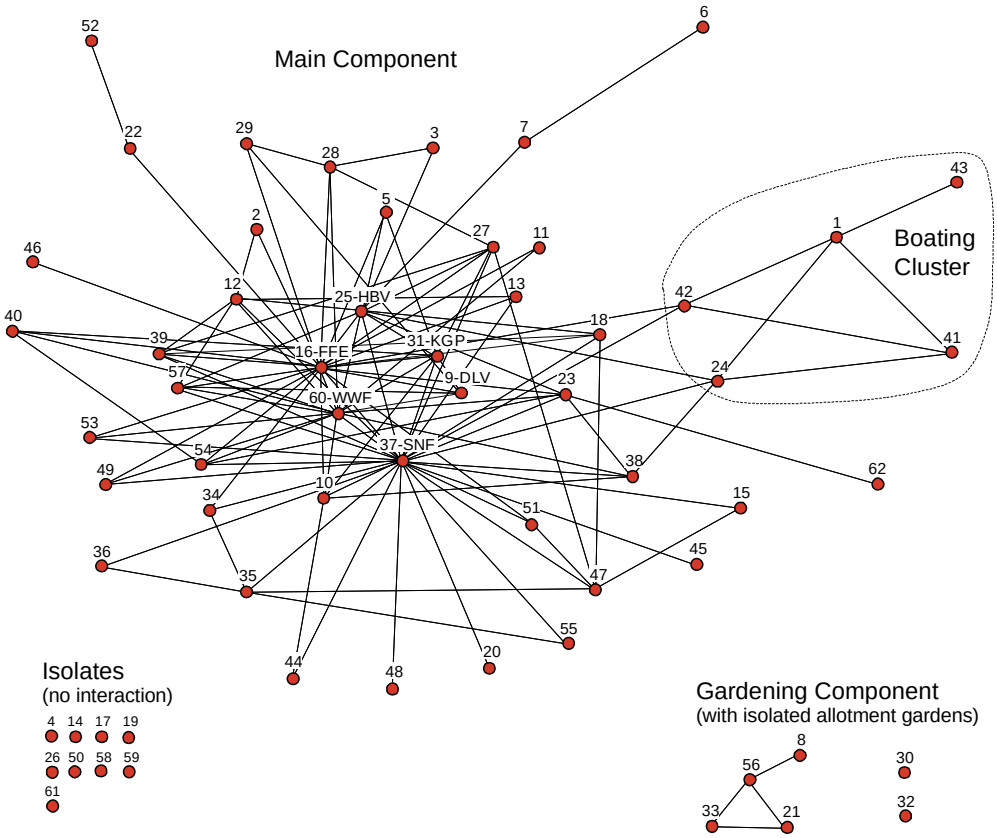
Using the recall list we asked about four network relations: (*A*) exchange of advices on cultural and political issues regarding the park; (*B*) exchange of advices on nature and ecological issues; (*C*) regular collaboration with other organizations; and (*D*) if the respondent had personal friends in other organizations (Table A1.3). These were chosen so as to capture information flow, coordination, and personal networks that we regarded as important in protecting a park framed by cultural history and conservation biology. Other scholars have used similar relations for similar movements (Diani 1995, Ansell 2003). Each respondent thus generated a row of ones and zeros for each of the four network relations; one symbolizing a relation to an organization, and zero signifying no relation. After having adjusted for that a couple of respondents had over-estimated their out-going ties (Appendix 1), we assembled four 62-by-62 adjacency matrices, one for each network relation. We then turned the four relational networks into a single network (*N*) through linear combination of the adjacency matrices. This increased the reliability of the final network as it relied on more data for each possible link (Marsden 1990), and also helped distinguish between strength of ties. In order to compensate for the leadership-bias of our data (since it was based on asking just the official leader of each organization) we gave double weight to "collaboration with other organizations" when combining the networks. Thus the final matrix addition was $N=A+B+2C+D$, which produced a network with directional links that had strengths from zero to five (0-5). For some calculations we transformed this network into a symmetrical and dichotomized network (i.e. without direction of links, and no strenghts, just zeros and ones)(Appendix 1).

In parallel, we generated data on SMO attributes suggested to influence network dynamics (see e.g. McCarthy and Zald 1977, Diani 1995). These included member size, number of activists, and type of funding. User intensity of the park was an attribute designed to gauge how much each SMO interacted with local ecosystems (see Introduction), by combining the number of days and type of activity that SMOs had reported (Appendix 1; Table A1.4). Political contacts was measured through a second recall list in which respondents marked contacts to formal organizations (e.g. municipal and state agencies). Scale of activity was based on asking where in the park (using a map) organizations had their main activities, but also through using secondary data (homepages and field documents). For example, allotment gardens are active inside the park, whereas the umbrella organization operates at the scale of the whole park. These attributes were used to find correlation patterns in the network structure.

To increase our ability to interpret the network structure, we also generated qualitative data focusing on the emergence of the movement, mobilization dynamics, and resources and methods used for protecting the park. Five interviewees were chosen from a list of most-cited activists generated out of the network survey, and we made four participatory observations at different meetings (for lists on interviews and observations, see Ernstson and Sörlin 2009).

In summing up, 45 of the 62 organizations in the movement completed a survey giving a response rate for the network analysis of 72.6 per cent. However, most analyses only concern the Main Component of 47 SMOs, increasing the response rate to 78.7 per cent. As mentioned earlier, the SMOs that did not complete a survey received few links and few affirmations of being active in the protection of the park. Therefore we feel confident that we have a sufficiently valid data set, especially as we refrain from single node analysis.

**Fig. 3.** The social network of the Ecopark movement consists of 62 organizations perceived as active in the protection of the National Urban Park by at least two respondents. They are divided in a Main Component (47 nodes), Gardening Component (4), and eleven un-connected Isolates (11). Indicated is also the Boating Cluster. The network is generally sparse and of low density; of the 2162 possible links, only 190 were realized in the valued network, while 119 in the symmetrical. Distances were nonetheless short with an average of 2.33, and a maximum distance of five in the symmetrical network.



## RESULTS

Merging the network survey's four relations yielded a sustained pattern of collaborative interaction between the diverse set of civil-society organizations in the Ecopark movement (Fig. 3). Regarding the network structure we found a Main Component that displayed a core-periphery structure with three positions. The core and semi-core positions were predominantly SMOs involved in nature and culture conservation with significantly higher mean levels of degree and betweeness centrality, as well as higher numbers of political contacts. The periphery position, with low centrality values and fewer political contacts, gathered those SMOs with significantly higher user-intensity. Most peripheral actors were allotment gardens found (except one) either in the disconnected Gardening Component or among the eleven non-linked Isolates. For other attribute data we found low correlations with degree centrality, except year of foundation indicating that recently founded SMOs are slightly more central. High levels of segmentation outside the core and semi-core positions were only recorded among boating clubs and allotment gardens.

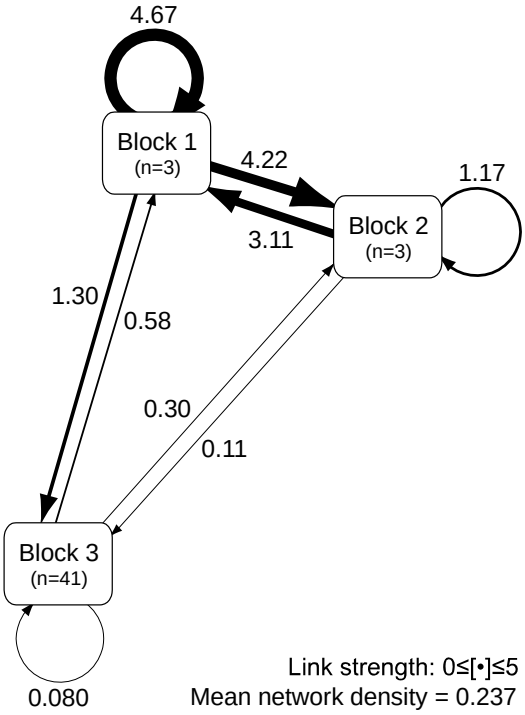
The results also underlined the impressive diversity of the movement. In interest and scale, the movement was found to span from voluntary local user groups, to national-level professionalized conservation organizations; over space with SMOs from all parts of the park, even outside; and through time, with founding dates from 1885 to 2001 (tables and details found in Ernstson 2007). From qualitative data we identified a quite fixed repertoire of methods to influence decision-making based on translating a set of identified resources into action (Table A2.2 and Table A2.3). Crucial resources were political contacts and activists' free-time labor, although two core SMOs had employed personnel.

### Block-modeling based on relational data

We simplified the movement's network – focusing on the Main Component – to better understand what social processes and mechanisms the network supports and constrains. This was done by searching for structurally equivalent actors (Lorrain and White 1971), which means to find actors with similar patterns of links to all other actors and group these into blocks. In the adjacency matrix, this means that actors with similar row and column vectors (out and in-going links) are more structurally equivalent and could constitute a block. Using these blocks, a simpler network can be drawn that still preserves important structural aspects of the original network. Note that this simplification is not based on organizational attributes but exclusively on the SMOs relations to each other (Wasserman and Faust 1994). Attributes will be used in a second step to analyze how the movement's diversity is played out in the structure.

We used a technique based on the similarity of Euclidean distances in the valued network, followed by hierarchical clustering of these similarities (Appendix 1; Wasserman and Faust 1994:363ff for details). However, this procedure often proposes several possible block partitions and it has been suggested that researchers should choose, guided by theory, one giving a meaningful interpretation

**Fig. 4.** The figure shows the simplified movement network reached through a block-model of the Main Component with three structurally equivalent positions (Block 1-3). The blocks were dubbed core, semi-core and periphery position, respectively and contained the following SMOs: Block 1 = [N16, N37, N60]; Block 2 = [N9, N25, N31]. Block 3 contained all other 41 SMOs.




(ibid.:383). We chose a partition with three blocks in which Block 1 and 2 had three organizations each, and Block 3 gathered all other 41 SMOs. This selection was based upon the fact that Block 1 and 2 remained the same for all possible partitions, while it was only Block 3 that splintered into further sub-blocks (see partition diagram in Fig A2.1). Thus, the main structure of the movement, being our focus in this paper, was captured with three blocks.

Partitioning the Main Component's 47-by-47 network matrix according to the blocks – keeping the directions and strengths (0-5) of links – we calculated the link density between and inside blocks as the mean value of reported ties. This produced the block-model of Fig. 4. Block 1 and 2 differed in two aspects. First, Block 1 had almost maximal internal cohesion (4.67), whilst Block 2 considerably lower (1.17). Second, Block 1 had more than four times as high link density to Block 3, than Block 2

(1.30 to 0.30). Comparing link densities between Block 1 and 3, the former showed twice as high link density to the latter than vice versa (1.30 to 0.58). In comparison with Block 3, both Block 1 and 2 were extreme as their internal and in-between link densities ranged from 5 to 20 times higher than overall network density of 0.237.

When exclusively comparing the Main Component with the movement models in Fig. 1, we made the following observations. The network is sparse, directly ruling out the clique model, and furthermore, since all actors are connected, we also ruled out the segmented-centralized model. With these excluded and with high network centralization it seemed that our data best fitted the wheel/star (core-periphery) structure. Block 1 clearly occupied the core position, being most active in sending links and most recognized by the others. Importantly the block had also high internal density, making the three organizations of Block 1 resembling the core actor in Fig. 1. Block 3, being more loosely linked to the others, constituted the periphery position while it had extremely low internal link density indicating low segmentation, a trademark for periphery positions.

However, the network departed in two ways from a classic core-periphery structure (Borgatti and Everett 1999). First, in the classic outline periphery actors send more links to the core than vice versa, explained theoretically through their greater interest in the concentrated resources of the core (ibid.). Here we had the opposite situation, pointing out that valuable resources also resided in the periphery. Second, we had one extra block, Block 2. While having too low internal link density, Block 2 could not be a core. At the same time, it was generally more recognized through having more incoming links than Block 3, and it had furthermore much higher interaction with the core actors of Block 1 than with the periphery actors of Block 3. Block 2 was thus socially closer to the core, which made us dub it the semi-core position. The policephalous model, finally, could have been the best-fit model if Block 2 would have shown more links to the periphery. As it was now, the network was mostly held together by Block 1, being thus rightfully seen as the core.

## Correlation analysis

Before reporting on the distribution of organizational attributes, we first note from Table 1 that degree and betweeness centrality was significantly and strongly correlated in the Main Component. A general characteristic of the network was thus that those actors directly connected to many others (high degree centrality) also tended to sit on paths between many others, i.e. with high potential to control resource flows (high betweeness centrality). Centrality is moreover strongly skewed. The three organizations with highest degree centralities – also being the core actors found above (N16, N37, N60) – were involved in 30 per cent of all existing symmetrical ties, giving further support to the notion of a core-periphery model for the network. Correlating other attributes with degree centrality we only found a strong and significant correlation with number of political contacts, whereas a weaker and less significant correlation was found with year of foundation (Table 1). Both these supported our pre-study finding that newly formed and more politically active organizations had played an active role in creating and sustaining the movement (also supported in field documents, see Ernstson 2007).

**Table 1.** The table gives correlation values between degree centrality and selected SMO attributes in the Main Component. For other organizational attributes in the study, correlation values gave too large p-values for being significant. Number of nodes for all calculations was 47 (N=47).

| *Attribute* | *Correlation with degree centrality* | *P-value* | *Missing data* | *Min* | *Max* | *Median* | *Mean* | *Std.dev.* |
|---|---|---|---|---|---|---|---|---|
| Degree centrality | - | - | 0 | 1 | 29 | 3 | 5.1 | 5.7 |
| Betweeness centrality | 0.859*** | $1.1\ 10^{-14}$ | 0 | 0 | 0.43 | 0.002 | 0.03 | 0.08 |
| Political contacts | 0.708*** | $1.2\ 10^{-6}$ | 11 | 0 | 70 | 5 | 12.5 | 16.1 |
| Year of foundation | 0.302* | 0.0551 | 6 | 1885 | 2001 | 1973 | 1955 | 37.1 |
| Affirmations of being active in protecting the park | 0.776*** | $1.5\ 10^{-10}$ | 0 | 2 | 32 | 6 | 8.6 | 6.4 |

**Table 2.** The table describes the structural positions in the Main Component through the distribution of SMO-attributes. The members of Block 4 are not strictly structurally equivalent, but a subset of heavy user groups from Block 3 ($Ui \geq 30$). Note: [v] and [s] means that the valued and symmetrical network was used for calculations, respectively; [1] and [2] means that the user intensity was calculated with and without the outlier WWF, respectively. The number of missing data for each calculation is given within parenthesis (NaN).

| **Measure** | **Block 1** Mean (NaN) | **Block 2** Mean (NaN) | **Block 3** Mean (NaN) | **Block 4** Mean (NaN) | ANOVA F | P-value |
|---|---|---|---|---|---|---|
| Degree centrality[v] | **117.7** (0) | **43.3** (0) | **13.2** (0) | - | 131*** | $3.2\ 10^{-19}$ |
| Degree centrality[s] | **24.0** (0) | **9.33** (0) | **3.37** (0) | - | 116*** | $2.7\ 10^{-18}$ |
| Betweeness centrality[s] | **0.28** (0) | **0.056** (0) | **0.0092** (0) | - | 48.2*** | $8.1\ 10^{-12}$ |
| No. of political contacts | **51.7** (0) | **20.7** (0) | **7.3** (11) | - | 27.6*** | $9.2\ 10^{-8}$ |
| User intensity[1] | **106.7** (0) | **3.3** (0) | **3.3** (9) | **231** (0) | 4.55** | 0.00876 |
| User intensity[2] | **10** (1) | **3.3** (0) | **3.3** (9) | **231** (0) | 4.74** | 0.00738 |
| Year of foundation | **1986** (0) | **1988** (0) | **1950** (6) | - | 2.76* | 0.0758 |
| No. of SMOs | 3 | 3 | 41 | - | | |
| No. of SMOs | 3 | 3 | 30 | 11 | | |
| Type of organization | 1 voluntary<br>2 professional | All voluntary | 39 voluntary<br>2 professional | All voluntary | | |
| Main interest | Culture/nature conservation | Culture/nature conservation (one env.prot.) | Mixed | User groups ($Ui \geq 30$) | | |
| Scale of activity | 2 whole-park<br>1 city-regional | All locally inside park | 20 (of 41) locally inside park | 10 locally inside park | | |

**Distribution of organizational attributes in the structure**

In Table 2 we have summarized how the most important organizational attributes were distributed across the core-periphery structure. The core and semi-core positions had, not surprisingly, significantly higher mean values of degree (and betweeness) centrality than the periphery; not even the periphery's maximum value of seven reached this. Regarding number of political contacts, core members had exceptionally high numbers, followed by semi-core members. Periphery members had on average significantly lower amount of political contacts, although three (out of 41) had a higher amount than the semi-core's average value of 20.7 and further six were found in the interval between 14-18. This pointed out that in order to be a member of the semi-core – and not the periphery – an SMO needed not only many political contacts, but also many links to core members. Another important trend was the distribution of the scale of activity, with core actors active on the scale of the park or above, and semi-core and periphery actors with activities predominately on scales inside the park.

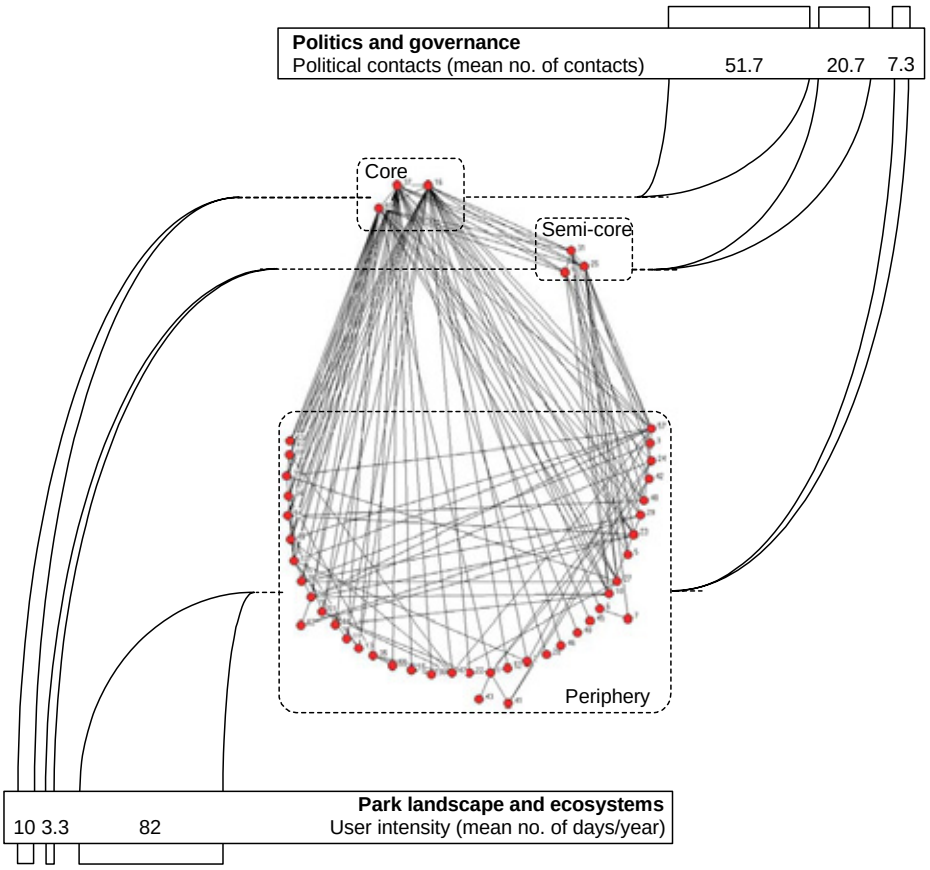
All user groups in the Main Component were found in the periphery position. This suggested that SMOs with high user-intensity, those potentially rich on local ecological knowledge, tended to occupy positions that gave them less potential to influence the movement. To test if data in the Main Component supported this, we took all user groups in the periphery position with high user intensity ($Ui \geq 30$) and created Block 4 (thus disregarding strict structural equivalence for this block). Block 4 proved through ANOVA-analysis to have significantly higher mean user intensity than other blocks (Table 2), supporting our suggestion. Here Block 1 scored second with less than half of the value, while Block 3 and 4 had much lower user intensities. However, the relative high user intensity of Block 1 came from just one SMO, being WWF. When removing this outlier, the user intensity of Block 1 dropped tenfold (106.7 to 10 user-intense days per year). Since our aim was to determine the pattern of where user groups were located in the network structure, we can justify this removal of WWF based upon our qualitative data. This informed us that WWF is not a user group in the same sense as for example boating clubs or allotment gardens. These can have as many as a hundred voluntary members, while in contrast, The Ecopark Fund WWF is a professional project under WWF run by practically one employee.

Referring finally to the whole movement network, we observed that all user groups, following the trend uncovered in the previous paragraph, were considerably marginalized in the movement. Most marginalized were the six allotment gardens; two were found among the Isolates, three in the disconnected Gardening Component, and one in the periphery position. The Gardening Component consisted of three allotment gardens (and a loosely connected theatre organization), including noteworthy the umbrella organization for all allotment gardens in Stockholm (N21). Network segmentation was also found in the Main Component where a community analysis (Girvan and Newman 2002) revealed a Boating Cluster consisting of all existing boating clubs (N1, N24, N41, N42, N43). However, the general result for the Main Component was that segmentation was low showing that most organizations interacted regardless of their main interest or other attribute.

## DISCUSSION

In this study we investigated why a set of civil society organizations played a crucial part in protecting the Stockholm National Urban Park, and as such, influenced the ability of this urban landscape to

**Fig. 5.** Through their struggle to protect the National Urban Park, the Ecopark movement has come to link the politics of the park with its ecosystems. Core and semi-core actors connect through many political contacts to decision-makers, whereas peripheral actors have higher user intensity and more day-to-day activity in the park. The values are taken from Table 2, with WWF removed as discussed in the main text.




generate ecosystem services. By conducting a social network analysis we show that the Ecopark movement consists of a social network that link a diverse set of actors. This network took shape in the beginning of the 1990's when newly formed organizations mobilized against large-scale exploitation plans. By constructing a holistic vision of the park, that included a greater connected geographical area, other groups in the area were also mobilized. The movement displays a wheel/star or

core-periphery structure with three positions: core, semi-core and periphery (Fig. 4) and two attributes, political contacts and user intensity, emerges as important descriptive factors (Table 2). A high level of political contacts correlates with many links to other SMOs, while high user intensity characterizes less central SMOs with fewer political contacts. In bringing this together we can produce the image in Fig. 5, which displays how the movement, in its struggle to protect the park, has come to link the decision-makers of the park with its ecological systems.

Previous studies show that environmental movements often match core-periphery profiles (Ansell 2003, Diani 2003a), and empirical studies of environmental movements in Britan and Milan have shown how core actors function as bridges to local actors (Lowe and Goyder 1983, Diani 1995). This resemble our findings with core actors active on the scale of the park or above, and semi-core and periphery actors predominately active at lower scales (Table 2). An importing parallel is also found from research on self-emerged collaborative ecosystem management, where Hahn et al. (2006) report – although not assessed through formal network analysis – of core-periphery structures in which 'bridging organizations' link, as in our case, between the politics of land use and user groups. We will use the movement's network structure as basis to discuss social mechanisms facilitated and constrained by social networks.

## The Ecopark movement – a scale-bridging local movement

Diversity is important, but it is the structure of diversity that transforms it into collective action.
We argue that the high organizational diversity found in the Ecopark movement, based in turn on the diversity of organizations attracted to the National Urban Park area, underpins protective capacity. But, we further argue that it is the structure of this diversity that transforms into action and materializes protection. In Table 3 we have summarized the two protective functions – stopping large- and small-scale exploitations – that the movement has created and maintained (A1-A2), the structural network factors that underpin these (B1-B5), and the factors responsible for the emergence and reproduction of the core-periphery structure (C1-C5). We will discuss these in the subsequent sections in pursue of the social mechanism responsible for protective capacity.

### *Dense social arenas and coordination of collective action*

The dense social arena between core and semi-core actors is key to understand the movement's success while it represents a perfect play-ground for collective learning. Theories on collective action tells us that high link density, or strong ties, is a sign of reciprocity and trust that facilitates collective action through lowering the cost and risk of collaboration (Granovetter 1973, 1985, Ostrom 1990, Burt 2003). It also facilitates the transfer of tacit or experience-based knowledge, a notion especially developed in theories on "communities of practice" and social learning (Wenger 1998) and explored in network studies (Borgatti and Foster 2003:997, Reagans and McEvily 2003). Through such dense social arenas, social practices on what to do and how to do it can develop and be sustained and guide interactions within and outside the community. In our case, this arena has helped to capture inflowing information (through weak ties) from both the movement's network and from the political contacts, so that it can be turned into fine-tuned knowledge about the decision-making process on land-cover change, and on how and when this process can be influenced. As such, the "strength of

**Table 3.** The table summarizes our findings in the following way: The Ecopark movement upholds two protective functions (A), which are facilitated through five structural network factors (B). There are further five factors that can explain the emergence and reproduction of this structure (C). The table can be read as follows: C has given rise to B, which in turn sustains A.

| *Function/factor* | *Description* |
|---|---|
| *A. Protective functions* | |
| **A1. Stopping large-scale exploitations** | Large-scale exploitation plans is a public process centralized around the municipalities with public consultation meetings before decision is taken in the municipal parliament. |
| **A2. Stopping small-scale exploitations** | Small-scale exploitations occurs more ad-hoc and without approval from the municipal parliament and represent a more distributive process to monitor. |
| *B. Structural network factors* | |
| **B1. Integration of information** | Core-periphery structures tend to integrate information to core actors (Leavitt 1951), which gives them access to relevant information from the network. |
| **B2. Dense social arena** | The dense social arena between core and semi-core actors captures experience over time and facilitate collective learning and the development and sustaining of protective methods (Wenger 1998, Borgatti and Foster 2003). |
| **B3. Brokerage and coordination** | The brokerage position of the core actors facilitate coordination of the movement since they have access to early and non-redundant information (Burt 2003). |
| **B4. Internal bridging links** (sustaining diversity) | The links between core and periphery, especially to the user groups, links across spatial, temporal and jurisdictional scales. This increases legitimacy of the political project and increases ability to detect small-scale exploitations. |
| **B5. Political contacts** (external bridging links) | The many links that core and semi-core actors have to authorities and formal actors, i.e. political contacts, give them both early access to information and channels to influence the decision-making process. |
| *C. Emergence factors* | |
| **C1. Diversity of civil-society groups** | The park area has through time attracted a wide range of different user and interest groups, suggestively explained through the various landscape types found in the park. |
| **C2. Politically active organizations** | A set of new organizations were formed that had a clear political objective to stop exploitation plans and protect the park |
| **C3. Holistic vision and protective story** | In taking purposive action to protect the park, the newly formed organizations constructed a protective story that linked park areas into a holistic vision and mobilized organizations with activities and interests in the park (Ernstson and Sörlin 2009). |
| **C4. Centralized institutional context** | The centralized institutional decision-making process on land-cover change has reinforced the core-periphery structure (Leavitt 1951), a tendency enhanced by the place-based character of the struggle (Ansell 2003). |
| **C5. Self-reinforcing mechanism** | The core-periphery structure tends to reinforce core and semi-core actors' control over vital resources, which in turn reproduce the structure (cf. Diani 2003c). |

weak ties" is dependent on dense social arenas of strong ties (Granovetter 1973, Newman and Dale 2005). In support of this, we noted, as activists explained how they went about to protect the park, their detailed knowledge on the decision-making process and the skills and resources of other core and semi-core activists. This included knowledge concerning state agencies involved in land-use decisions, friends and foes within these, and the laws that could be useful in obstructing exploitation,

but also who within the movement beholds knowledge on ecology, juridical oddities, or has contacts to power-holders. We therefore interpret the movement's repertoire of methods (Table A2.2) as an outcome from an iterative trial-and-error process through earlier struggles, an outcome facilitated by the dense social arena as it captures and also socializes gained experience into prescribed practices, i.e. methods.

Coordination of collective action is also facilitated through the core-periphery structure since it turns core actors into brokers. Brokers, as explained by Burt (2003, 2005), have a structural advantage based on their exclusive links to actors that are not directly linked to each other. This implies that they gain access to many more pieces of information captured inside different actors to continously be able to synthesize more information. The advantage is thus emergent from the larger structure, and not dependent directly on certain attributes of the organization. Through this, the broker gains what Burt calls adapative implementation, an ability to navigate in a continously changing social landscape and coordinate the actions of a network, and learn on which actors to depend upon in times of action, knowing whom to connect (and not to connect), how to connect them, and when. In our field work we encountered several examples of this performed by core and semi-core actors, for instance when they were mobilizing in direct reaction to exploitation plans. This demanded coordination of a row of sequential activities that they often divided amongst themselves, sometimes – it seemed – without actually meeting, giving further credit to the capacity of dense social arena to socialize experience. The activities included also to interact and mobilize certain periphery organizations found suitable for the situation (for details, see Ernstson 2007). As we will return to below, this is also a question of power in which core and semi-core actors shape to greater extent than others – consciously or not – the collective action that unfolds.

*Network diversity and stopping small-scale exploitations*

Core actors send on average more links to the periphery than vice versa, pointing out that core members find valuable resources in the periphery. We suggest two reasons for the core's interest in the periphery: First, these links sustain overall political legitimacy for the movement since to represent a great and diverse field of organizations is a political asset, especially for core and semi-core actors in meeting media and authorities. As pointed out by a core activist: "Our strength relies upon that we can succeed in keeping together so many different interests". Second, these links sustain a protective mechanism for small-scale exploitations that would otherwise be difficult to handle and which we will discuss here.

Large-scale exploitation plans must take the centrally structured route through the municipalities and are thus easily detectable by core and semi-core members through their many political contacts. However, small-scale exploitations, for instance car-parks, sheds, or the cut-down of single trees as mentioned in the interviews, do not need to be handled by the municipalities and could be missed. Though, and captured in an interview with a core activist, these can be detected by people that spend time in the park:

*[…] there are many things going on in the park. It can for example be that Solna municipality starts a very rough restoration of the Tivoli Park, and we are not out in the Tivoli Park all the time. So it*

*all boils down to that somebody that lives in the neighborhood and happens to be a member of the [umbrella organization] can notify us and sound the alarm.*

Since periphery members are spread out geographically and have higher user intensity, they spend more time in the park than core and semi-core actors and are better able to monitor such small-scale exploitation. The core actors can make use of this information and take effective action through their developed methods, something out of reach for peripheral actors. We see how the links between core and peripheral user groups sustain a protective mechanism that links across spatial scales (cf. Adger et al. 2005, Borgström et al. 2006). Seen in a longer time-perspective, this protective mechanism is of additional importance. We here refer to what activists call "the tyranny of small steps" that include both occasional small-scale exploitations, but also the sequence by which green areas slowly degrade through small-scale activities. Such sequences could for instance start when public events are held in the park (e.g. circus, theatre, concerts, running competitions) and lead to that grass-land, through repeated use over years and even decades, is slowly turned into beaten-up soil. As pointed out by one experienced core activist, green areas can in this way become completely lost. A typical example was a green field that was first used to stage a public event and then gradually lost as municipal workers started parking their cars there, first covering it with gravel and a while later with asphalt turning it into a 'functional' car-park.

**The emergence and reproduction of social network structure**

Social network structures are left patterns of dominant social processes (Marsden 1990:447 and references therein) and thus retain clues on the social mechanisms responsible for their emergence and reproduction. Here we make use of this to find factors explaining the core-periphery structure of the movement and the emergence of the area's protective capacity (C1-C5 in Table 3).

From 1885 until today, a growing number of organizations with different interests and activities have found their home in the park area, both interest and user groups. As proposed by our findings, and supported by Barthel et al. (2005), this suggests an interesting linkage between the geological and ecological characteristics of a place and the potential to protect and management it; a diverse landscape, as in the Stockholm Urban National Park, with open fields, deep forests and water surfaces, can sustain a greater range of different activities and attract more organizations, which could facilitate collective action towards protection and management capacity. Another reason for the high organizational diversity probably lies in the growing city that on one hand serves as a source of members for these organizations, but on the other also constantly diminishes the total amount of green space available, thus increasing the number of organizations active in each remnant area.

However, as we have shown above, the core-periphery structure is crucial for protective capacity, which directs us towards the politically active organizations that mobilized the diversity of organizations. These were purposefully created for political struggle by activists that already had political contacts, or gained them during course of action. As pointed out in interviews, the older organizations (many based on user activities) were either not known of or not regarded as fit for political action. As mobilization picked up, older organizations were notwithstanding seen as an asset to increase political legitimacy. Further, protection efforts were mediated through a centralized institutional setting in which municipalities have monopoly on landuse decisions (cf. Leavitt 1951, Bor-

gatti and Everett 1999). Taken together, these factors account for the emergence of a core-periphery structure. During this process, it was only the allotment gardens that formed their own component (Fig. 3), explained partly through their already established relations to their own umbrella organization (N21), active at the scale of the city.

This core-periphery structure has then tended to reinforce itself. Core and semi-core actors have, as we have seen, a position that allow them to take earlier and more effective action. This reinforces their control over valuable resources such as political contacts and information, while sustaining internal movement links. This explains the high correlation we found between degree centrality and political contacts and we argue that this combined effect gives core and semi-core actors' greater real influence in the movement, i.e. more power. We stress that this need not to be true for all movements; in movements dependent on direct action or mass media, many links to others might be less important. In further support, we also note that the movement's methods – based on qualitative data – centres around the access to information (gained through having many links) and political contacts (Table A2.2 and Table A2.3).

The structure sustains a self-reinforcing network mechanism. This has been observed in other network studies (Diani 1995, Ansell 2003, Diani 2003c) and Diani (2003a:311) argues that once movements reach a core-periphery structure, they tend to become politically settled and content with the political goals of the core actors. Ansell (2003) also suggests that place-based movements have fewer tendencies of segmentation and cleavages, since goals need to be tied to a physical place and not to abstract principles as in issue-based movements (e.g. the feminist or global justice movement). There are factors explaining the general low segmentation in the movement. However, segmentation exist and becomes of crucial concern below.

**Social network structure and collaborative ecosystem management**

Important prerequisites for collaborative ecosystem management are fulfilled by the Ecopark movement (Barthel et al 2005). There is high organizational diversity (to negotiate the stakes), a multitude of user groups (to have access to ecological feedbacks), and a social network (to facilitate information flows)(Berkes et al. 2003, Olsson et al. 2004a, Fabricius et al. 2007). However, we have empirical evidence that user groups do not participate on existing collaborative arenas and consequently that all stakes are not represented, and perhaps more crucially, that there is less access to ecological feedbacks. Instead, core and semi-core groups – with few days of activity in the park – are highly represented. The clearest indication is that in the official coordination group of the park, lead by the County Administrative Board, there are no user groups but only core and semi-core actors as representatives of civil society (FFE and KGP). In addition, debates and discussion forums that we have visited have been dominated by core and semi-core organizations. We argue that the reason for this can be traced to the same social network structure that facilitated the protection of the park. Thus an important emergent hypothesis is that network structures that facilitate protection of ecosystems, might at the same time hinder collaborative management of the same ecosystems.

To explain this we argue that the movement's core-periphery structure also structured collaborative arenas, in two ways. Firstly, core and semi-core actors – faciliated through the structure – interacted more actively with authorities and became to be seen as good representatives of civil society; the

Ecopark movement, or more correctly the umbrella organization, were (incorrectly) viewed as a homogenous community of organizations. Although this approach seems to have worked in other cases – recall the centralized structure reported by Hahn et al. (2006) in which a bridging organization linked user groups to joint decision-making arenas – it seems not to have worked here. The reason, we believe, lies in how the core-periphery structure secondly came to influence the framing of values that ought to have highest priority on collaborative arenas. We trace this to the early 1990's when the park's identity – facilitated by its royal heritage – was constructed on the pillars of cultural history and conservation biology. This framing process was dominated by core and semi-core actors through their advantageous structural position (as we have seen), whereas user groups were peripheral and had less influence on this process. As a consequence, the value of the park as a space for their user activities, tend to have been downplayed (Ernstson and Sörlin 2009). In fact, intensive use of the park was seen as a potential threat by core and semi-core organizations (ibid.) since it could erode "their" values based on cultural history and conservation biology. This conflict of values seems to further explain the segmentation of heavy users – allotment gardens and boating clubs – in Fig. 3. In contrast to castles and planned English parks, these groups leave behind small huts, chicken wire fences, and landing stages that might be deemed out of place, unimportant or just disturbing. A core activist also expressed that boating clubs makes it difficult for bird watchers and other nature enthusiasts to follow the shoreline, while a boating club chairman expressed that they felt excluded from the park's cultural history, although "we have been here for more than a hundred years". This segmentation have had direct implications as well; when one allotment garden lost plots to exploitation, core and semi-core members remained passive while allotment gardens acted in vain to stop it (Ernstson 2007).

The core-periphery structure has mutually reinforced two crucial processes, both that of protecting the park from direct exploitation, and to produce its identity through framing its values. Simultaneously, this has constrained collaborative ecosystem management. More generally, this exemplifies that structures are both facilitative and constraining, or as expressed by Anthony Giddens (1984:171), "[t]hey serve to open up certain possibilities of action at the same time as they restrict or deny others."

## Grounded speculation

Social networks are often mentioned as a prerequisite for collaborative management (Carpenter et al. 2001, Olsson et al. 2004a). Most models treat them as either existing or not (ibid.), or regard them as having 'bonding'/'horizontal' links within communities of stakeholders and usergroups, and 'bridging'/'vertical' links when connecting to authorities (Newman and Dale 2005). Our case of the Stockholm National Urban Park demonstrates that these models may be too simplistic. Although a social network exists, connecting stakeholders, user groups and authorities, it is not obvious if and how this entails an advantage. Instead we need to analyze the structure of social networks and address their inherent double-nature (Diani 2003a). The same structure that helps protect the park and sustain ecosystem functioning, could simultaneously constrain collaborative ecosystem management. This is of real importance when discussing bridging organizations that link over various scales and connect politics and ecosystems. Adger et al. (2005) suggest that such cross-scale linkages are determined by power relations in which "more powerful actors can tilt the playing field [in resource management institutions] such that information and knowledge are further skewed in their favor".

Our analysis, shows that even community and civil-society actors can tilt the playing field, and that their networks should also be treated as highly structured in which certain actors have more influence than others.

This also relates our study to studies of adaptive capacity. In their review of research on adaptive governance, Folke et al. (2005) identified social memory – defined as the arena to capture experience of ecosystem change actualized through community debate and decision-making – as a source of resilience that "key persons" can use to guide and frame collective action in times of crisis and reorganization (also Barthel 2006 pers.comm.). A more critical stance would wonder how this social memory was constituted, who constructs it, and who uses it (Halbwachs 1952/1992). As we have shown, core and semi-core actors in the Ecopark movement – sometimes in alliance with authorities – have been central in decision-making and in constructing the identity of the park, resembling social memory. For us this points out that social memory should also be treated as an outcome of power relations. Consequently, if it is in time of crisis that social memory gets activated to frame activity, this turns the whole issue of adaptive capacity to a political issue where certain actors will shape the unfolding collective action towards benefitting them more than others (Halbwachs 1952/1992, Melucci 1996, Boström 2004). On a systemic level, the domination of some actors – state agencies and/or civil-society organizations – can come to work as a conservative force through locking certain landscapes into a certain identity that could hinder experimentation and decrease adaptive capacity (Gunderson and Holling 2002). This resonates with social theory where system reproduction is more seen as the result of "selective 'information filtering' whereby strategically placed actors" seek to regulate the system to keep things as they are or to change them (Giddens 1984:27). We therefore argue, following Adger et al.(2005), for a broader and deeper engagement with issues of power in analyzing adaptive capacity in social-ecological systems, especially those aspects by which social memory gets constituted and enacted.

## CONCLUSION

We have shown that the core-periphery structure of the Ecopark movement's social network plays a crucial role in protecting the Stockholm National Urban Park from exploitation, and thus in securing ecosystem services generated in the area. We argue that high organizational diversity is an important factor for increasing this green area's protective capacity, but diversity is not sufficient. Instead it is the structure of that diversity that underpins collective action and the social mechanisms important for stopping both large and small-scale exploitations. The dense social arena of politically active organizations is needed to develop and sustain methods for stopping large-scale exploitations, while links to user groups in the landscape are important for stopping smaller-scale exploitations that would otherwise be missed. However, we have also shown that the same structure that helped protect the park and sustain ecosystem functioning, could simultaneously have constrained collaborative ecosystem management. Especially user groups with valuable local ecological knowledge have not been included in collaborative arenas. We traced this to their peripheral position in the network structure, especially during the early framing process of the park's identity that was tilted – by core and semi-core actors – towards singular aesthetical and nature preservation ideals, rather than active use. This shows that collaborative ecosystem management is not just about knowledge (as generally treated in literature), but about values as well. And how and by whom (through interaction in social networks) knowledge and values become constructed and interlinked (cf. Emirbayer and Goodwin

1994). We therefore recommend authorities and other actors interested in initiating collaborative management to aim at empowering user groups. This might be done through discourses on local ecological knowledge that can upgrade their knowledge about the park.

Our study therefore points to theoretical developments. Along with others (Crona and Bodin 2006), we argue that analysts of ecosystem management will benefit greatly from assessing the structures of social networks. This will increase the explanatory power of the analysis and take analysts closer to many of the social mechanisms that collaborative ecosystem management seeks and depends upon, like collective action (Ostrom 1990), social learning (Holling 1978, Pahl-Wostl et al. 2007), trust (Hahn et al. 2006), and social memory (Folke et al. 2005), which are all intertwined with social network structure (Bodin et al. 2006 and references therein). We propose that assessing the social network structure could follow as a complementary step in methods used for identifying actors linked to ecosystems and we would like to emphasize that there are various other methods to generate social network data (Marsden 1990, Wasserman and Faust 1994, INSNA 2008).

The Ecopark movement represents an interesting phenomenon in linking ecology and politics, and in producing large-scale transformation of governance structures. Given the rapid worldwide urbanization (UN 2005) and its deteriorating effect on ecosystem services (McGranahan et al. 2005), this phenomena should be followed up by researchers in natural resource management and sociology alike. There is, however, a need for a more critical perspective on a larger spatial scale since, for instance, the exceptionally high protective capacity of the National Urban Park translocate exploitation pressures to other areas so that distant neigbourhoods may loose their green areas instead (cf. Harvey 1996, Heynen 2003). Further, if these lost green areas are crucial in regional ecological networks, such effects could influence ecosystem functioning at larger spatial scales (Andersson and Bodin submitted). In light of this: What seeds of transformative capacity in creating sustainable cities reside in civil society? What hopes are there that these transformations also produces more equal societies and cities, and not just reproduce, or even strengthens, already existing inequalities in the face of rapid change? Social network theory and social movement theory can prove helpful in addressing these questions and in improving theories and applications of collaborative ecosystem management in urban areas and beyond.

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## LITERATURE CITED

**Abrahamson, E., and L. Rosenkopf.** 1997. Social network effects on the extent of innovation diffusion: A computer simulation. *Organization Science* **8**(3):289-309.

**Adger, N. W., K. Brown, and E. L. Tompkins.** 2005. The political economy of cross-scale networks in resource co-management. *Ecology and Society* **10**(2):9. [online] URL: **http://www.ecologyandsociety.org/vol10/iss2/art9/**.

**Alberti, M., and J. M. Marzluff.** 2004. Ecological resilience in urban ecosystems: linking urban patterns to human and ecological functions. *Urban Ecosystems* **7**:241-265.

**Andersson, E., S. Barthel, and K. Ahrné.** 2007. Measuring social-ecological dynamics behind the generation of ecosystem services. *Ecological Applications* **17**(5):1267-1278.

**Andersson, E., and Ö. Bodin.** submitted. Testing network based models of habitat fragmentation in complex landscapes - implications for management. *Journal of Applied Ecology*.

**Ansell, C. K.** 2003. Community embeddedness and collaborative governance in the San Francisco Bay Area Environmental Movement. Pages 123-144 in M. Diani and D. McAdam, editors. *Social Movements and Networks - Relational Approaches to Collective Action*. Oxford University Press, Oxford.

**Armitage, D.** 2007. Adaptive capacity and community-based natural resource management. *Environmental Management* **35**(6):703-715.

**Barthel, S.** 2006 pers.comm. Seminar on "Collective environmental memory" by S. Barthel at the Dept of Systems Ecology, Stockholm University, 15 December.

**Barthel, S., J. Colding, T. Elmqvist, and C. Folke.** 2005. History and local management of a biodiversity-rich, urban, cultural landscape. *Ecology and Society* **10**(2):10. [online] URL: **http://www.ecologyandsociety.org/vol10/iss2/art10/**.

**Berkes, F., C. Folke, and J. Colding,** editors. 2003. *Navigating social-ecological systems: building resilience for complexity and change*. Cambridge University Press, Cambridge.

**Bodin, Ö., B. Crona, and H. Ernstson.** 2006. Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology and Society* **11**(2):r2. [online] URL: **http://www.ecologyandsociety.org/vol11/iss2/resp2/**.

**Bodin, Ö., and J. Norberg.** 2005. Information network topologies for enhanced local adaptive management. *Environmental Management* **35**(2):175-193.

**Bolund, P., and S. Hunhammar.** 1999. Ecosystem services in urban areas. *Ecological Economics* **29**:293-301.

**Borgatti, S. P., and M. G. Everett.** 1999. Models of core/periphery structures. *Social Networks* **21**:375-395.

**Borgatti, S. P., and P. C. Foster.** 2003. The network paradigm in organizational reserach: a review and typology. *Journal of Management* **29**(6):991-1013.

**Borgström, S., T. Elmqvist, P. Angelstam, and C. Alfsen-Norodom.** 2006. Scale mismatches in management of urban landscapes. *Ecology and Society* **11**(2):16.

**Boström, M.** 2004. Cognitive practices and collective indenties within a heterogenous social movement: the Swedish environmental movement. *Social Movement Studies* **3**(1):73-88.

**Burt, R. S.** 2003. The social capital of structural holes. Pages 148-189 in M. F. Guillen, R. Collins, P. England, and M. Meyer, editors. *The new economic sociology: developments in an emerging field*. Russell Sage Foundation, New York.

**Burt, R. S.** 2005. *Brokerage and closure: an introduction to social capital*. Oxford University Press, Oxford.

**Carpenter, S., B. Walker, J. M. Anderies, and N. Abel.** 2001. From metaphor to measurement: resilience of what to what? *Ecosystems* **4**(8):765-781.

**Castells, M.** 1983. *The city and the grassroots*. E. Arnold, London.

**Chiesura, A.** 2004. The role of urban parks for the sustainable city. *Landscape and Urban Planning* **68**:129-138.

**Colding, J.** 2006. 'Ecological land-use complementation' for building resilience in urban ecosystems. *Landscape and Urban Planning* (doi:10.1016/j.landurbplan.2006.10.016).

**Colding, J., J. Lundberg, and C. Folke.** 2006. Incorporating green-area user groups in urban ecosystem management. *Ambio* **35**(5):237-244.

**Crona, B., and Ö. Bodin.** 2006. What you know is who you know? Communication patterns among resource users as a prerequisite for co-management. *Ecology and Society* **11**(2):7.

**Daily, G. C.,** editor. 1997. *Nature's services: societal dependence on natural Ecosystems*. Island Press, Washington D.C.

**Dale, A., and J. Onyx,** editors. 2005. *A dynamic balance*. University of British Columbia Press, Vancouver.

**Degenne, A., and M. Forsé**. 1999. *Introducing social networks*. Sage Publications, London.

**della Porta, D., and M. Diani**. 2006. *Social movements: an introduction*. Blackwell Publishing, Oxford.

**Diani, M.** 1992. The concept of social movement. *Sociological Review* **40**:1-25.

**Diani, M.** 1995. *Green networks*. Edinburgh University Press, Edinburgh.

**Diani, M.** 2003b. Introduction: social movements, contentious actions, and social networks: 'from metaphor to substance'? Pages 1-18 in M. Diani and D. McAdam, editors. *Social movements and networks: relational approaches to collective action*. Oxford University Press, Oxford.

**Diani, M.** 2003c. 'Leaders' or brokers? Positions and influence in social movement networks. Pages 105-122 in M. Diani and D. McAdam, editors. *Social movements and networks: relational approaches to collective action*. Oxford University Press, Oxford.

**Diani, M.** 2003a. Networks and social movements: a reserach programme. Pages 299-319 in M. Diani and D. McAdam, editors. *Social movements and networks: relational approaches to collective action*. Oxford University Press, Oxford.

**Diani, M., and D. McAdam,** editors. 2003. *Social movements and networks: relational approaches to collective action*. Oxford University Press, Oxford.

**Drayton, B., and R. B. Primack.** 1996. Plant species lost in an isolated conservation area in Metropolitan Boston from 1894-1993. *Conservation Biology* **10**(1):30-39.

**Elmqvist, T., J. Colding, S. Barthel, S. Borgström, A. Duit, J. Lundberg, E. Andersson, K. Ahrné, H. Ernstson, C. Folke, and J. Bengtsson.** 2004. The dynamics of social-ecological systems in urban landscapes: Stockholm and the National Urban Park, Sweden. *Annual New York Academy of Science* **1023**:308-322.

**Emirbayer, M., and J. Goodwin.** 1994. Network analysis, culture and the problem of agency. *American Journal of Sociology* **99**:1411-1454.

**Ernstson, H.** 2007. *The drama of urban greens and regimes: social movements and ecosystem services in Stockholm National Urban Park*. Licentiate in Philosophy Thesis. Stockholm University, Stockholm.

**Ernstson, H., and S. Sörlin.** 2009. Weaving protective stories: connective practices to articulate holistic values in Stockholm National Urban Park. *Environment and Planning A*. (in press)

**Fabricius, C., C. Folke, G. Cundill, and L. Schultz.** 2007. Powerless spectators, coping actors, and adaptive co-managers: a synthesis of the role of communities in ecosystem management. *Ecology and Society* **12**(1):29. [online] URL: **http://www.ecologyandsociety.org/vol12/iss1/art29/**.

**Folke, C., T. Hahn, P. Olsson, and J. Norberg.** 2005. Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.* **30**:441–473.

**Freeman, L.** 1979. Centrality in social networks. Conceptual clarifications. *Social Networks* **1**:215-239.

**Gadgil, M., P. Olsson, F. Berkes, and C. Folke**. 2003. Exploring the role of local ecological knowledge in ecosystem management: three case studies. in F. Berkes, J. Colding, and C. Folke, editors. *Navigating social-ecological systems: building resilience for complexity and change*. Cambridge University Press, Cambridge.

**Giddens, A.** 1984. *The constitution of society: outline of the theory of structuration*. Polity Press, Cambridge.

**Girvan, M., and M. E. J. Newman.** 2002. Community structure in social and biological networks. *PNAS* **99**(12):7821-7826. [online] URL: **http://www.pnas.org/cgi/content/abstract/99/12/7821**.

**Granovetter, M.** 1973. The strength of weak ties. *American Journal of Sociology* **76**(6):1360-1380.

**Granovetter, M.** 1985. Economic action and social structure: the problem of embeddedness. *American Journal of Sociology* **91**:481-510.

**Grimm, N. B., J. M. Grove, S. T. A. Pickett, and C. L. Redman.** 2000. Integrated approaches to long-term studies of urban ecological systems. *Bioscience* **50**(7):571-583.

**Gunderson, L. H.** 1999. Resilience, flexibility and adaptive management - antidotes for spurious certitude? *Conservation Ecology* **3**(1):7. [online] URL: **http://www.consecol.org/vol3/iss1/art7/**.

**Gunderson, L. H., and C. S. Holling,** editors. 2002. *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington D.C.

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

**Halbwachs, M.** 1952/1992. *On collective memory*. University of Chicago Press, Chicago.

**Harvey, D.** 1996. *Justice, nature and the geography of difference*. Blackwell, Oxford.

**Heynen, N. C.** 2003. The scalar production of injustice within the urban forest. *Antipode* :980-998.

**Holling, C. S.** 1978. *Adaptive environmental assessment and management*. John Wiley & Sons, New York.

**INSNA.** 2008. Homepage of International Network of Social Network Analysis, http://www.insna.org, 1 June, 11:15. *in*.

**Leavitt, H.** 1951. Some effects of certain communication patterns on group performance. *Journal of Abnormal and Social Psychology* **46**:38-50.

**Lorrain, F., and H. C. White.** 1971. Structural equivalence of individuals in social networks. *Journal of Mathematical Sociology* **1**:49-80.

**Lowe, P. D., and J. M. Goyder**. 1983. *Environmental groups in politics*. Allen and Unwin, London.

**Löfvenhaft, K.** 2002. *Spatial and temporal perspectives on biodiversity for physical planning: examples from urban Stockholm, Sweden*. Doctoral thesis. Stockholm University, Stockholm.

**MA**. 2005. *Millenium ecosystem assessment: biodiversity synthesis*. World Resources Institute, Washington D.C.

**Marsden, P. V.** 1990. Network data and measurement. *Annual Review of Sociology* **16**:435-463.

**McAdam, D., J. D. McCarthy, and M. N. Zald,** editors. 1996. *Comparative perspectives on social movements. Political opportunities, mobilizing structures, and cultural framings*. Cambridge University Press, Cambridge.

**McCarthy, J. D., and M. N. Zald.** 1977. Resource mobilization and social movements: a partial theory. *American Journal of Sociology* **82**(6):1212-1241.

**McGranahan, G., P. Marcotullio, X. Bai, D. Balk, T. Braga, I. Douglas, T. Elmqvist, W. Rees, D. Satterthwaite, J. Songsore, H. Zlotnick, J. Eades, E. Ezcurra, and A. Whyte**. 2005. Urban systems. Pages 795-825 in *Millennium ecosystem assessment: conditions and trends assessment*. Island Press, Washington, DC, USA.

**Melucci, A.** 1995. The process of collective identity. Pages 41-63 in H. Johnston and B. Klandermans, editors. *Social movements and culture*. University of Minnesota Press, Minneapolis.

**Melucci, A.** 1996. *Challenging codes. collective action in the Information Age*. Cambridge University Press, Cambridge.

**Miller, B.** 2000. *Geography and social movements*. University of Minnesota Press, Minneapolis.

**National Parliament.** 1994/95. Parliamentary proposition 1994/95:3 handed in by Swedish Government, Sveriges riksdag, SE-100 12 Stockholm. Name: *Riksdagsproposition 1994/95:3: Nationalstadsparken Ulriksdal-Haga-Brunnsviken-Djurgården (The National Urban Park)*.

**Newman, L., and A. Dale.** 2005. Network structure, diversity, and proactive resilience Bbuiliding: a response to Tompkins and Adger. *Ecology and Society* **10(1)**:r2. [online] URL: **http://www.ecologyandsociety.org/vol10/iss1/resp2/**.

**Nyström, M., and C. Folke.** 2001. Spatial resilience of coral reefs. *Ecosystems* **4**:406-417.

**Olsson, P., and C. Folke.** 2001. Local ecological knowledge and institutional dynamics for ecosystem management: a study of Lake Racken watershed, Sweden. *Ecosystems* **4**(2):85-104.

**Olsson, P., C. Folke, and F. Berkes.** 2004a. Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management* **34**(1):75–90.

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

**Ostrom, E.** 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge University Press.

**Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tabara, and T. Taillieu.** 2007. Social learning and water resources management. *Ecology and Society* **12**(2):5. [online] URL: **http://www.ecologyandsociety.org/vol12/iss2/art5/**.

**Prell, C., K. Hubacek, and M. Reed.** forthcoming. Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources*.

**Reagans, R., and B. McEvily.** 2003. Network structure and knowledge transfer: the effects of cohesion and range. *Administrative Science Quarterly* **48**(2):240-267.

**Redman, C. L., J. M. Grove, and L. H. Kuby.** 2004. Integrating social science into the Long-Term Ecological Research (LTER) Network: social dimensions of ecological change and ecological dimensions of social change. *Ecosystems* **7**(2):161-171.

**Sandström, U. G., P. Angelstam, and A. Khakee.** 2006. Urban comprehensive planning—identifying barriers for the maintenance of functional habitat networks. *Landscape and Urban Planning* **75**:43-57.

**Schwartz, M. W.,** editor. 1997. *Conservation in highly fragmented landscapes*. Chapman and Hall, New York.

**Snow, D., B. J. Rochford, S. Worden, and R. Benford.** 1986. Frame alignment processes, micromobilization, and movement participation. *American Sociological Review* **51**:464–481.

**Stahre, U.** 2004. *Den gröna staden (The green city)*. Atlas, Stockholm.

**Stenhouse, R. N.** 2004. Fragmentation and internal disturbance of native vegetation reserves in the Perth metropolitan area, Western Australia. *Landscape and Urban Planning* **68**:389–401.

**UN**. 2005. *World urbanization prospects: the 2005 revision*. United Nations Population Division, New York.

**Wasserman, S., and K. Faust**. 1994. *Social network analysis - methods and applications*. Cambridge University Press, Cambridge.

**Weimann, G.** 1982. On the importance of marginality: one more step into the two-step flow of communication. *American Sociological Review* **47(6)**:764-773.

**Wenger, E.** 1998. *Communities of practice: learning, meaning, and identity*. Cambridge University Press, New York.

**White, D. R., and M. Houseman.** 2002. The navigability of strong ties: small worlds, tie strength, and network topology. *Complexity* **8**(1):72-81.

**Young, C. H., and J. Jarvis.** 2001. A simple method for predicting the consequences of land management in urban habitats. *Environmental Management* **28**(3):375-387.

**APPENDIX 1 Methodology and Data Analysis**

In this Appendix we give detailed comments on how we generated and treated data, especially the social network data. We worked with this case during three years, although most empirical work was conducted during one year (2004-2005). The survey was sent out in April 2005 and most respondents returned them a month later. We followed up respondents not returning a survey through phone calls. Respondents (official leader or other knowledgable person) were identified through organizational documents or through phoning known persons in the organization. In a cover letter all were promised anonymity in any presentation of the survey results. Network and statistical calculations were done using UCINET (Borgatti et al. 2002) and NetMiner (Cyram 2004). All raw data can be found in Ernstson (2007).

*1. Pre-study* — The pre-study consisted of interviewing authorities, civil society organizations and to study field documents. The aim was to find all organizations in the field, and to gain a first better understanding in how the movement had emerged. The latter was primarily based on interviews with activists and their written accounts, or by people standing close to the movement (e.g. Ekman 1995, Waldenström 1995, Holm and Schantz 2002). We triangulated these accounts with newspaper articles and official reports.

*2. Qualitative data* — The survey asked respondents for their most valuable contacts, giving us a most-cited-list of activists. In total we interviewed seven activists, four among the six most-cited, allowing interviewees to develop their answers (Bryman 2002:301). Since the most-cited-list was collectively generated by the movement itself this suggests higher reliability than using random or snow-ball sampling techniques. In parallel we made six participatory observations at meetings organized by both authorities and movement organizations while also studying organizational documents. We have also engaged in informal conversations with user groups, especially boating clubs and allotment gardens. For details see Ernstson and Sörlin (2009) and Ernstson (2007).

*3. Recall lists* — In total we listed 128 organizations (adding blank lines to allow respondents to fill in missed organizations), which leaves us just under a proposed maximum limit of 135 suggested by Erickson and Nosanchuk (1983) to avoid tiredness from respondents. However, we designed an easy-to-fill-in questionnaire with one column for each relational question and tried it on persons with different education levels and ages before sending it out. Some respondents did find them difficult to fill in (approx. 30%), but most found them easy (55%). A better response rate might have been achieved with shorter lists, that could have been accomplished through having key-informants screening them from non-active organizations. In the tables below (Tables A1.1-A1.3), we show the compilation and sources of the recall lists, a table over those SMOs not receiving a survey, and the wording of the relational questions.

*4. Respondents overestimating their out-going links* — Some respondents seemed to had overestimated the number of links they had to others. We checked this tendency by comparing the total quotient of all out- and in-going links (for all five relations) with the quotient for each organization. The quotient for the whole set was reasonably close to one, which turned our suspicion to three organizations that sticked out with approx. 7 times as many out- than in-going links. For these three (N12, N38, N39) only reciprocated links for each relation was kept and the number of political contacts was set to zero.

*5. Calculation of the symmetrical network* — The symmetrical network is a transformation of the valued network; first it was dichotomized at the cut-off value of two (i.e. links with strengths less than two were removed, and others were set to one), and then symmetrized keeping the maximum value for each link (allowing non-reciprocated links).

*6. Calculation of structural equivalence* — The computer program UCINET (Borgatti et al. 2002) was used for calculations letting the routine structural profile operate on the valued and asymmetrical network with the transpose included and the diagonal ignored. This produced the partition diagram in Fig. A2.1 from which blocks 1, 2 and 3 were identified.

*7. User intensity and other calculated attributes* — Table A1.4 summarizes how three attributes were calculated from survey generated attributes. In regard to user intensity, SMOs outside the NUP were given zero values, and for some SMOs, from which we lacked an answer, estimation was made through comparing them with similar other organizations. Three boating clubs and allotment gardens were in this way given 100 days of activity per year (N1, N24, N7), and three non-user groups were given five days per year (N2, N9 , N29).

**Table A1.1.** The table describe the composition and sources of the recall lists used in the study to generate social network data. The network analysis of the movement is based on recall list 1, wheras the number of political contacts to formal organizations were measured based on recall list 2. Both lists had six relational questions attached to them described in Table A1.2..Recall lists 3 and 4 were present in the survey, but the data generated from these was not used in this paper.

| *Recall list* | *Compilation and sources* |
|---|---|
| **1. Civil-society organizations** | **In total 91:** 32 nature and culture conservation groups; 12 park, gardening and allotment garden groups; 6 sporting clubs; 5 outdoor life associations; 5 boating and sailing clubs; 5 political interest groups; 2 non-classified organizations. (21 museums and 3 university organizations were included but never used for analysis).<br>**Sources:** *(i) Previous study* — Organizations known to be linked to NUP from a previous study (Barthel et al. 2005); *(ii) Member list* — Current member list of the umbrella organization FFE (FFE 2005); *(iii) Information maps* — Map from The National Land Survey Office (2001) displaying organizations with day-to-day activity in the NUP along with a map in Holm and Schantz (2002); *(iv) Homepages and written material* — Searching for organizations on homepages and in written material (e.g. minutes of meetings, remittance reports) from already encountered organizations (cf. Ansell 2003). |
| **2. Authorities and formal organizations** | **In total 37.** Departments and agencies at different levels: 8 Stockholm municipality; 8 Solna municipality; 2 County Administrative Board; 2 Stockholm County Council; 5 State and National Parliament (*Riksdagen*); 8 Political parties; 3 Others (including land-owners)<br>**Sources:** Official documents were used and the list was checked for relevance by two key-informants at Stockholm and Solna municipalities. (The Royal Administration of Djurgården (*Kungl. Djurgårdsförvaltningen*) was part of recall list A in the survey, but since it is an authority it was regarded as belonging to recall list B in the analysis.) |
| **3 and 4. Other organizations** | **In total 50.** 32 Schools, sport/boat/riding clubs, higher education, and hospitals in the area; 18 civil society organizations with activities outside the National Urban Park (nature conservation, cultural history conservation, outdoor life groups etc.) to check for spatial outreach. |

**Table A1.2.** Here descriptive data is given of the SMOs that never completed a network survey. As discussed in the main text, all had few links and were deeemed not to influence the data set. Organizations N2, N19 and N50 were added by respondents on blank lines we had left for that purpose.

| *SMO* | *No. of affirmations as being active in protecting the park (relation F)* | *In-going links from others* | *Network position* | *Main interest* |
|---|---|---|---|---|
| N2 | 2 | 5 | Periphery | Culture conservation |
| N4 | 2 | 0 | Isolate | Sports and outdoor |
| N19 | 2 | 0 | Isolate | Nature conservation |
| N45 | 2 | 4 | Periphery | Sports and outdoor |
| N50 | 3 | 0 | Isolate | Culture conservation |
| N58 | 2 | 0 | Isolate | Sports and outdoor |
| N61 | 2 | 0 | Isolate | Sports and outdoor |

**Table A1.3.** We here quote the relational questions used in the network survey (translated from Swedish). Questions A-D were used for generating the network data analyzed in the main text. Question E was used, besides A-D, to measure political contacts to authorities. Question F was used in defining the movement's boundary; those receiving at least two affirmations were regarded as participants in the movement, i.e. an SMO. Question G was not used in this paper.

| *Relation* | *Formulation of relational questions (translated from Swedish)* |
|---|---|
| **A. Politics/Culture** | "Mark those organizations (including your own) where there are persons that you regularly exchange information on the **politics**, the **city planning** or the **cultural values** of the National |

**Table A.1.3.** (continued)

| | |
|---|---|
| | Urban Park." |
| **B. Nature/Ecology** | "Mark those organizations (including your own) where there are persons that you regularly exchange information on the **nature** or the **ecology** of the National Urban Park." |
| **C. Collaboration** | "With which organizations does your organization **regularly collaborate** with? Mark these organizations in the list. (It could be different types of collaborations.)" |
| **D. Personal friend** | "Are you a **personal friend** of somebody that is active in another organization? Mark these organizations in the list. (A personal friend is somebody you know well and can entrust with.)" |
| E. Lobbying | "If you **court decision-makers** (so called lobbying), which [formal] organizations have they belonged to? Mark these." |
| F. Boundary | "Which organizations in the list do you consider as **active in the protection** of the National Urban Park? Mark these." |
| G. Acquaintance | "Mark those organizations in which you know active persons. (You do not need to be personal friends, but **acquaintance** is enough.)" |

**Table A1.4.** Based on the survey we combined data to create calculated attributes. The formulas for these are given below. The most important for us was user intensity as it correlated with structural variables in the network. The latter two were constructed to test for variables indicated as important by resource mobilization theories (McCarthy and Zald 1977), but these had weak correlation.

| *Calculated attribute* | *Data gathered through respondents* | *Comment* |
|---|---|---|
| User intensity ($U_i$)<br>$U_i = T \cdot I$<br>$U_i \in [0,1095]$ | $T$ = days in the park/year<br>$I$ = relative intensity of activity | A proxy for how intensely the SMOs are using the park landscape and how much they can be regarded as user groups.<br><br>The main activity of each organizatoin were given a relative intensity ($I$) from 0-3 as follows:<br>3 = Gardening and management of habitats and natural values;<br>2 = Bird watching, mushroom and berry gathering;<br>1 = Sports *(horse riding, orienteering, skiing, running, cycling, ice-skating)*; Water sports *(boating and sailing, canoeing, kayaking, rowing)*; Guiding of the park *(cultural/natural values, botanical walks, picnics)*; Management of cultural values *(e.g. buildings)*;<br>0 = Indoor activities *(e.g. theatre, concerts, seminars and exhibitions)*; Activities outside the National Urban Park. |
| Internal activity (normalized) ($nA_I$)<br>$nA_I = \frac{(a_1 + a_2 + a_3)}{A_{I,\max}}$<br>$nA_I \in [0,1]$ | $a_1$ = no. of active members<br>$a_2$ = no. of member activities/year<br>$a_3$ = no. of current projects | Captures the amount of internal activity in an SMO to distinguish those that are very active from those with less activity. The values of $a_1$, $a_2$ and $a_3$ are added and normalized with the highest sum over all SMOs as base. Note that $a_1$, $a_2$ and $a_3$ are the quotients from dividing the respondents answer with the maxium value to choose from on that particular question ($a/a_{max}$). |
| Level of organizational formalization ($F$)<br>$F = b_1 + b_2 + b_3$<br>$F \geq 0$ | $b_1$ = no. of employees<br>$b_2$ = own office (1) or not (0)<br>$b_3$ = type of financing (1/0) | Measures how formalized, or bureaucratized, an SMO is. The value of $b_3$ is zero ($b_3$=0) if the SMO only has member fees, and one ($b_3$=1) if the SMO receives money through paid missions, donations, or project applications. |

**APPENDIX 2 Tables and Figures**

In this Appendix we publish complementary tables and figures referred to in the main text.

**Table A2.1.** Examples of when and where the Ecopark Movement has successfully protected the park. Letters refer to places in Fig. 2. The examples are based upon on our interviews (Ernstson and Sörlin 2009), but also on newspaper articles, official reports and written accounts (e.g. Holm and Schantz 2002, Waldenström 2004, Melin 2005, Sundström 2005, DN 2006).

| *Ex.* | *Description* |
|---|---|
| *A.* | *Housing at Bergius Road, 1990.* Stockholm Ornithological Association (*Stockholm ornitologiska förening*; N49) mapped the movement of birds in the region. Together with principles on dispersal corridors from the UN conference on biodiversity 1992, the Bergius Road building project was stopped, partly with support of the bird data. |
| *B.* | *Motorway through Bellevue Park, 1994 (Norra länken).* Movement organizations (N3, N25, N31) cooperated with a resident in the area and appealed the building plans of a motorway tunnel under the Bellevue Park. The case was taken to The Supreme Administrative Court (*Regeringsrätten*) which stopped the exploitation. |
| *C.* | *Housing at Tre Vapen, 2005.* In a public meeting, neighbours raised their concerns concerning this exploitation and an attending core activist from WWF (N60) met with them afterwards. Together they managed to put pressure on local politicians and exploitation was delayed. |
| *D.* | *Housing at Husarviken, 2005.* Stockholm municipality planned a new town district with 3-5 000 apartments. This lead to heavy movement mobilization, partly spurred by the Royal Administration of Djurgården (*Kungliga Djurgårdsförvaltningen*) which contacted core and semi-core actors (N9, N16, N25, N31) to form a task-group. Through lobbying activities, local public meetings and alternative landscape plans, the task group managed to get the County Administrative Board to cancel the plans and a call for new plans were made. This demonstrates the reproduction of the core-periphery movement structure as core and semi-core actors sustain their advantage of resources and their links to periphery actors. |
| *E.* | *Motorway through Bellevue Park, 2006 (Norra länken, the sequal).* The once stopped motorway returns, now in a deeper tunnel. Although not stopping the project, the umbrella organization (FFE; N16) manages to obtain the rights to negotiate directly with the National Road Administration (*Vägverket*) on how to construct the tunnel so as to not harm cultural historical and biological values. |

**Table A2.2.** Movement methods as interpreted from qualitative data. These practices translate the resources in Table A2.3 into collective action (numbers 1-7 are from Table A2.3).

| | *Resources used (Table A2.3)* | | | | | | |
|---|---|---|---|---|---|---|---|
| *Method* | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| Monitor the municipalities' centrally issued land cover plans (exploitation plans) | ● | | ● | ● | | | ● |
| Attend public consultation meetings on exploitation plans | ● | | | | | | |
| Arrange early meetings with actors planning to build | ● | | ● | ● | ● | | |
| Write letters and commitment for considerations to authorities | ● | | | ● | ● | ● | |
| Lobby civil servants and politicians | ● | ● | ● | ● | ● | | |
| Initiate and run juridical processes together with rightful claimants to stop exploitation | ● | | ● | ● | ● | ● | |
| Participate in official consultation groups | ● | ● | ● | | | | |
| Exhibit alternative land cover plans to point out alternative futures for specific areas | ● | | | ● | ● | ● | ● |
| Write op-ed articles | ● | | | ● | ● | ● | |
| Arrange public meetings, seminars and debates (often in prestigious buildings) | ● | | ● | ● | | | ● |
| Organize supportive parties and galas | ● | | ● | ● | | | ● |
| Publish books regarding the park | ● | | | ● | | ● | |
| Arrange guiding of natural and cultural values for citizens and tourists | ● | | | | | ● | |

**Table A2.3.** Movement resources as interpreted from qualitative data.

| *No.* | *Category* | *Description* |
|---|---|---|
| 1. | **Free labor** | *Activists* (working for free on their spare-time) |
| 2. | **Professional labor** (money) | *Professional "activists"* (employed personnel in two core organizations, WWF and SNF). |
| 3. | **External contacts** | *Political contacts* (to authorities and established parties)<br>*Active supporters* (landscape architects, artists, musicians, celebrities working for free)<br>*Media* (journalists)<br>*Rightful claimants* (neighbors to exploitation or tenant's associations) |
| 4. | **Internal contacts** | *Relations to other SMOs* (i.e. the movement network in itself as accounted for in the main text) |
| 5. | **Information** | *Information* (concerning exploitation plans from either internal or external contacts or official sources) |
| 6. | **Skills** | *Professional knowledge* (on planning process, juridical processes, cultural history, conservation biology)<br>*Writing skills* (in crafting op-ed articles and appeals) |
| 7. | **Physical** | *Information tools* (Internet, phones, computers, copy-machines, accessed often through activists' work-places)<br>*Prestigious meeting places* (accessed through external contacts, e.g. The Royal Academy of Fine Arts and The National Museum of Natural History) |

**Table A2.4.** Acronyms and Swedish proper names for core and semi-core organizations referred to in the paper.

| *No.* | *Position* | *Acronym* | *English translation* | *Swedish proper name* |
|---|---|---|---|---|
| N16 | Core | FFE | The Alliance of the Ecopark | Förbundet för ekoparken |
| N37 | Core | SNF | The Swedish Association of Nature Protection in Stockholm County | Naturskyddsföreningen i Stockholms län |
| N60 | Core | WWF | The Ecopark Fund WWF | Ekoparksfonden WWF |
| N9 | Semi-core | DLV | The Environmental Protection Association of Djurgården-Lilla Värtan | Djurgården-Lilla Värtan miljöskyddsförening |
| N25 | Semi-core | HBV | Friends of Haga-Brunnsviken | Haga-Brunnsvikens vänner |
| N31 | Semi-core | KGP | The Committee for the Gustavian Park | Kommitén för Gustavianska parken |

**Fig. A2.1.** Structurally equivalent positions in the Main Component were identified through this partitioning diagram of the Euclidean distances of the valued network. The three positions Block 1, Block 2 and Block 3 were found at level 11.679. Since it is only Block 3 that splinters into further sub-blocks (from level 9.397), the main structure was captured with choosing just these three blocks. (SMO id numbers along the horizontal axis.)

```
        SMO Id.no. -->
        3 1 6   2 3 1 3   2 4 1 5 4 5 2 2 2 3 5 1   2 1 4 5 3 3 2 4 4 5 3         1 4 2 5 4 4 4 1 4 6
  Level 7 6 0 9 5 1 2 9 5 3 0 0 7 7 1 7 8 9 8 4 8 1 4 3 9 3 5 4 0 5 8 5 6 6 7 3 2 1 6 2 2 2 1 3 5 4 2
------- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 0.000  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXX . . . . . .
 2.000  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX XXX . . . . . .
 2.207  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX . . . . . .
 2.236  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX XXX . . . . . .
 2.449  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX XXX . XXX . . . . . .
 2.771  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXX . . . . . .
 2.828  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXX . . . . XXX XXX .
 3.000  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXXXX XXX . XXX XXX .
 3.464  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXXXX XXX XXXXX XXX .
 3.742  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXXXX XXX XXXXX XXXXX
 3.919  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX . XXXXX XXX XXXXXXXXXXX
 3.971  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX XXX XXXXXX XXX XXXXXXXXXXX
 4.000  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . . XXXXXXXXXXX XXX XXXXXX XXX XXXXXXXXXXX
 4.095  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . . XXXXXXXXXXX XXX XXXXXX XXXXXXXXXXXXXXX
 4.285  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . XXXXXXXXXXXXX XXX XXXXXX XXXXXXXXXXXXXXX
 4.412  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . XXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXX
 5.000  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXX . XXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXX
 5.012  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXX XXXXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXX
 5.118  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXXXXXXXXXXXXXXXXX XXX XXXXXXXXXXXXXXXXXXXXX
 5.240  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX
 5.818  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 6.245  . . . . . . . . . . XXX . . . . . . . . . . . . . . . . . . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 6.403  . . . . . . . . . . XXX . . . . . . . XXX . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 6.633  . . . . . . . . . . XXX . . . . . XXX XXX . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 6.793  . . . . . . . . . . XXX . . . . . XXX XXX . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.071  . . . . . . . . . . XXX . . XXX . XXX XXX . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.241  . . . . . . . . . . XXX . . XXX XXXXX XXX . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.429  . . . . . . . . . . XXX . . XXX XXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.616  . . . . . . . . . . XXX XXX XXX XXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.913  . . . . . . . . . . XXXXXXX XXX XXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7.937  . . . . . . . XXX . XXXXXXX XXX XXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 8.071  . . . . . . . XXX . XXXXXXX XXX XXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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 8.578  . . . . XXX XXX . XXXXXXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 8.784  . . . . XXX XXX . XXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 9.265  . . . . XXX XXX . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 9.397  . . . . XXX XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10.812  . . . . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11.679  . . . XXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12.306  . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
16.763  . XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
18.586  XXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
19.496  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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**LITERATURE CITED**

*These references are exclusively cited in Appendix 1 and 2. For all other references, see main text.*

**Borgatti, S. P., M. G. Everett, and L. C. Freeman.** 2002. Ucinet 6 for Windows: Software for Social Network Analysis. *in*. Analytic Technologies, Harvard.

**DN.** 2006. Parkvänner vill inte se nya bostäder (Parkfriends don't want more flats). *in* Dagens Nyheter, 12 October, Stockholm.

**Ekman, H.** 1995. Bygga eller skydda - hundra års kamp om marken (Build or protect - one hundred years of struggle about the land). in G. Brusewitz and H. Ekman, editors. *Ekoparken: Djurgården - Haga - Ulriksdal (The Ecopark: Djurgården - Haga - Ulriksdal)*. Wahlström & Widstrand, Stockholm.

**Erickson, B. H., and T. A. Nosanchuk. 1983.** Applied Network Sampling. *Social Networks* **5**:367-382

**FFE.** 2005. List of member organisations. *in*. Förbundet för Ekoparken (The Alliance of the Ecopark). Homepage: http://www.ekoparken.org/ , 2005-01-24, 10:34 (last updated 2005-01-03).

**Holm, L., and P. Schantz,** editors. 2002. *Nationalstadsparken: ett experiment i hållbar utveckling (The National Urban Park: An experiment in sustainable development)*. Formas, Stockholm.

**National Land Survey Office.** 2001. Karta över Nationalstadsparken (Map of the National Urban Park). *in*. Lantmäteriverket, Lantmäteriet, SE-801 82 Gävle, Sweden. Homepage: www.lantmateriet.se, 2004-10-05, 10:10.

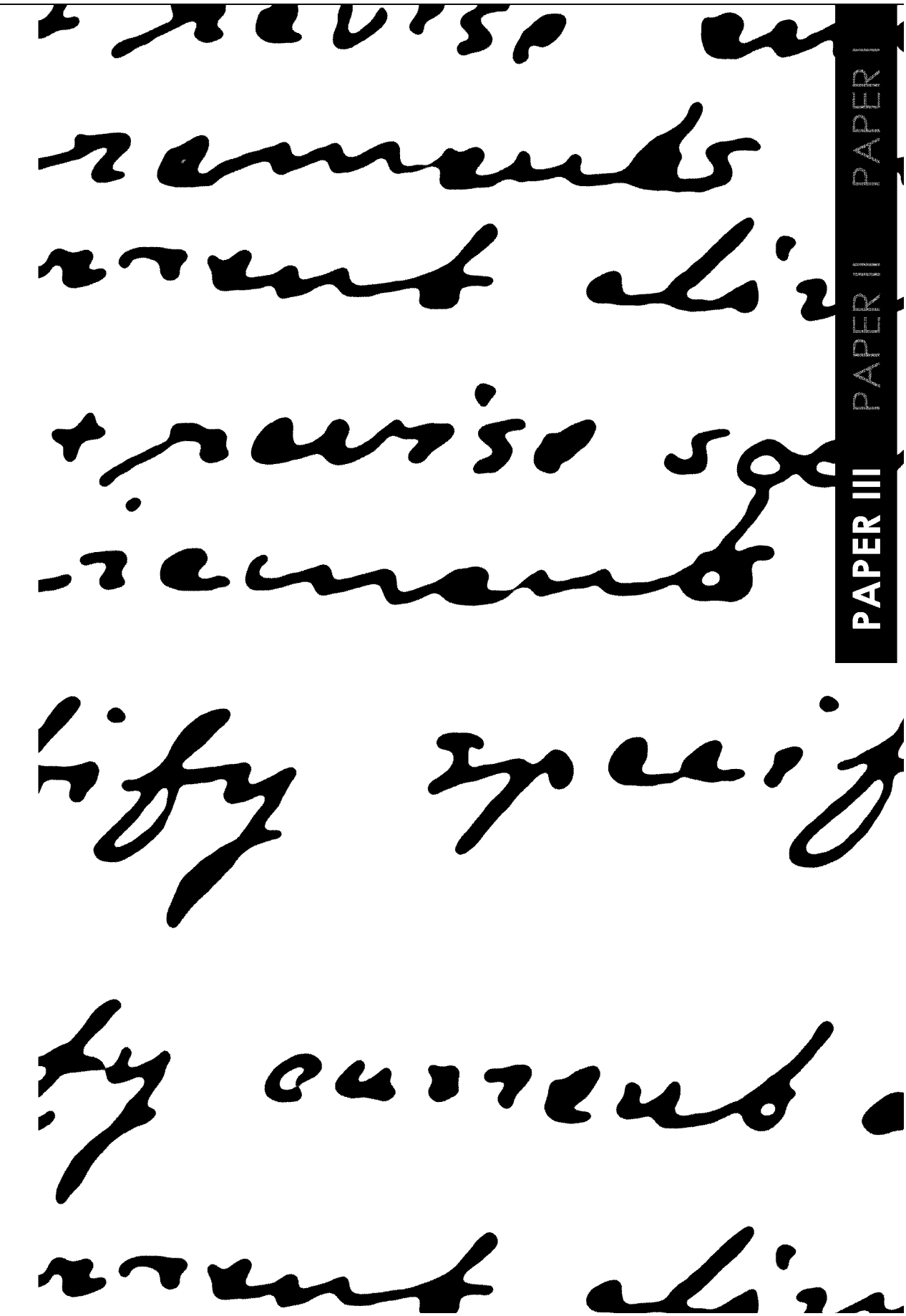
**Melin, K.** 2005. Nätverket tänker försöka hejda flera av de byggplaner som finns (The network tries to stop several existing building plans). Pages 10 *in* Mitt i Östermalm, 15 March, Stockholm.

**Sundström, A.** 2005. Nej till bostäder vid Husarviken (No to flats in Husarviken). *in* Dagens Nyheter, 13 December, Stockholm.

**Waldenström, H.** 1995. Ekopark blir nationalstadspark: Kampen om Ulriksdal - Haga-Brunnsvik - Djurgården (The Ecopark becomes the National Urban Park). Pages 157-170 in B. Hallerdt, editor. *Ekoparken: Nationalstadsparken Ulriksdal - Haga-Brunnsviken - Djurgården (The Ecopark: The National Urban Park)*. Samfundet S:t Erik Stockholm, Uppsala.

**Waldenström, H.** 2004. Ekoparkens historia (The history of the Ecopark). *in*. Förbundet för ekoparken (The Alliance of the Ecopark). Homepage, www.ffe.org, 2004-10-14, 15:12.

**Cyram.** 2004. NetMiner II. Ver.2.5.0 Seoul: Cyram Co., Ltd. Copyright (c) Cyram Co., Ltd. 2001-2004. All rights reserved



PAPER III PAPER II PAPER I

Ernstson, H. and S. Sörlin. 2009. Weaving protective stories: connective practices to articulate holistic values in Stockholm National Urban Park. *Environment and Planning A* (in press; EPA 40/349)

# Weaving protective stories: connective practices to articulate holistic values in Stockholm National Urban Park

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**Abstract.** With rapid worldwide urbanization it is urgent to understand processes leading to protection of urban green areas and ecosystems. Although natural reserves are often seen as preserving "higher-valued" rather than "lower-valued" nature, it is more adequate to describe them as outcomes of selective social articulation processes. This is illustrated in Stockholm National Urban Park. Despite strong exploitation pressure, a diverse urban movement of civil society organizations has managed to provide narratives able to explain and legitimize the need for protection, a *protective story*. Based on qualitative data and building on theories of value articulation, social movements and actor networks (ANT), it is shown how activists by interlacing artefacts and discourses from cultural history and conservation biology managed to simultaneously link spatially separated green areas previously seen as disconnected, while also articulating the interrelatedness between the cultural and natural history of the area. This *connective practice* constructed holistic values articulating a unified park, which heavily influenced the official framing of the park's values and help explain the success of the movement. In contrast to historically top-down led designation of natural reserves, it is argued that the involvement of civil society in protecting nature (and culture) is on the rise. This nonetheless begs the question concerning who can participate in these value-creating processes and the paper also strives to uncover constraining and facilitating factors for popular participation. Four such factors are suggested: (i) the number and type *of artefacts* linked to an area; (ii) the capabilities and numbers of *activists* involved; (iii) the access to *social arenas*; and (iv) the *social network position* of actors.

**Keywords.** Protective story, urban landscape, national parks, social networks, urban movements, narratives, conservation

## Introduction: social articulation and protection narratives

Natural reserves are often seen as preserving "higher-valued" nature rather than "lower-valued". This is, however, a circular argument. There is no innate absolute geographical hierarchy of places or objects. That a part of nature (or culture) is preserved demonstrates only that it has acquired higher value in a particular society at a particular time (Sörlin, 1998). A more adequate way of conceiving the status of natural reserves is therefore to describe them

as results of social processes operating in the background, "selecting" some areas, or species, worthy of protecting (Adams, 1996; 2004).

This is illustrated in the National Urban Park in Stockholm (figure 1), a large and central green area associated with Sweden's royal past, which in 1995 acquired legal protection through a new law adapted to urban green areas. The Ecopark Movement has been actively and successfully protecting the park areas from exploitation since the early 1990's and, as we have previously shown in a social network study (Ernstson et al, 2008), the movement played a critical role in the establishment of the new law, and in directly stopping or changing several exploitation plans. Thus, despite one of the highest exploitation pressures in Sweden, with sky-rocketing real estate prices, the integrity of the green area is upheld (figure 2).

In our empirical research we have found interesting factors that explain the success of the Ecopark Movement. At the same time our results speak to the establishment of protection of nature and culture in general. The Ecopark Movement has managed to engage, in the form of a network, a diverse set of different organizations, from local user groups to politically active organizations, as well as provide narratives able to explain and legitimize the need for protection. These narratives have become widely spread both within the Ecopark Movement and among the public at large. The movement has, both literally and metaphorically, woven a *protective story* about and around the park. In this article we analyze this protective story. What values does it articulate? What components does it contain? How do movement activists construct it? And how is it possible for them to perform their craft?

Research on value-creating processes highlights the importance of social articulation, i.e. the work of social actors to mobilize recognition for certain places or objects (Sörlin, 1998). Such processes are typically also connected to the formation of collective identities, most significantly national identity but also local, regional, ethnic, colonial, or competitive market identities (Paasi, 1986; Harvey, 1996; Sörlin, 1999; Adams, 2004). Crucial in these processes are artists, authors, and scientists. They produce artefacts such as paintings, maps, buildings, and scientific reports that in turn are used on different social arenas, especially media, through which landscapes and objects are represented and become part of public discourse and collective memory (Halbwachs 1952/1992; Connerton, 1989). The articulation of values by knowledge elites through social arenas often precedes the designation of certain sites or landscapes as protected areas, reserves, or national parks. Landscapes have been, just like people, "nationalized" through the active work of social elites (Mosse, 1975; Sörlin, 1999; Sörlin and Nordlund, 2003).

Inspired by actor-network theory (Latour, 2005; Callon, 1986; Castree and MacMillan 2001), we here view value-creating processes as a *political programme* that gain power as actors "pick up" artefacts produced by other actors and translate them to fit the programme to give it "weight" (Latour, 2005). This process of assembling actors and artefacts into actor-networks could for instance mean to demonstrate how an historical photo or map, or a researcher's diagram over red-listed species, relate to a certain place or object. With Callon (1986) we may speak of a "sociology of translation" whereby certain "A-actors" start this process of assembling actor-networks to both become its "obligatory passage point", and, if successful, manage to sustain an actor-network that articulates or translates certain values (and not other). While such networks do not possess power in any formal sense they can achieve a lot, i.e. gain power, both as a "community of practice" wielding power and knowledge (Fox, 2000; Wenger, 1998; Foucault 1980), but also through mobilizing yet more actors

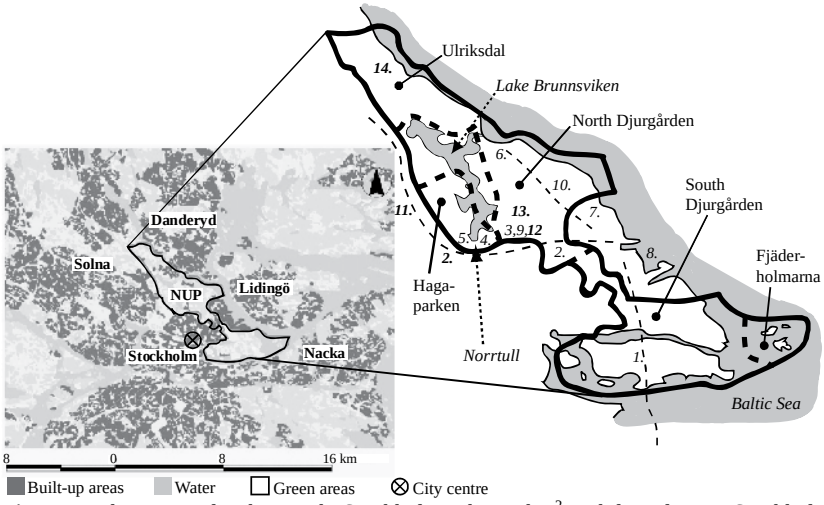


**Figure 1.** The National Urban Park, Stockholm. The 27 km$^2$ park lies close to Stockholm City, Sweden's political and economic centre, and stretches mainly into Stockholm and Solna municipalities (see left map). It is made up of different historical parts (right map), which were conceptually linked by the Ecopark Movement through their protective story and later also administratively united and protected through the National Urban Park Law in 1995. Numbers in the right map show planned exploitations, some already built (bold numbers). More information on exploitation plans are found in Ernstson (2007).

and artefacts to make the actor-network grow (Forsemalm, 2007). Focus in our analysis will thus be on the practice of weaving actors and artefacts together in order to produce narratives able to explain values, but also why just a certain set of values are allowed to resonate through the protective story. In this context narrative is practice, and as we shall see a very useful one when it comes to supporting preservation.

Historical research has uncovered an increasing number of such constructivist narratives of nature and landscape, often resulting in conservation (Baer and Snickars, 2001; Nordlund, 2001). In his *How the Canyon Became Grand*, Stephen Pyne (1998) illustrates how this process unfolded during the 19$^{th}$ and early 20$^{th}$ centuries for the Grand Canyon, which emerged as one of the natural marvels of the world, rising from insignificance through a range of articulations and representations by geologists, painters, authors, photographers, and preservationists – who had a pre-conceived ideology for protecting it – and finally with President Theodore Roosevelt and his wife visiting the "sight" that the site had then become.

However, this and similar research has mainly focused on non-urban landscapes and has only rarely dealt with processes that have taken place in the very recent past, say since the 1980's. This means that they have not yet adequately considered the "recombinant ecology" (Barker, 2000) and what has been called "living cities" (Hinchliffe and Whatmore, 2006) in which urban inhabitants and urban ecology is acknowledged as made up of both humans and non-humans, i.e. both humans, plants and animals, and the call for what we might refer to as a recombinant conservation of the "more-than-human" urban geography (Braun, 2005). Likewise, and as a consequence, most approaches have largely missed out on

**Figure 2.** The photos show some of the many environments of the Stockholm National Urban Park, with (a) oak-dotted pasture lands, (b) deeper forests, and (c) allotment gardens. The building crane in the midst of trees at the fringe of the park (d) exemplifies the ongoing exploitation pressure directed towards the park. Photos by Henrik Ernstson.

the formation of "new social movements" (della Porta and Diani, 2006, pages 8 – 11) or urban movements (Castells, 1983), in which also non-elites are engaged in creating structural change in modern urban societies. Observations in recent research indicate that while the general pattern of social articulation is still valid – i.e. the need for construction of values and the mobilizing role of knowledge broking elites – the social forms and practices of nature conservation may be in a state of change, or at least demonstrate a rather broad variation.[1] Classical "monumental" wilderness areas are complemented by urban "heterotopian" (Foucault, 1967/1984) or "a-monumental" sites. Therefore, the tools, or "artefacts" used in political programmes for conservation are also likely to change, as will some of the content of the narrative itself. National, or nationalist, arguments that functioned to legitimate grand "green field" sceneries are being supplemented, even replaced, with arguments advocating for "brown field" urban nature conservation (Alfsen-Norodom et al, 2004), and the protection of

[1] Here are a few examples from literature of this broad variation of nature conservation: "[T]he grassroots groups" of the South Park Campaign "claiming the creation of a protected green belt in the Southern Milanese periphery" (Diani, 2003b, page 110); the diverse San Francisco Bay Area movement with professional organizations and "local groups working to preserve small neighbourhood natural areas" (Ansell, 2003, page 125); the public space-framed fight over People's Park in Berkeley, California (Mitchell, 1995); the protection of biodiversity rich areas in poor Cape Town suburbs in collaboration with community organizations (Stanvliet et al, 2004); and the restoration of river plains in England (Castree and MacMillan, 2001).

urban green space takes place through the agency of both local movements, NGOs and organizations of low-status groups (Stanvliet et al, 2004).

It is thus an urgent task to research empirically the social forms and articulations of new and emerging protection practices and compare those with similar processes in the past. In the present context of rapid world-wide urbanization (UN, 2005), such research can shed light on what Hinchcliffe and Whatmore (2006) call the "politics of conviviality" to inform practices that are involved in sustaining urban ecosystems to provide better living environments for both humans and non-humans, and resonates with UN's call to intensify research for sustaining urban ecosystems (MA, 2005a). However, although social forms change and more groups are active in protection work now than in the past, not all communities or individuals have the same structural possibilities to engage in the process of constructing values. Consequently, and following the emergent field of urban political ecology (Keil, 2003; 2005), we also analyze critically the actors involved in weaving the protective story to understand the type of values constructed, as well as what factors facilitate and constrain the participation in value-creating processes.

To this end our case-study analysis (Yin, 1994) is based on empirical data that we have generated through ten theme-structured and open-ended interviews (Bryman, 2001), four participatory observations at highly profiled events (regarded by us as important social arenas for articulating values), and through analyzing documents, maps and other artefacts used and/or produced by activists and others (Latour, 2005). Most importantly, five interviewees were selected from a list of most-cited activists generated through the abovementioned social network study (Ernstson et al, 2008). This assured that interviewees were considered by the Ecopark Movement itself to be of importance in protecting the park and thus supposedly more involved in value-creating processes. Descriptive data of these interviews and participatory observations (part.obs.) can be found in Appendix.[2]

**Analysis of the protective story**

In structuring our account we first backtrack the emergence of the Ecopark Movement and the trajectory towards protection of the National Urban Park, here stressing the spatial dimension of these processes and how the emergent protective story link them both. We then use two "A-actors" as entry points for analysis, followed by a description of the different components of the protective story. The components are our analytical meta-categories and we show how the two main components, cultural history and conservation biology, both have a clear spatial dimension and how this have helped construct holistic values, while the third, the usage and welfare component to which we have grouped aspects concerning the direct public use of the park, have been used less for linking areas into a unified whole. In fact, this points to the double-edge character that the "public" represents for the movement, while too much use can harm values constructed by the other two components. In summing up, we describe what we refer to as the movement's *connective practice* of value creation in which the story's components are used to both reinforce each other, as threads in a textile, while simultaneously also linking areas to form greater spatial wholes. We finalize with a critical analy-

[2] All data is stored with the first author who carried out all field work from 2003 to 2006 including low intensity periods of lecturing and parental leaves. Analysis and write-up have been done with the second author. For a detailed information on the method, see Ernstson (2007) and Ernstson et al (2008).

sis of the protective story and compare our findings with earlier research on value-creating processes.

**Linking green areas and mobilizing actors**

In the beginning of the 1990's, the Swedish government negotiated a large infrastructure agreement with a series of linked, major investments of especially motorways in the Stockholm area (Stahre, 2004). Some of these fell inside or close to the present park area. Yet others were issued by the municipalities of Stockholm and Solna, for instance a big hotel and conference centre and thousands of apartments (figure 1). In reaction, a city-wide protest movement grew with some important victories but with a rather quick rise and fall (ibid.). Out of this, the Ecopark Movement emerged as a more long-lived network of civil-society organizations that collectively pursued the narrower goal of protecting the present park areas from exploitation (Ernstson et al, 2008).

In contrast to the city-wide struggle, which used a more direct action repertoire like open demonstrations, blocking of traffic, and even at some instances destroyed construction machines (Stahre, 2004), the Ecopark Movement cultivated a more dialogic and non-confrontational approach. Frequently, and coordinated through a small set of five to six core organizations, the movement lobbied politicians, held informal meetings with civil servants, organized seminars, debates and concerts, and even arranged art exhibitions and guided park tours that spurred media coverage (Ernstson et al, 2008). In the course of these actions, both actors and artefacts were mobilized by movement activists in constructing the protective story we will later analyze. The result was to actually define a new park in Stockholm. The protective story demonstrated that physically distant park areas could be seen as constituting a greater whole through their ecological as well as cultural historical linkages. Before the 1990's, these green areas had generally been regarded as administratively different, separated by their historical past, municipal borders, motorways and power lines that cut through the landscape (Barthel et al, 2005; Bråvander and Jacobsson, 2005).

Following Miller (2000) we may say there is an important geographical dimension to this movement's identity, mobilization and success. The effect of "jumping scales" and to link green areas to a greater whole not only allowed activists to fight spatially separated exploitation plans, but also for core organizations – mainly culture and nature preservation organizations – to mobilize hitherto non-aligned user groups active in different parts of the park (Ernstson et al, 2008). The expanding geography of the protective story stretched the identity of the park and mobilized both boating and horse riding clubs, along with allotment gardens and outdoor life associations (ibid.). This process of linking struggles over space and time is, as Diani (2003a) points out, a characteristic of social movements. However, although informal networks grew stronger during the first years, they remained in general quite weak except for the set of core organizations that shared a strong sense of collective identity and determination (Ernstson et al, 2008; Diani 2003a). It was these tightly-knit organizations and their activists that came to develop a "community of practice" (Wenger, 1998) on how to protect the park through using both their increasing amount of contacts to politicians, civil servants and experts, as well as a range of useful artefacts as we will see. In figure 3, taken from our social network study (Ernstson et al, 2008), this core-periphery structure of the movement is nicely shown, and we will have reason to come back to this figure later on.

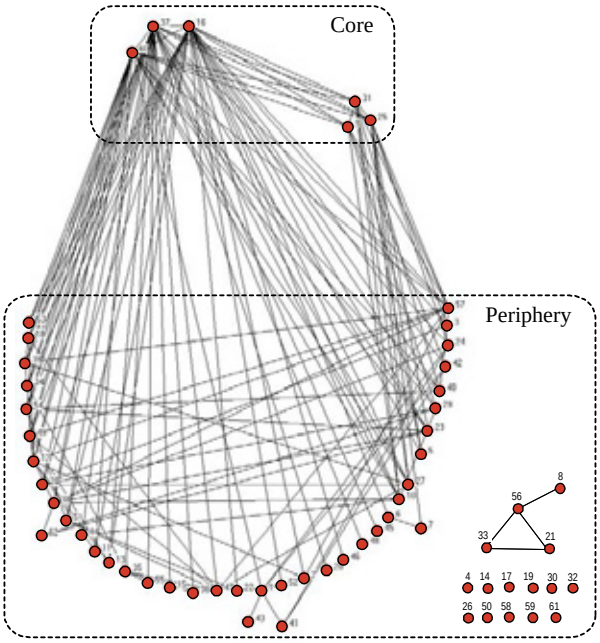


**Figure 3.** The social network of the Ecopark Movement showed a core-periphery structure (Ernstson et al, 2008). All user groups were found in the periphery, while five nature and culture conservation organizations (and one environmental protection organization) constituted the core. A striking pattern was that the core, in direct contrast to the periphery, spent few days in the park but had many political contacts to authorities. The core thus have, through ties to both peripheral organizations and authorities, higher social capital, i.e. contacts from which to gain resources (Bourdieu, 1985). The social network of the 62 organizations was based upon asking all organizations with whom they collaborate and exchange advice (details in Ernstson et al, 2008).

In 1991 an open call was made by 22 organizations to protect the park areas, which soon led to the formation of an umbrella organization, The Alliance of the Ecopark. Today this gathers over 50 member organizations, although some of the most politically active organizations never became members showing that there is more to the movement than just the umbrella organization. Earlier the same year, three parliamentary motions, two initiated by core organizations (interview 1), were submitted that called for protection (for details, see Ernstson, 2007). This sparked heavy resistance from municipal politicians fearing that valuable urban space would be locked away from housing and infrastructure projects seen as needed to boost Stockholm's competitiveness in a globalizing economy (Stahre, 2004; cf. Sassen, 2002). Nonetheless, through sustained political activity, the movement encouraged and put pressure on decision makers, which aided the passing of the law in 1995 (National Parliament, 1994/1995). The law and its supplementary proposition reflected the movement's holistic vision of a connected park, with very similar references to both the park's biological

and cultural historical values, as well as its geographical extension (interviews 1, 6 and 9; Waldenström 1995; Holm and Schantz, 2002). The movement had won a great victory, and although other factors certainly played a role in passing the law, the movement played a crucial part in creating and providing conceptual tools that were later adopted by authorities (cf. Boström, 2004; Melucci, 1996). In our analysis these are gathered under the concept, "the protective story".

**Entry points to the protective story: The early labour of two "A-actors"**

Two activists, later to become leading figures, embodied the early aspiration in the movement. They reminisce of Callon's (1986) A-actors, mobilizing interests, organizations, and providing knowledge based arguments for and prototype versions of the narrative that was later to coalesce into the full bodied protective story. They would also later function as "obligatory passage points" with key power wielding positions. We here briefly introduce them as ideal types in the Weberian sense, and use them, based on interviews and field documents (interviews 1 and 10; Waldenström, 1991, 1995, 2004; SvD, 1990; Schantz, 1990, 2004), as entry points for our analysis.

The first activist was already politically active in 1990 in the environmental movement. He grew up close to the park and was a devoted bird watcher. In reaction to the exploitation plans in the North part of the park he launched a project within Stockholm Ornithological Association to monitor birds in the area. The data indicated that the different historical park areas were ecologically connected. For example, the tawny owl and the stock dove were shown to be linked to the historical landscape of the oak-dominated forest originating from the royal heritage. To manage the area in a sustainable way, they proposed that the area needed to be managed as whole, not just as smaller sub-areas. Through his personal contacts with the Royal Administration of Djurgården (KDF), an organization managing greater parts of the area, he was commissioned to write a report on the findings released in January 1991. In the report, the area of *Ulriksdal-Haga-Brunnsviken-Djurgården* and *Fjäderholmarna* was baptized "The Ecopark" (figure 1). Later the report formed the blueprint for one of the three parliamentary motions that demanded protection of the area.

The second activist had not been politically active before. He grew up in the affluent inner-city area just south of the Haga Park and played in the park as a boy. In 1990, without knowing about the first activist, he worried about the mounting exploitation plans around *Lake Brunnsviken*. Since no public sources gave him answers, he compiled, mainly using newspaper articles and official reports, a startling image of all building plans directed towards the area. In November 1990 he was given the opportunity to voice his opinion as the leading Stockholm and national conservative newspaper published a critical editorial regarding the heavy exploitation plans. He reckoned that if a conservative paper was hostile to exploitation, siding surprisingly with the environmental movement, there were possibly powerful interests that wanted to stop exploitation. In a reply he argued for a restoration from an "aesthetical-historical" perspective of the park area at *Norrtull* and he later pointed out a cultural historical "axis" that runs from the North to the South along the different royal parks of *Ulriksdal-Haga-Bellevue* towards the city centre and the Royal Castle. He argued that this landscape, in its entirety, should be considered of national interest, and that the issue of exploitation should be lifted to a national level. Another of the three parliamentary motions originated from his efforts.

These two holistic visions – or stories, one focused mainly on the ecological connections between the areas and the other on connections through cultural history – were later merged as the struggle intensified and activists and organizations started to cooperate on a more regular basis. We now turn to these aspects, and show both the extraordinary ability of the area to attract artefacts from artists and scientists, and how this seems to have facilitated and also structured the weaving of the protective story.

**Cultural historical component: Connectivity through artefacts**

The National Urban Park is known as a prestigious area in Stockholm, mainly because large parts of the present park became Royal land in the 16th century with a growing legacy of artefacts such as castles, opera houses, planned English parks, landscapes and sculptures that conveniently form "natural" parts of Sweden's cultural history (see extensive table in Ernstson, 2007). The Royal family also decided to make *Haga* its official burial site, connecting it through the spirit of the soul to time immemorial, and from the 19th century the already existing artefacts were complemented by an impressive array of scientific institutions and national museums (ibid.). We can derive the area's significance as a site of production of artefacts from two mutually reinforcing phenomena. One was the direct buying power of the King, or of nobility with estates in the area, that commissioned works and projects from artists. The other was the willingness or eagerness of artists to do work for the King as they thought this could enhance their status and secure their name for posterity.

Artefacts thus produced have been used by culture conservation groups and preservation authorities (Ernstson, 2007). An especially illustrative example is the usage of century old maps for planned English parks. In these maps, nationally recognized landscape architects working for the King had hundred of years earlier marked out "sight lines" from which the landscape should be admired. By "picking up" these artefacts from archives and libraries, and reprint the maps in books and exhibition material, activists could translate a cultural-historical value that also made the trick of connecting different green areas to each other. The "cultural historical" sight lines, which stretched over plains and water surfaces, should, according to activists, not be disturbed with new buildings or other exploitation that might muddle their backdrop or even cut them off (Holm and Schantz, 2002). Instead the "intention" of the "original" landscape should be conserved as once envisioned by the original landscape architects (ibid.).

The cultural historical component of the protective story thus moves on the time-scale of centuries as it weaves into the fabric artefacts from different epochs, especially the period between the 16th to 19th century with high centrality for Baroque and Classicist elements – sculptures, buildings, gates, ornaments – and of the English park, but there are also examples when activists have referred to the cultural-historical values of 20th century industrial and harbour landscapes and to ancient remains from the Stone and Bronze ages.

**Conservation biology component: Connectivity through reproduction flows**

The conservation biology component of the protective story originates from a much later period. Conservation biology developed less than half a century ago, and urban ecology started to grow only in the 1990's (Drayton and Primack, 1996; Kingsland, 2005 chapter 9). Concepts like "biotopes", "dispersal corridors", and "core and buffer areas" have been picked up

by a concerned wider public and used for arguing for the preservation of "biodiversity" and "red-listed species".

However, of special importance for movement activists (exemplary shown by the first A-actor) have been on the one hand, principles from landscape ecology through their explicit spatial focus aiding in linking areas to a greater whole, and on the other hand, the production of scientific artefacts linked directly to the area. Activists from core organizations were especially keen on extending the actor-network to find supportive civil servants and university researchers with skills and time to make ecological and biological assessments of the area (interview 1 and 9). As one interviewee explained, these forged collaborative links, while the movement simultaneously put political pressure on the municipalities, were crucial in the early struggle (interview 1):

> "[With the investigation of the municipalities in 1992] the extent of the park's biological diversity was discovered and a great number of its species were found on the national list of threatened species. This new knowledge was merged into a holistic landscape ecological view with descriptions of biological core areas and dispersal corridors."

This scientific effort created valuable artefacts for movement activists (interview 1 and 9), but also seemed to have turned the area into a hot-spot for urban conservation biology research (which in fact continued an old trajectory of natural history in the area). Through more sophisticated analyses using aerial photos and digital mapping techniques, researchers translated species movements, for instance amphibians, into detailed maps of the park's valuable habitats and dispersal corridors (Löfvenhaft et al, 2004), and with the park as a model, tools to account for biodiversity in spatial planning were developed in peer-reviewed articles (Löfvenhaft et al, 2002). This was followed by further reports, dissertations and master theses focusing on the park landscape (see extensive table in Ernstson, 2007). This widened the portfolio of scientific artefacts linked to the park. For activists, this meant that they, typically as here when stating in an appeal that "the last links between the ecological core areas of North and South Djurgåden are threatened" (HBV, 2005), could support their arguments with colourful maps and tables contextualized for their particular area. A more recent example comes from a Stockholm-based research group that selected the park as a local case study, one of 30 worldwide, for the UN Millennium Ecosystem Assessment.[3] This generated even more contextualized scientific artefacts (e.g. Elmqvist et al, 2004; Barthel et al, 2005; MA, 2005b; Lundberg et al, 2008), this time centred on "ecosystem services", or benefits humans gain from ecosystems (Daily, 1997), in which the "social-ecological systems" of the park were translated as production units of such services.

The point is this: not only could activists lend concepts from conservation biology to explain their point, but also – through reproducing artefacts in exhibitions, homepages and books (Holm and Schantz, 2002) – gain scientific support contextualized to their own particular area. And although both Stockholm University and the Royal Institute of Technology actually lie inside the park, which could explain some of the extensive research activity, the

[3] The research group was based at the home department of the first author of this paper.

production of artefacts was also triggered through the labour of activists in forging collaborative links, mobilizing and aligning new actors and artefacts to the emergent actor-network.

**Usage and welfare component: Ambiguity of people**

The Ecopark Movement often claims to preserve the park in the name of the citizens of Stockholm. In framing its history, the movement often presents the park as an area that has been used by "ordinary" people, not just the "aristocracy" (e.g. Brusewitz and Ekman, 1995). The love of Stockholmians of "their" park is envisioned by activists as a "mental protection" towards further exploitation (interview 9). Moreover, initiated strategically by a core organization (WWF), tourism has been used as a weight for the political programme. With guided tours, especially by boat, the values of the park and the various threats it faces, have been disseminated to a larger audience, while at the same time objectifying the park and turning it into an economic value for the tourist industry (interview 9, part.obs. 2; Waldenström 2001, pages 5 and 84 – 85).

These recreational and tourist aspects seem, however, to have been used less to connect the landscape and bring out holistic values, which partly might have to do with the ambiguous connotations that the "public" represent for the movement. Too much "recreation", too many people visiting and using the park, could lead to degradation of the cultural historical and conservation biology values. This becomes clear when opponents and others frame the park as a collective utility and argue for increased exploitation close to the park, as in this consultancy report (Nordström and Ståhle, 2006, page 5):

> "If the objective is to increase the number of potential and real visitors to the park in order to reach a more effective use, then the exploitation rate around the park should increase. At the end, the attractiveness of the National Urban Park and its usage as a collective utility, depend on its users."

This ambiguity, the double-edge character of the public-turned-users, has surfaced and produced conflicts also within the movement as core organizations have turned hostile and taken action to stop certain events to be staged in the park, e.g. concerts, circuses and orienteering competitions (interview 6 and 9). For instance, when the umbrella organization decided to oppose one of the most famous orienteering events in Sweden, the orienteering club seceded as member (interview 6).

**A connective practice of value creation (for certain values)**

As we have tried to make clear, starting with the two A-actors, there was at the early stage two quite separate visions of the park. One centred on conservation biology, and the other on cultural history, both with a clear spatial and narrative pattern. They told of something that had emerged and grown over long periods of time: the establishment and adaptation of species, the growth of majestic, solemn buildings and beautiful, dignified parks and vistas, designed by leading Swedish architects on behalf of royals and nobility. This challenged the traditional way of arguing for natural and cultural "values", which was built on stacking facts and artefacts meeting a set of legislative criteria in what can be referred to as an *additive practice*. True, Swedish legislation for preservation of culture, dating from the 17$^{th}$ century in its original form, had undergone change but retained a focus on objects and sites, slowly

complemented by a cultural landscape orientation only since the 1980's. Nature conservation, since its inception in 1909 (Sundin, 1989), functioned in a similar way, focusing on the so called protection value of individual species or unique sites.

In contrast, core activists in the Ecopark Movement developed, as they went along, a novel approach of constructing values for conservation. We refer to this as a *connective practice* of value-creation, which rests upon two dimensions. Firstly, the spatial character, as we have seen, was employed in order to link areas together to form greater spatial wholes. Secondly, the interrelatedness of the two stories, of cultural history and conservation biology, was articulated, we might even say discovered as an effective urban protective narrative, which hitherto had been uninterested in recombinant brown field ecologies. The early explorations in 1991 by one A-actor and his ornithological allies, showed for example how the tawny owl and the stock dove (the biology) were linked to the historical and royal oak forests (the cultural history) and this was an indication followed up by other actors. Especially researchers could in detail strengthen the notion that the cultural use of the park, both by royals and allotment gardeners, had generated high levels of biodiversity and ecosystem services (e.g. Löfvenhaft, 2002; Barthel et al, 2005).

One part of the connective practice was, as we have seen, to "pick-up" existing artefacts to articulate the linkages they felt existed between nature and culture. Another crucial part was to produce distinctly new artefacts crafted especially to express this dimension of the protective story. Besides argumentative opinion editorials, homepages, and lavish hardcover books (extensive account in Ernstson, 2007), the most illustrative example of this were the sketches and maps produced by an engaged landscape architect. These were aimed at displaying the interconnectedness of values in the landscape and an example is shown in figure 4. Activists presented these sketches as outcomes from "citizen planning" processes (interview 1) and used them as base for arranging exhibitions and debates at several points in time. This not only directly confronted politicians and decision-makers to alternative plans for areas planned for exploitation, but also established important social arenas on which to articulate the protective story (part.obs. 3). The sketches – some also reproduced by journalists – helped to project the protective story, both into the future, and onto a real landscape, making it more tangible. This illustrates not only the obvious, that it takes an actor to make an artefact, but also the important linkages between actors, artefacts and social arenas and how they build upon each other in articulating values.

The connective practice, in sum, has linked not only different parts of the landscape into a unified narrated whole, but also produced a narrative interlacing culture and nature in which the collective value of the individual species, trees, buildings, monuments, places, vistas etcetera, became more than the sum of the parts. It became concrete, coherent and visible to everybody; not just the public, but the experts as well; conservation and preservation specialists came together across the conventional ecology/history divide, and city and urban planners also had to align with the new rules of the game as expressed eventually in the protective law. This trick, so to speak, of combining different sets of values creates flexibility in that the protective story can be used differently on different social arenas, to gain the support of different types of audiences. This looseness also helps explain the movement's success in that opponents have had difficulties both in brushing them off as just another Nimby group ("not-in-my-backyard"), or as an elite project (to guard the "King's park"). The components of the protective story firstly link the movement to a context larger than the neighbourhood: a

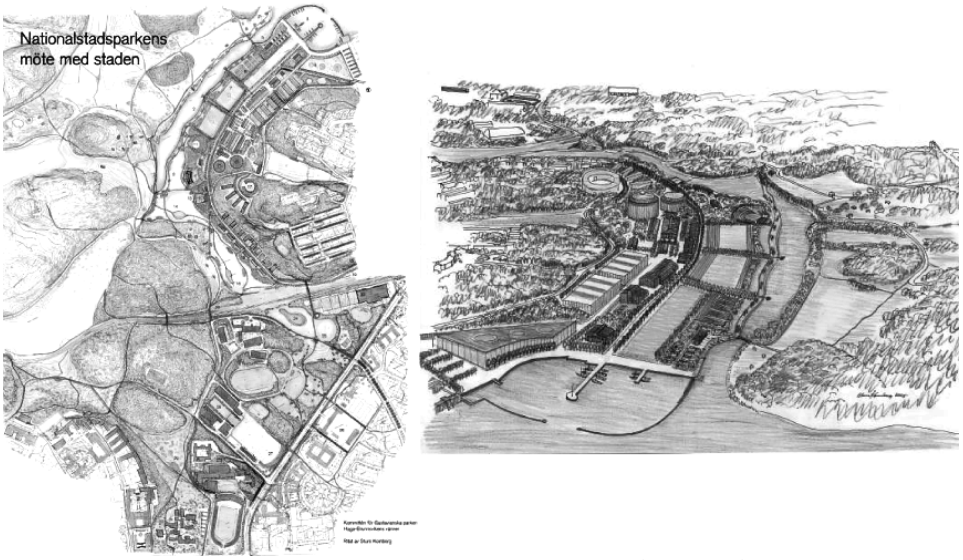


**Figure 4.** The Ecopark Movement has also produced their own artefacts. The figure shows sketches made by an engaged landscape architect and points out an alternative future for the *Husarviken* area. Building on these sketches, movement organizations arranged in 2005 an exhibition and debate at the Royal Academy of Fine Arts, Stockholm (part.obs. 3) to confront municipal plans for exploitation. Similar sketches and exhibitions for other areas have been produced before (1991-1992, 2005) and is recurrent practice for the movement. (Images by courtesy of landscape architect Sture Koinberg, copyright 2006. Original versions in colour.)

cultural history that builds the identity of a city and a nation, and conservation biology principles that underpin the political goals of sustainable development. Secondly, the place-based and local aspects of the protective story, have made it easier to mobilize support among local user groups to increase legitimacy of the political programme.

We can now turn to the more critical question of why certain values do not resonate in the protective story, especially those of direct use. First, and by recollecting the social network graph in figure 3, core organizations are all nature and culture conservation organizations (and one environmental protection organization), while user groups are peripheral. As shown in our network analysis (Ernstson et al, 2008), their greater social capital in the form of contacts to both movement organizations and state agencies (Bourdieu, 1985; Burt, 2005), give core organizations greater access to both actors, artefacts and social arenas and they can thus easier become dominant in assembling the actor network. Cast differently, we suggest that it is their social capital that sustain them as the "obligatory passage point" of this political programme and based on this dominance they can "select" values to include and exclude. The motive for excluding values of direct use seems to be both out of tactical reasons – direct use lacks a clear spatial dimension and is not very helpful in linking green areas – and for ideological reasons – too much use of the park, as we saw above, can destroy the values cre-

ated by the two other components of the protective story.[4] Here it is also worth mentioning that in spite that social equity arguments were often used in the planning of Stockholm's city parks throughout the 20th century, in particular the notion that parks are "for everybody", regardless of class and wealth (Bucht, 1997; Sandell and Sörlin, 2000), these play a minor role in the protective story of this case. We can partly explain this through the fact that the National Urban Park is situated in the vicinity of almost universally wealthy areas, making such arguments sound hypocritical and with a potential to challenge the unity of the movement.

**Knowledge production and the political geography of urban landscapes**

This case points to the importance for analysts to direct attention not just to political ideas or abstract discourses, or simplistically explain social change by referring to "leaders with a vision". But, to also search for those artefacts that actors "pick-up" and construct themselves in order to articulate their visions and give weight to their political programmes. Both actors *and* artefacts are important. It is the continuous assembling of humans and non-humans into actor-networks that give shape to values, "visions", and protective stories, and through this type of analysis we can come close to the actual construction process. Furthermore, through tracing the actors in their course of action (Latour, 2005), we can encounter important social arenas on which these assemblages of actors and artefacts are articulated. As argued by Latour (2005), political programmes gain power as they are set in a constant state of "becoming" on various social arenas, for instance in a debate forum directing a large audience, in newspapers through opinion editorials, or in television programs, exhibitions, and lecture rooms. And although existing artefacts certainly seem to facilitate this process, knowledgeable actors are nonetheless needed to make the connections and bring the political programme to life on these arenas.

This observation is in line with research on social movements, which have been viewed as important knowledge producers in society as their practice or activism creates new conceptual tools (Eyerman and Jamison, 1991; Melucci, 1996; Boström, 2004). Through our analysis we have seen how closely linked this is to the use of artefacts and emergence of actor-networks where some actors strive to play the role of "obligatory passage points" and thus to control the knowledge produced (Fox, 2000). Casting this against the emergent literature that "challenge the view that cities are the antithesis to nature" (Braun, 2005), we can also observe how the heterogeneous set of actors – from the movement organizations of the Ecopark Movement to researchers and civil servants – are engaged in a "politics of conviviality" (Hinchcliffe and Whatmore, 2006). As they partake in weaving the protective story, they create a new sensibility, a new ontology (captured in the actor-network), out of which new urban values can be translated or uncovered, and in which both humans and non-humans are recognized as members of a "more-than-human" urban fabric (cf. Braun, 2005).

To sum up, our case suggests at least four interlinked factors that influence the weaving of protective stories for urban green areas: (i) the number and type of *artefacts* linked to an area, especially such artefacts that can be used in a connective practice to link dispersed spatial units and bring out holistic values; (ii) the capabilities and also the numbers of *activ-*

[4] This suggests an interesting dialectical relationship between social network structure and value-creation processes, and how Callon's "obligatory passage points" are constituted. We will elaborate this in a forthcoming paper.

*ists* involved while it is just certain actors that possess the skills to recognize certain types of artefacts and know how to link them together; (iii) the access to *social arenas* on which the values of the protective story can be articulated; and (iv) the *social network position* of actors, while this seems to influence the selection of values articulated in the protective story. High levels of these factors would facilitate, whereas low levels would implicate constraints in the preservation of urban greens.

In that sense there is a salient political geography of protection at the city level that needs to be analyzed in dimensions of power, resources and equity rather than be regarded as a linear historical process of progress or decline (cf. Heynen, 2003; Brownlow, 2006). In Stockholm this means that there might be neighbourhoods and communities losing "their" green areas as these are sacrificed on the altar of the National Urban Park. The strong protection of the latter repels the exploitation pressure, which will seek out green areas for which a strong enough voice for resistance does not exist, or can not be created, presumably following patterns of unequal human geographies (Harvey, 1996). This in fact also relates to the city's ecological resilience (Alberti and Marzluff, 2004; Andersson, 2006), while if these lost green areas are crucial in city-spanning ecological networks, then the overall capacity in maintaining functioning ecosystems might decrease drastically (cf. Andersson and Bodin, *submitted*). As also recognized by Heynen (2003), this points to the importance of recognizing ecological processes and scales in urban political analysis. However, as our analysis also implies, the Ecopark Movement might have increased the general protection value of green areas in Stockholm through placing them on the agenda and in developing new conceptual tools from which to recognize their multiple values.

**Conclusion: A new understanding of preservation?**

As a reserve this urban green space has been unusual all through. Natural reserves typically are located far away from urban centres. The largest Swedish national parks have, since the first park legislation in 1909, been in extremely sparsely populated areas in Northern Sweden (*Lapland*), partly because of the nationalist values that were articulated about the mountain landscape but also because few existing economic interests were infringed upon by the parks.

In Stockholm, the pattern is starkly the opposite: the Ecopark Movement, and the strong popular opinion, was formed because of the density of people and the amount of organized activity in relation to the area. There are also similarities, importantly the fact that social knowledge elites played important roles both here and in the articulation of yesterday's protective values. But the dissimilarities dominate. The National Urban Park differs from most parks and reserves insofar as boundaries are permeable and not strict. Typically, in old style reserves, there existed tight regulations of what was allowed (e.g. hiking and similar outdoor activities, for nature-loving city-people) and what was prohibited (e.g. hunting, forestry etc., by user-oriented local people). In most cases, urban elites have been favoured *vis-à-vis* local populations. Further, earlier formation of reserves was expert-based, centralistic, "top-down", exclusive, and dualist: either you are in the park under a strict set of rules, or you are outside with no rules. Perhaps most strikingly, local citizens and stakeholders were rarely consulted and had little initiative in forming the protective story (Sundin, 1989).

The National Urban Park follows a different trajectory. Here civil society reacted and put pressure on politicians and decision-makers to protect a natural and cultural area. Activists from civil society, organized through informal networks, constructed the area's specific

values, not experts or bureaucrats. The same activists put pressure on the National Parliament in order to pass a protective legislation. The law itself is of an unknown kind, both since it concerns an urban area but primarily because activists purposively blended different genres of values into their protective story and not only biological values. The boundary is negotiable, rather than strict, and permeable rather than solid. More activities are allowed and the geographical boundary is blurred and vague; exploitation outside the park can also be stopped if natural or cultural values are infringed upon inside the protected area. This is a non-dualist version of territorial protection, based on civil initiative by activists, "bottom-up", and a result of an interactive process between organizations, media, local and public authorities.

Rather than scarcity of people it is the density of social activity and organization in and around the protected area that on a general analytical level can explain the establishment of the National Urban Park. This may seem like a paradox in the preservation discourse, but should come as no surprise in social theory. Significant results from the social sciences have demonstrated the importance of dense social networks to establish and maintain an active democracy and a good economic performance (a classic is Putnam et al, 1994). Dense social networks and active social relations go hand in hand with trust and openness which brings down transaction costs and makes cooperation, and hence efficient resource use, easier.

These observations, we argue, carry a lot of weight for the analysis of how sustainability and conservation issues are playing out socially and politically in contemporary society. Old style top down, expert based conservation was the natural outcome of government and brokerage of traditional vested interests. The National Urban Park indicates rather that flexible, citizen-based, interactive and permeable forms of conservation – moderated through a political geography – are on the increase. Social involvement, rather than social exclusion – more people and high social density – seem to be favourable properties of conservation trajectories.

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**References**

Adams W N, 1996 *Future nature: A vision for conservation* (Earthscan Publications, London)

Adams W N, 2004 *Against extinction: The story of conservation* (Earthscan Publications, London)

Alberti M, Marzluff J M, 2004, "Ecological resilience in urban ecosystems: Linking urban patterns to human and ecological functions" *Urban Ecosystems* **7** 241 – 265

Alfsen-Norodom C, Lane B D, Corry M, 2004, "Urban biosphere and the society. Partnerships of cities" *Annals of the New York Academy of Sciences* **1023** 1 – 334

Andersson E, 2006, "Urban landscapes and sustainable cities" *Ecology and Society* **11**(1) 34

Andersson E, Bodin Ö, "Testing network based models of habitat fragmentation in complex landscapes - implications for management" Submitted to *Journal of Applied Ecology*

Ansell C K, 2003, "Community Embeddedness and Collaborative Governance in the San Francisco Bay Area Environmental Movement" in *Social Movements and Networks - Relational Approaches to Collective Action* Eds M Diani, D McAdam (Oxford University Press, Oxford) pp 123 – 144

Baer N S, Snickars F (Eds), 2001 *Rational Decision-making in the Preservation of Cultural Property* (Dahlem Workshop Report, Dahlem University Press, Berlin)

Barker G (Ed), 2000 *Ecological Recombination in Urban Areas*. (The Urban Forum/English Nature, Peterborough)

Barthel S, Colding J, Elmqvist T, Folke C, 2005, "History and local management of a biodiversity-rich, urban, cultural landscape" *Ecology and Society* **10**(2) 10

Boström M, 2004, "Cognitive Practices and Collective Identities within a Heterogenous Social Movement: the Swedish environmental movement" *Social Movement Studies* **3** 73 – 88

Bourdieu P, 1985 "The forms of capital" in *Handbook of theory and research for the sociology of education* Ed J.G. Richardson (New York: Greenwood) pp 241-258

Braun B, 2005 "Environmental issues: writing a more-than-human urban geography" *Progress in Human Geography* **29**(5) 635 – 650

Bråvander L-G, Jacobson R, 2005, "Skötselplan Nationalstadsparken" (Management plan of the National Urban Park), Kungliga Djurgårdens förvaltning (KDF; The Royal Administration of Djurgården), Stora Skuggans väg 22, SE-11542 Stockholm

Brownlow A, 2006 "Inherited fragmentations and narratives of environmental control in entrepreneurial Philadelphia" in *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism* Eds NC Heynen, M Kaika, E Swyngedouw (Routledge, London) pp 208 – 225

Brusewitz G, Ekman H, 1995 *Ekoparken: Djurgården – Haga – Ulriksdal (The Ecopark : Djurgården – Haga – Ulriksdal)* (Wahlström & Widstrand, Stockholm)

Bryman A, 2001 *Social Research Methods* (Oxford University Press, Oxford)

Bucht E, 1997 *Public Parks in Sweden, 1860-1960: The Planning and Design Discourse* PhD dissertation, Swedish University of Agricultural Sciences, Alnarp, Box 7070, SE-75007 Uppsala

Callon M, 1986 "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay" in *Power, action and belief: a new sociology of knowledge* Ed J Law (Routledge, London) pp 196 – 223

Castells M, 1983 *The City and The Grassroots* (E. Arnold: London)

Castree N, MacMillan T, 2001 "Dissolving Dualisms: Actor-networks and the Reimagnitation of Nature" in *Social Nature: Theory, Practice, and Politics* Eds N Castree, B, Braun (Blackwell, Oxford) pp 208 – 224

Connerton P, 1989 *How Societies Remember* (Cambridge University Press, Cambridge)

Daily G C (Ed), 1997 *Nature's Services: Societal Dependence on Natural Ecosystems* (Island Press, Washington D.C.)

della Porta D, Diani M, 2006 *Social Movements: An Introduction* (Blackwell Publishing, Oxford)

Diani M, 2003b "Leaders' or Brokers? Positions and Influence in Social Movement Networks" in *Social Movements and Networks: Relational Approaches to Collective Action*, Eds M Diani, D McAdam (Oxford University Press, Oxford) pp 105-122

Diani M, 2003a, "Networks and Social Movements: A Reserach Programme" in *Social Movements and Networks: Relational Approaches to Collective Action* Eds M Diani, D McAdam (Oxford University Press, Oxford) pp 299 – 319

Drayton B, Primack R B, 1996, "Plant species lost in an isolated conservation area in Metropolitan Boston from 1894-1993" *Conservation Biology* **10**(1) 30 – 39

Elmqvist T, Colding J, Barthel S, Borgström S, Duit A, Lundberg J, Andersson E, Ahrné K, Ernstson H, Folke C, Bengtsson J, 2004, "The Dynamics of Social-Ecological Systems in Urban Land-

scapes: Stockholm and the National Urban Park, Sweden" *Annual New York Academy of Science* **1023** 308 – 322

Ernstson H, 2007 *The Drama of Urban Greens and Regimes: Social Movements and Ecosystem Services in Stockholm National Urban Park* Licentiate in philosophy thesis, Department of Systems Ecology, Stockholm University, SE-10691 Stockholm

Ernstson H, Sörlin S, Elmqvist T, 2008 "Social Movements and Ecosystem Services - The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm" *Ecology and Society* (in press)

Eyerman R, Jamison A, 1991 *Social Movements. A Cognitive Approach* (Polity Press, Cambridge)

Forsemalm J, 2007 *Bodies, Bricks and Black Boxes: Power Practices in City Conversion* PhD dissertation, Department of Ethnology, Gothenburg University, SE-40530 Göteborg

Foucault M, 1967/1984, "Des Espace Autres" *Architecture, Mouvement, Continuité* 5 **October 1984** 46 – 49

Foucault M, 1980 *Power/Knowledge: Selected Interviews and Other Writings 1972-1977* (Harvester, Hempsted)

Fox S, 2000 "Communties of Practice, Foucault and Actor-Network Theory" *Journal of Management Studies* **37**(6) 853 – 867

Halbwachs M, 1952/1992 *Les cadres sociaux de la mémoire* (Presses Universitaires de France, Paris) translated and edited into English in L A Coser, 1992 *On Collective Memory* (University of Chicago Press, Chicago)

Harvey D (1996) *Justice, Nature and the Geography of Difference* (Blackwell, Oxford)

*HBV*, 2005, "Husarviken – en gudomlig del av nationalstadsparken? Samrådsyttrande över detaljplan för del av Norra Djurgårdsstaden i Hjorthagen" (Husarviken – a divine part of the National Urban Park?), a statement of opinion from Haga-Brunnsvikens vänner (The Friends of Haga-Brunnsviken) dated Nov 8, 2008, call number S-Dp 2001-07633-54, Stockholms stadsbyggnadskontor (Stockholm City Building Office), Tekniska Nämndhuset, Fleminggatan 4, Box 8314, SE-104 20 Stockholm

Heynen N C, 2003, "The Scalar Production of Injustice within the Urban Forest" *Antipode* 980-998.

Hinchliffe S, Whatmore S, 2006 "Living cities: Towards a politics of conviviality" *Science as Culture* **15**(2) 123 – 138

Holm L, Schantz P (Eds), 2002 *Nationalstadsparken: ett experiment i hållbar utveckling (The National Urban Park: an experiment in sustainable development)*(FORMAS, Stockholm)

Keil R, 2003 "Progress Report: Urban Political Ecology" *Urban Geography* **24**(8) 723 – 738

Keil R 2005 "Progress Report: Urban Political Ecology" *Urban Geography* **26**(7) 640 – 651

Kingsland S E, 2005 *The Evolution of American Ecology, 1890-2000* (The John's Hopkins University Press, Baltimore)

Latour B, 2005 *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford University Press, Oxford)

Löfvenhaft K, 2002 "Biologisk mångfald i urban miljö" (Biological diversity in urban areas) in *Nationalstadsparken - ett experiment i hållbar utveckling (The National Urban Park – an experiment in sustainable development)* Eds L Holm, P Schantz. (Formas, Stockholm)

Löfvenhaft K, Björn C, Ihse M, 2002, "Biotope patterns in urban areas: a conceptual model integrating biodiversity issues in spatial planning" *Landscape and Urban Planning* **58** 223 – 240

Löfvenhaft K, Runborg S, Sjögren-Gulve P, 2004, "Biotope patterns and amphibian distribution as assessment tools in urban landscape planning" *Landscape and Urban Planning* **68**(4) 403 – 427

Lundberg J, Andersson E, Cleary G, Elmqvist T, 2008, "Linkages beyond borders: targeting spatial processes in fragmented landscapes" *Landscape Ecology*

*MA*, 2005a *Ecosystems and Human Well-being: Synthesis* Millenium Ecosystem Assessment Series (Island Press, Washington D.C.)

*MA*, 2005b *Ecosystems and Human Well-Beeing: Multiscale Assessments – Findings of the Sub-global Assessments Working Group* Millennium Ecosystem Assessment Series (Island Press, Washington D.C.)

Melucci A, 1996 *Challenging Codes. Collective Action in the Information Age* (Cambridge University Press, Cambridge)

Miller B, 2000 *Geography and social movements* (University of Minnesota Press, Minneapolis)

Mitchell D, 1995, "The End of Public Space? People's Park, Definitions of the Public, and Democracy" *Annals of the Association of American Geographers* **85** 108 – 133

Mosse G L, 1975 *The Nationalization of the Masses: Political Symbolism and Mass Movements in Germany from the Napoleonic Wars through the Third Reich* (Howard Fertig, New York)

*National Parliament*, 1994/1995, "Riksdagsproposition 1994/95:3. Nationalstadsparken Ulriksdal-Haga-Brunnsviken-Djurgården (The National Urban Park Ulriksdal-Haga-Brunnsviken-Djurgården) parliamentary proposition 1994/95:3 handed in by Government, Sveriges riksdag, SE-100 12 Stockholm

Nordlund C, 2001, "'On Going Up in the World': Nation, Region and Land Elevation Debate in Sweden" *Annals of Science* **58** 17 – 50

Nordström T, Ståhle A, 2006, "Nationalstadsparkens lokala tillgänglighet: Underlag till Länsstyrelsens program för Nationalstadsparken" (The local access to the National Urban Park: Basis for the County Administrative Board's program for the National Urban Park)", call number: Rapport 2006:12, Länsstyrelsen i Stockholms län (County Administrative Board), Hantverkargatan 29, Box 22067, SE-10422 Stockholm

Paasi A, 1986, "The Institutionalization of Regions: a Theoretical Framework for Understanding the Emergence of Regions and the Constitution of Regional Identity" *Fennia* **164** 104 – 146

Putnam R D, Leonardi R J, Nanetti R Y, 1994 *Making Democracy Work: Civic Traditions in Modern Italy* (University Presses of California, Columbia and Princeton, New Jersey)

Pyne S, 1998 *How the Canyon became Grand: A Short History* (Viking Penguin, New York)

Sandell K, Sörlin S (Eds), 2000 *Friluftshistoria (A History of Out of Doors)* (Carlsson Bokförlag, Stockholm)

Sassen S, 2002, "Locating Cities on Global Circuits" in *Global Networks Linked Cities* Ed S Sassen (Routledge, New York) pp 1 – 38

Schantz P, 1990, "Låt Hagaparken växa på bredden" (Let the Haga Park grow in breadth) *SvD (Svenska Dagbladet)* 20 November, page 2

Schantz P, 2004, "Människor att minnas" (People to remember) *Hagabladet* **3-4** 7 – 8, Haga-Brunnsvikens vänner (HBV), Box 23224, SE-10435 Stockholm

Sörlin S, 1998, "Monument and Memory: Landscape Imagery and the Articulation of Territory" *Worldviews: Environment, Culture, Religion* **2** 269 – 279

Sörlin S, 1999, "The Articulation of Territory: Landscape and the Constitution of Regional and National Identity" *Norsk Geografisk Tidsskrift* **53** 103 – 112

Sörlin S, Nordlund C, 2003, "Modernizing the National Landscape" *Kenyon Review (Akron, Ohio)* **25** 3 – 4, 301 – 314

Stahre U, 2004 *Den gröna staden (The Green City)* (Atlas, Stockholm)

Stanvliet R, Jackson J, Davis G, de Swardt C, Mokhoele J, Thom Q, Lane B D, 2004, "The UNESCO Biosphere Reserve Concept as a Tool for Urban Sustainability: The CUBES Cape Town Case Study" *Annals of the New York Academy of Sciences* **1023** 80 – 104

Sundin B, 1989, "Environmental Protection and National Parks" in *Science in Sweden: The Royal Swedish Academy of Sciences, 1739-1989* Ed T Frängsmyr (Science History Publications, Canton, Mass)

*SvD*, 1990, ”Attentatet mot Norrtull (The outrage on Norrtull)” *SvD (Svenska Dagbladet*) 25 October, page 2 (editorial)

*UN*, 2005 *World Urbanization Prospects: The 2005 Revision* (United Nations Publication, New York)

Waldenström H, 1991 *Ekoparken – sammanhängande natur- och kulturpark i storstad (The Ecopark – coherent nature and cultural park in the city*, Kungliga Djurgårdens förvaltning (KDF), Stora Skuggans väg 22, SE-11542 Stockholm

Waldenström H, 1995, ”Ekopark blir nationalstadspark: Kampen om Ulriksdal-Haga-Brunnsvik-Djurgården” (Ecopark becomes National Urban Park: The struggle for Ulriksdal-Haga-Brunnsviken-Djurgården) in *Ekoparken: Nationalstadsparken Ulriksdal-Haga-Brunnsviken-Djurgården (The Ecopark: The National Urban Park Ulriksdal-Haga-Brunnsviken-Djurgården)* B Hallerdt Ed (Samfundet S:t Erik Stockholm, Stockholm) pp 157 – 170

Waldenström H, 2001 *Guide till Ekoparken: Världens första Nationalstadspark (Guide to the Ecopark: The world’s first National Urban Park* (Birka energi, Stockholm)

Waldenström H, 2004, ”Ekoparkens historia” (The history of the Ecopark) from the webpage of The Alliance of the Ecopark, http://www.ffe.org, 14 October, 15:12, Förbundet för ekoparken (FFE), Stora Skuggans väg 30, SE-115 42 Stockholm

Wasserman S, Faust K, 1994 *Social Network Analysis - Methods and applications* (Cambridge University Press, Cambridge)

Wenger E, 1998 *Communities of practice: Learning, meaning, and identity* (Cambridge University Press, New York)

Yin R K, 1994 *Case Study Reserach - Design and Methods* (Sage Publications, Newbury Park)

## Appendix

**Table A1.** Descriptive data of interviewees and interviews made during the study.

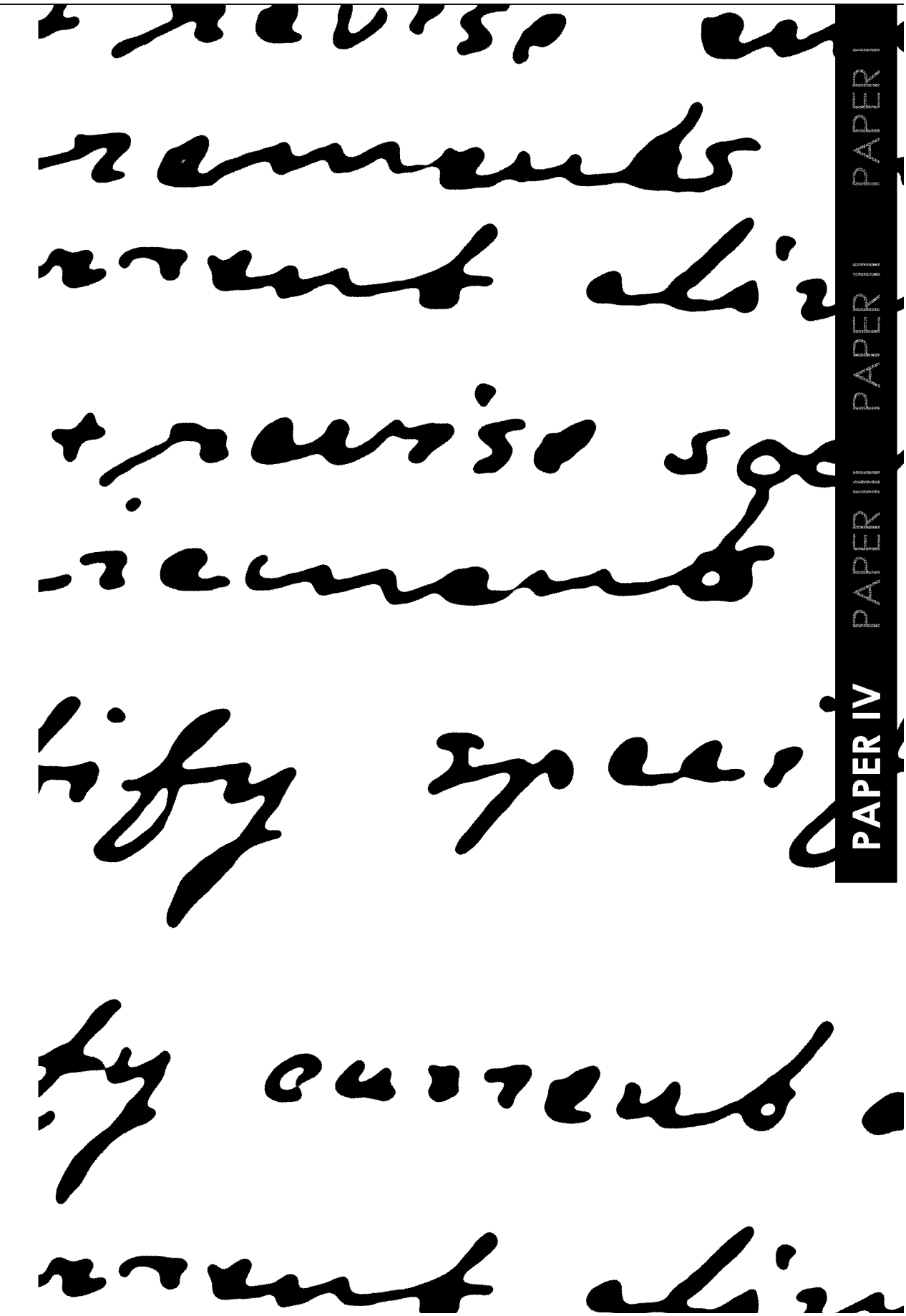
| *Interviewee: Position and organizational affiliation [Sex, education, occupation, age]*<br>*-- Interview: Date, location [Duration in hours – Procedure – Position in most-cited list]* |
|---|
| **1. Founder and secretary, Kommitéen för Gustavianska Parken** (The Committee for the Gustavian Park) [Male, PhD, health and sports researcher, 40's]. *(NB! Two interviews were held)*<br>-- 25 Nov 2004[b], Office of first author [2h-RT-3]<br>-- 1 Nov 2005, Office of interviewee [2h-RT-3][c] |
| **2. Treasurer, Föreningen för natur och samhälle i Norden** (The Association of Nature and Society in the Nordic Countries) [Male, university degree, insurance officer, 60's]<br>-- 8 Dec 2004[b], Office of first author [2h-RT-26] |
| **3. Employee, Bergianska botaniska trädgården** (Bergianska Botanical Garden)[a] [Female, PhD, director, 50's]<br>-- 14 Dec 2004[b], Office of interviewee [2h-R-NaN] |
| **4. Employee, Stockholms stad (Stockholm municipality)**[a] [Female, university degree, municipal ecologist, 40's]<br>-- 21 Dec 2004[b], Office of interviewee [2h-N-NaN] |
| **5. Employee, Kungliga Djurgårdens förvaltning** (KDF; Royal Administration of Djurgården)[a] [Male, university degree, forester, 40's]<br>-- 8 June 2005[b], Excursion in the National Urban Park [2h-NW-17] |
| **6. Chairman, Förbundet för Ekoparken** (The Alliance of the Ecopark) [Male, PhD, economist, 50's]<br>-- 17 Oct 2005, Office of interviewee [2h-RT-2] |
| **7. Chairman, Haga-Brunnsvikens vänner** (HBV; Friends of Haga-Brunnsviken) [Male, NaN, retired civil servant, 60's]<br>-- 24 Oct 2005, Café in Stockholm city centre [2h-RT-15][c] |
| **8. Chairman, Djurgården-Lilla Värtan miljöskyddsförening** (The Environmental Protection Association of Djurgården-Lilla Värtan) [Male, university degree, economist, 50's]<br>-- 7 Nov 2005, Office of interviewee [2h-RT-6][c] |
| **9. Founder and employed project leader, Ekoparksfonden WWF** (Ecopark Fund WWF) [Male, NaN, tourist guide, 50's]<br>-- 3 Aug 2006, Excursion in the National Urban Park [2.5h-NW-1] |
| Informal conversations were also held with a male boating club chairman in May 2005 through telephone and with several allotment gardeners at *Lilla Frescati* and *Söderbrunn* during May 2005 and March 2006. |

*RT=Recorded and transcribed; NR=Notes and written report, i.e. no recording*
*a. Non-movement organization; b. Pre-study interview; c. Parts of the interview transcribed.*

**Table A2.** Participatory observations (part.obs.) made during the study. (NUP – The National Urban Park)

| *Venue, date and organizer of meeting with short description* |
|---|
| **1. Polstjärnan Conference Centre on Svevägen (3 April 2003), organized by the County Administrative Board:** Open meeting about the management plans for NUP. Present were several authorities: Royal Administration of Djurgården (KDF), County Administrative Board (CAB), Stockholm and Solna municipality; many representatives from various movement organizations along with interested citizens. |
| **2. Member boat trip (Summer 2003), organized by The Alliance of the Ecopark:** Annual boat-trip for the member organizations on the waters surrounding the park with a tour guide from the movement. |
| **3. Royal Academy of Fine Arts (7 September 2005), organized by The Committee of the Gustavian Park and Friends of Haga-Brunnsviken:** Exhibition, debate and open meeting about the building plans at *Husarviken* where the movement presented its alternative exploitation plan for the area. Invited speakers and tough debates. Present were civil servants, municipal politicians, movement participants and interested citizens. |
| **4. Swedish Musuem of Natural History (6 October 2005) organized by The Ecopark Fund WWF:** Open meeting about threats and management of NUP. Invited speakers and debate. All authorities present (KDF, CAB, municipalities, government official, King of Sweden), along with movement organizations. |
| **5. Hjorthagen Church (20 October 2005) organized by The Environmental Protection Association of Djurgården-Lilla Värtan and the neighbourhood organization Friends of Hjorthagen:** Information meeting about exploitation plans for *Husarviken*. Present are local residents. Movement organizations present alternative plan for *Husarviken* (part.obs. 3). Civil servants from municipality had turned down the meeting. |
| **6. Swedish Museum of Natural History (7 June 2006) organized by The Royal Administration of Djurgården:** Open meeting about the new management plan for NUP. Invited speakers and debate. All authorities present (KDF, CAB, municipalities, the government through Minister of Environment, King of Sweden) along with representatives from many movement organizations. |

*Part.obs. number 1 and 2 were made during the pre-study period.*



PAPER IV PAPER III PAPER II PAPER I

*For submission to Environmental Management.*

# Ecological scales and social network structure in urban landscapes: management and governance of urban ecosystem services in Stockholm, Sweden

**Henrik Ernstson · Stephan Barthel ·**
**Erik Andersson · Sara T. Borgström**

**Abstract** Continous management of urban ecosystems is crucial for securing ecosystem services on which human well-being depends. One crucial challenge is to address scale mismatches between ecological processes and the social processes of management. In this article we synthesize a set of case studies from Stockholm, Sweden, and discuss suitable ecological scales for management, and how actor groups can be linked through social networks across ecological scales so as to overcome scale mismatches. We also discuss the ability of such network structures to respond to slow, fast and unpredicted change. Based on empirical data we suggest an alternative management system organized around three ecological scales, local green areas, city-green networks and the regional green infrastructure. The existing diversity of actor groups, ranging from municipal agencies to currently neglected civil society groups, are each recognized as having scale-dependent responsibilities. We also introduce new actors seen as necessary; those responsible for the management of the unattended mid-scale, along with scale-crossing brokers. The latter have as main objective to network with actors across ecological scales so as to sustain a social network structure that can facilitate monitoring and adaptive management. The contribution of this study to the literature lies firstly in demonstrating how urban ecosystem management can be assessed in a way that acknowledges social-ecological interactions within urban green areas, thus highlighting local actor groups and their knowledge. Second, through combining ecological scales with the perspective of social network structure, we bring more understanding in how social networks underpin collective action and social learning. Third, in response to the demands imposed by the extreme heterogeneity of urban landscapes, we describe a more spatially explicit management system than what present theories of adaptive management and governance have been capable of mustering.

**Keywords** Ecosystem management · adaptive governance · scale mismatch · ecological scales · social network structure · ecosystem services · urban ecology

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## Introduction

Urban landscapes represent an extreme point of a gradient of social-ecological systems in which human activities effect ecosystem processes (Collins and others 2000; Grimm and others 2000; Pickett and others 2008). At the same time, urban green areas are increasingly being recognized for their role in generating critical ecosystem services important for human well-being and society at large (Daily 1997; Bolund and Hunhammar 1999; McGranahan and others 2005). Services range from providing shade, cleaner air and space for recreation, to absorbing $CO_2$ emissions and sustain pollination and seed dispersal processes that underpin biodiversity and the ability to maintain ecological function (Alberti 2005 and references therein). Furthermore, in a rapidly urbanizing world (UN 2005), green areas within walking distance could prove crucial in enhancing broad-based support for sustainable development (cf. Miller 2005).

The management of urban ecosystems faces several challenges. Urban landscapes are characterized by extreme heterogeneity of land use, by high rates of change, limited capacity for ecological renewal, and by the many administrative units (Collins and others 2000; Pickett and others 2001; Borgström and others 2006; Grimm and others 2008), with every patch of land politically contested (Heynen and others 2006). This has been argued to produce a high tendency for scale mismatch, i.e. a temporal or spatial mismatch between the scale of ecological processes and the scale of social organization for management (Folke and others 1998; Cumming and others 2006). Although studies in urban ecology have embraced cities as social-ecological systems, they have mainly focused on exploring how the heterogeneity of land use patterns and dynamics affect ecosystem function (Alberti 2005; Cadenasso and others 2006; Grimm and others 2008; Pickett and others 2008) with less focus on actual management. Humans have tended to be regarded as part of larger passive groups (of class or ethnicity), or as anonymous drivers of pollution or urban development (Alberti 2005; Pickett and others 2008). In contrast, we focus on actors that intentionally interact with urban ecosystems at different scales, for example cemetery/park managers and allotment gardeners at the local scale, to urban planners at greater scales. This approach acknowledges a wider importance and diversity of green areas. Besides being parts of green spatial patterns, they also constitute physical sites of social-ecological interaction that can nurture ecological knowledge and open for human agency in manipulating and improving ecological processes (cf. Miller 2005, cf. Berkes and others 2003). In this article we synthesize a set of case studies from the Stockholm metropolitan area, Sweden. We discuss what we found to be suitable ecological scales for management, and how actor groups can be linked through social networks across ecological scales so as to decrease scale mismatch and increase the ability to respond to slow, fast and unpredicted change. Inspired by Wenger (1998, 2000) we define such networks as *management systems* alluding to his "social learning systems" of linked actor groups (or communities-of-practices) to approach complex problems. As we do not explicitly engage with issues of power-sharing, we refrain from using the concept of governance although our article pertains to this concept as well (Folke and others 2005; and see below).

Studies of adaptive co-management and governance of ecosystems (Gunderson and Holling 2002; Berkes and others 2003; Folke and others 2005) that hitherto have been less applied in urban landscapes, argue for a general shift of management paradigms. Instead of single-species and the control of a few selected variables (Holling and Meffe 1996), management should take holistic approaches that acknowledge the inherent uncertainty of social-ecological systems (Berkes and others 2003) and focus on ecological processes (e.g. nutrient flows and pollination) and functional groups of species that play complementary roles in facilitating these processes (Nyström and Folke 2001). The overarching objective can be stated as overcoming scale mismatches (Folke and others 1998; Cumming and others 2006). Here, collaboration between various actor groups, active at different scales and with different and often scale-specific knowledge and information about the ecosystem, is seen as critical since it contributes to social learning processes towards understanding non-linear dynamics and cross-scale linkages (Bandura 1977; Ashby 2003; Olsson and others 2007).

Collaboration and social learning depend on several social processes, for instance trust, conflict resolution, knowledge integration, and vision building (e.g. Folke and others 2005; Manring 2007). However, all of these depend (in one way or another) on creating and sustaining social networks for information flows (ibid.; Bodin and others 2006a). In this article we therefore focus on social networks, and especially the structure of social networks, i.e. the patterns of mutual relations (Wasserman and Faust 1994). Although a network in itself does not 'do' or 'learn' anything – only actors are capable of this (Guenther and Newig manuscript) – we can by uncovering the 'architecture' of information flows bring greater clarity into the structural factors facilitating and constraining social processes for ecosystem management (Schneider and others 2003; Bodin and Norberg 2005; Crona and Bodin 2006; Prell and others forthcoming; Ernstson and others 2008). However, here we take this even further by combining the analytical perspective of social network structure with an empirical analysis of ecological scales, seen as the most suitable scale to monitor ecosystem dynamics (Cumming and others 2006 and below). This combination can improve understanding of scale mismatch (ibid.), and might be even more central to the study of urban landscapes due to that urban ecosystem functioning is so deeply intertwined with spatial patterns and extreme heterogeneity (Alberti 2005). The urban context has therefore forced us to seek a more spatially explicit management system, i.e. how green areas spread out in space are linked socially and ecologically, than what present theories have been capable of mustering (see e.g. polycentric structures (Ostrom 1998), multilevel, collaborative, or adaptive governance (Folke and others 2005; Pahl-Wostl and others 2007), and ecosystem management/learning networks (Manring 2007).

We singled out two principal goals of ecosystem management that need to be fulfilled to secure the flow of ecosystem services: First, *sustaining ecosystem functioning*, i.e. increasing the ability for urban ecosystems to regenerate through ecological processes and structures at multiple scales. Second, *creating and maintaining flexibility*, i.e. increase the ability to respond to both fast, slow and unpredicted changes in social-ecological systems and keep as many future options as possible open (e.g. Holling 1978; Gunderson and Holling 2002; Folke and others 2005).

Based on these goals, and using Stockholm as empirical background, the objective of this article is two-fold: to show how urban ecosystem management can be assessed, and propose ideas of improvements to overcome scale mismatches. Our main contributions is to show the importance of using empirically grounded ecological scales, that social network structure is important to account for, and that it is important, especially in urban landscapes, to find spatially explicit models of management and governance to overcome scale mismatches.

## Short Description of Case Studies

Our synthesis is based on seven case studies from the urban landscape of Stockholm, Sweden (Figure 1) published in separate papers (Table 1). The individual studies focused on different aspects of ecosystem management in Stockholm and generated both social and ecological data in order to capture the dynamics of social-ecological processes. Ecological data focused on functional groups of ecosystems (especially pollinators, seed dispersers, and insectivores) and were generated through field surveys of birds and bumblebees, complemented with ecological landscape analysis based on land cover structure from satellite images. Social data were generated through engaging with different actors at different scales using different methodological tools such as text analyses, questionnaires and interviews (Figure 1). Actors included were regional and municipal agencies, cemetery and park managers employed by the public or private sector, and civil society groups such as allotment gardens, outdoor life associations, boating clubs and cultural-history and nature conservation groups. We refer to individual papers for detailed information. In the results section we refer to the case studies with their Roman numerals (I-VII) as given in Table 1. This is to indicate the origin of the findings, either directly or emerging from the synthesis, but also to separate our findings from those of others in Stockholm and elsewhere that we supplement the result section with.

## Methodology: A Framework for Social-Ecological Synthesis

Our methodology for synthesizing individual case studies is based upon a framework developed while working with the synthesis. We were faced with a set of results from different case studies that we wanted synthesize in a relevant way since they originated from the same social-ecological system. We started by testing emergent findings against a proposed theoretical model for adaptive management (see below), which eventually lead us to formulate a framework that merges ecological scales with social network structure, including the concepts of actor groups, and scale-crossing brokers (Figure 2). Through this framework, which we explicate below, we could identify scale mismatches, assess the criteria of ecosystem functioning and flexibility, and come with suggestions of necessary changes. Although the framework is new, it is in line with other approaches to

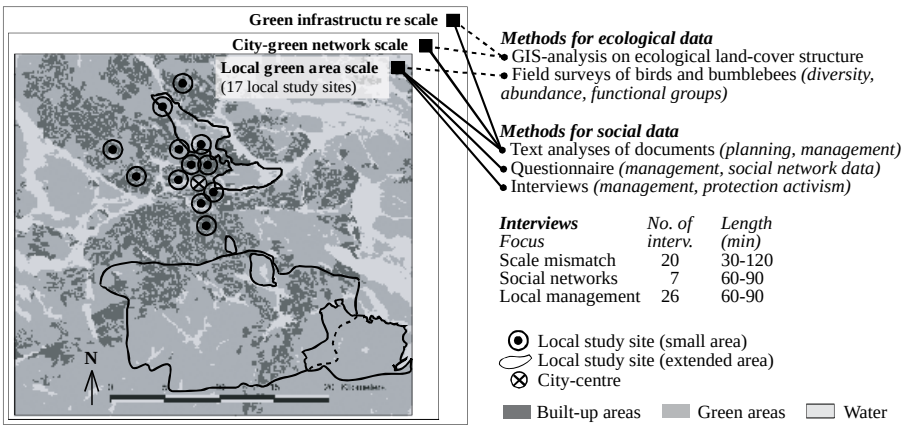



**Figure 1.** The map shows Stockholm Metropolitan Area marked with 17 local study sites and the methods used for data generation. Stockholm is situated at the boundary between the northern hemisphere boreal zone and the mid-European nemoral zone, and at the outlet of the freshwater lake Mälaren into the brackish Baltic Sea (59º20'N, 18º05'E). The physical landscape is shaped by the last glacial period 10.000 years ago and consists of fissured bedrock and clay covered valleys. The small scale rough terrain and the climatic conditions convey a relatively high biodiversity (CAB 2007). Stockholm hosts a current population of 1.2 million people, and it is the most rapidly growing and most densely populated region in Sweden with 2500 inhabitants/km$^2$ (SCB 2002). The case studies used different methods to generate data on different ecological scales.

**Table 1.** The table shows the empirical case studies synthesized in this paper. The numbers are used in the main text to clarify results from the case studies. Number VI and VII were primarily carried out by collegues from the same research group.

| *No.* | *Publication* | *Short description of study* |
|---|---|---|
| I. | Barthel and others 2005<br>Barthel 2006<br>Barthel and others in prep. | Ecological land use analysis and stake holder analysis of a large green park (the National Urban Park; NUP). |
| II. | Borgström and others 2006 | Comparative study of ecosystem management in five local green areas: large green area (NUP), large cemetery, nature reserve, urban forest, and a watershed. |
| III. | Andersson and others 2007 | Comparative study of management practices between different actor groups: cemetary managers, urban park managers, and allotment gardeners. |
| IV. | Ernstson and Sörlin 2009<br>Ernstson and others 2008 | Social network analysis of local urban movement protecting a large urban green area (NUP) followed by value creation analysis. |
| V. | Andersson and Bodin in press | Ecological network analysis of bird species movements. |
| VI. | Lundberg and others 2008 | Mobile link analysis of the Euroasian Jay and oak forest generation for a large urban green area (NUP). |
| VII. | Colding and others 2006 | Spatial assessment of different types of urban green areas with focus on allotment gardens, domestic gardens, and gold courses vs. protected areas |

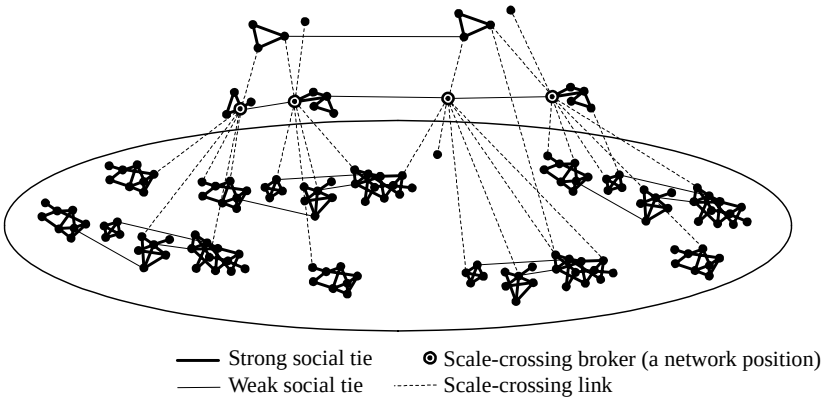
analyze social-ecological systems (e.g. Hanna and others 1996; Berkes and Folke 1998; Olsson and Folke 2001; Cundill and others 2005; Hahn and others 2006; Young and others 2006).

Ecological scales are context sensitive and difficult to readily define in practice. Our aim was to identify, guided by theory and empirical measurements, those ecological scales most suitable for purposeful monitoring as outlined by Cumming and others (2006). In theory ecological scales are viewed as hierarchically and dynamically linked (Gunderson and Holling 2002); interactions between parts in ecosystems are nonlinear and local, and constrained by larger scales, but local interactions may have emergent effects that could influence other scales and the system as a whole (Pickett and others 2008). Different interactions will be important on different scales, e.g. interactions such as competition are local while resource use and population dynamics occur on landscape or regional scales. One key to finding the relevant scales for management is to understand how different organisms perceive and interact with the landscape (Hostetler and Holling 2001; Farina and Belgrano 2006; Lundberg and others 2008). With this in mind, lower scales are assessed through analyzing patch quality and inter and intra species interactions, while greater scales are dependent on configurational aspects such as landscape supplementation and complementation, and neighbouring effects (e.g. Dunning 1992). At even larger spatial and temporal scales, dispersal corridors and sink-source dynamics become of importance (ibid.). Another issue is the scales and dynamics of disturbances, and in cities theses are often caused or controlled by humans and should be addressed from a social perspective (Pickett and others 2008).

Just as ecological patches are part of greater scale patterns (Alberti 2005), social actors are part of emergent social network structures (Wasserman and Faust 1994). A presumption is that all ties come with a cost, first for establishing it and then to sustain it (Granovetter 1973), which tends to direct information flows through established patterns of interaction (Diani 2003b). These patterns are consequently an outcome of localized interactions and no actor can fully control the emergent structure, which opens for human agency to change at least parts of the network structure through interacting with new actors (ibid.). This is partly what happens in transformational changes when for instance a bridging organization invests time and effort in creating new links (Olsson and others 2004b; Manring 2007). However, this also demonstrates the inertia of social network structure (and why we refer to it as ‘structures’)(Degenne and Forsé 1999).

In relation to ecosystem management, Bodin, Crona, and Ernstson (2006a) have outlined a network model conducive for adaptive co-management. Others have pointed to similar models (Newman and Dale 2005; Guenther and Newig manuscript); what we do is to complement this model with information on ecological scales. As illustrated in Figure 2, the model consists of separate actor groups that interact with the ecosystem at different spatial scales. They have strong internal ties, and weaker bridging ties to other actor groups (i.e. they meet less frequently or less intensely with them). Strong ties support long-term generation of knowledge, practice and trust, while weak ties are important in spreading information over greater distances in the network (Granovetter 1973). Weak

*a. Stylized network model*




*b. Conceptual framework*

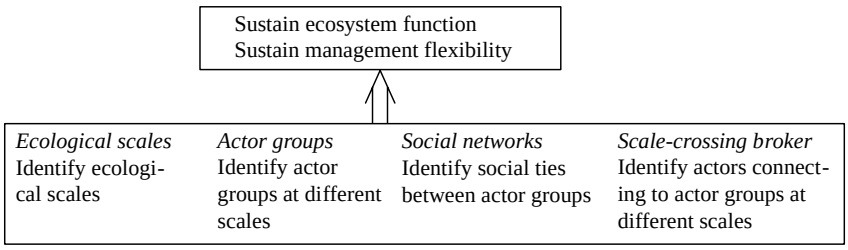



**Figure 2.** The top figure (a) shows a stylized image of the social network model that bridges across ecological scales and facilitates adaptive co-management. It is adapted from Bodin, Crona and Ernstson (2006a). In the figure below (b) we summarize the adjoining framework used for synthesis of case studies. To assess how well current management meats the dual goal of sustaining ecosystem function and management flexibility, we identify and build our analysis on four analytical categories: (i) *ecological scales*; (ii) *actor groups* intentionally interacting with the ecosystem at these scales (also referred to as managers); (iii) *social networks* linking these actors; and (iv) actors holding the position of *scale-crossing brokers*.

ties therefore play a crucial role in innovation and adaptation to new situations (ibid.), and in breaking group thinking in closed groups (Oh and others 2004). There is also a set of a few actors that occupy brokerage positions between groups that are not directly linked (Burt 1992). In our model it is important that these actors are *scale-crossing brokers* that link to actors on different spatial ecological scales. The main task is to facilitate information flows between actor groups that take part in management practice on different spatial sites and at different spatial scales in order to decrease scale mismatches. A key reason for why this network structure can facilitate adaptive co-management is that it strikes a balance between centralization (for effective collective

action) and modularity (for autonomous knowledge generation), while also harboring a high actor diversity (for high management flexibility).

**Results from the Synthesis**

Based on the framework presented in this study we assessed the management of ecosystems in Stockholm. We suggest that there are at least three relevant ecological scales for management. Based on these we identified several actor groups that address two of these. Importantly one ecological scale vital for ecosystem management was unattended. Furthermore it became clear that actor groups from civil society, which take part in ecosystem management, are neglected. Sustained social networks that link across space seem to exist, however these stretch only within actor groups, no bridges between them exist, and there is no overall strategy from municipal agencies to harvest the existing diversity of actor groups for monitoring and management. Although no scale-crossing brokers were identified potential candidates exist. Our findings, are summarized in Table 2.

Ecological Scales for Management

Most of Stockholm's ecosystems are remnants from cultural usage and shaped by humans over the millennia, and ecosystem services generated today can be considered as emergent from a long-term social-ecological interaction or co-evolution (I). It is thus important to recognize that different actors with different objectives have created different ecological conditions, which in turn has increased the diversity of green areas and affected species composition, ecological functions and consequently the production of ecosystem services (I; II; III; VI; VII).

An important consequence is that most green areas are small, which increases the significance of spatial structure, i.e. the habitat suitability of a patch is to a large extent dependent on its surroundings. Some species become dependent on small scale networks of one type of green areas (V), while others need access to several different types (VII). The small sizes of green areas also increases the probability that many organisms will exhibit meta-population dynamics with local extinction and re-colonization as shown by others in Stockholm (Mörtberg 2001) and elsewhere (Reale and Blair 2005). At a larger scale a system of larger green areas, or "green wedges", is found partly due to the city's transport infrastructure and to land allocated for future expansion. These are recognized by authorities (Stockholm stad 2003) as providing ecological connectivity at a larger scale thus potentially replenishing sink populations of local green areas (cf. Sandström and others 2006, cf. Crooks and others 2004).

Current management focuses on one hand to facilitate large scale ecological flows within the whole green infrastructure, and on the other to preserve selected local green areas where red listed species or high biological diversity have been recorded (VII). However, many other green areas have been missed due to the narrow definition used by authorities (VII; cf. Lundgren Alm 2001). Local green areas such as allotment gardens, golf courses

and private home gardens are all classified as "developed land" and not recognized in management (VII), which is in accordance with findings for Baltimore (Pickett and Cadenasso 2008). In recollecting the significance of spatial structure, both here (III; V; VI) and generally (Alberti 2005), this is a serious drawback of current management since such local green areas sustain species movements and landscape ecological flows (III).

Based on this we separate between three spatial scales of various ecosystem processes relevant to management. At the lowest scale we have *local green areas*, and at the highest we have a *regional green infrastructure*. At the mid-scale, linking hierarchically between the other two, we define *city-green networks* as a selected set of local green areas and their ecological linkages or dispersal corridors (V; cf. Sandström and others 2006). City-green networks are spatially found in between the "green wedges" and among built-up areas. This mid-scale is an important scale for management while our investigations focusing on city-green networks and their specific aspects, such as connectivity and complementarity (V; VI), showed that city-green networks to a large extent determine whether different species are present or not. In comparison to the other two ecological scales, city-green networks are understudied,and we found no actors that explicitly address them, although candidates exist. With a somewhat changed focus municipal agencies, municipal ecologists, and/or umbrella organizations from civil-society could become mid-scale actors.

Actor Groups in Social-Ecological Processes

Management of urban green space in Stockholm is formally organized by the municipalities according to user purposes. This has influenced how many municipal managers, such as park and cemetery managers, perceive their local green area. Instead of seeing them as part of city-green networks and an ecologically linked landscape they are seen as belonging to a group of areas assigned to the same user classification (II; cf. Sandström and others 2006). Cemetery managers for example, tend to form stronger social ties with other cemetery managers, and less – if any – with actors from adjacent green areas. This indicates less ability to synchronize management to provide complementary habitats to sustain ecological processes as argued by (Colding 2007). Interviews also revealed that green areas are conventionally viewed as temporally static and spatially isolated entities (II). Our studies of a selected set of urban parks and nature reserves indicate that there is an awareness of the importance of management at multiple spatial scales, but that the recognition of interactions across scales is very limited (II), which we interpret as a limited understanding of cross-scale ecosystem dynamics (Gunderson and Holling 2002). A further example of spatial mismatch is caused by the municipal planning monopoly which sharpens the borders between municipalities and hinders cross-border cooperation. There are also temporal mismatches. Although regional authorities and the municipalities have long-term plans stretching 10 years ahead, this is not reflected in the annual plans of practical management (II) and there is a general lack of monitoring and evaluation of management activities, which inhibit adaptation (II; Gunderson and others 1995, Busch et al. 1995).

We also identified local green area managers that in spite of their important role in supporting the generation of ecosystem services are more or less unrecognized by municipal actors (I; III). Allotment gardeners, along with park and cemetery managers (I; III) and even urban golf course managers (VII), have the capacity to capture fine-tuned and continuous ecosystem feedback necessary for engaging in adaptive management (cf. Holling 1978). When comparing employed personnel of cemeteries and urban parks, with volunteers from allotment gardeners, the latter group exhibited greater local ecological knowledge together with the widest range of management practices that offered protection of species and improved habitat to sustain pollination and seed dispersal processes (III). In these communities of allotment practices, slow and rapid ecosystem processes, which underlies the generative capacity of flowers, vegetables, fruits and berries, are captured, and stored in social memory (I). These actor groups, through their practices in their local social-ecological system, can like no others adapt to gradual change and develop, and retain experiences and modify practices in relation to a constantly changing ecology (I; III; cf. Scott 1988). It is reasonable to think that such local actor groups are prime candidates for responding to local, slow or disrupting ecosystem changes (I). Furthermore, social networks exist within these actor groups that span across the landscape; cemetery and park managers have professional networks, while the allotment movement with approximately 80 gardens are organized through their umbrella organization (I).

Actor groups can also influence green areas by protecting them from exploitation. Indirectly this influences ecosystem functioning by changing the patterns of urban development (cf. Alberti 2005). Our studies suggest that protection partly rests upon the capacity of actors to articulate values for green areas in competition with other land use interest such as infrastructure, office and housing (IV). Additionally, and exemplified in other studies (Diani 1995; Ansell 2003), areas attracting a high diversity of interest and user groups stand higher chances of being protected, either formally or informally, since this increases the possibility of collective action in civil society (cf. Putnam and others 1994). This could even include the protection of city-green networks. Our studies (IV) showed how a network of civil society organizations managed to articulate the linkages between local green areas (based on cultural-history and biological dispersal corridors) to construct holistic values worthy of legal protection. In their struggle they were facilitated by their spatially extensive social network that linked politically active interest organizations on one hand, and user groups (riding clubs, allotment gardens etc.) on the other. Interestingly however, the same network structure that was effective for initiating protection might have hampered ecosystem management as user groups with deep ecological knowledge were marginalized due to their peripheral network position (IV). This serves as a good example of the duality between network structure and process; a structure effective for certain collective action might simultaneously constrain other types of collective action (Diani 2003b).

Although problems exist, Stockholm municipality has launched several efforts to interact with different actor groups regarding urban biodiversity. As the municipality reports (Stockholm stad 2003), educational projects have been carried out with park and street managers and private entrepreneurs, along with restoration projects in collaboration with

civil society, including ornithological associations and nature protection organizations. Local user's agreements ("brukaravtal") exist in which management rights are devolved to local neighbourhood groups and allotment gardens. However, and based on our case studies, these efforts seem to lack an overall strategy of how emergent social networks could be used for longer-term and wider scale management of ecological processes across the landscape.

## Discussion

Based on our findings, we argue that the current management of Stockholm's ecosystems does not fully appreciate the connection between land use and ecological functions, neglects cross-scale dynamics, and is carried out by actors who do not engage in dialogue with each other concerning ecosystem management. While actors on the regional scale do recognize ecological functions within the landscape and include them in planning to some degree, actors on other scales do not hold this holistic landscape view. Certain local actors, such as allotment gardens and cemetery and park managers, are valuable for sustaining practices conducive for the generation of ecosystem services. These often neglected actors, if they are allowed to continue, evolve into communities of practice with the emergent effect of shared social-ecological memory that links to valued ecosystem services (cf. Wenger 1998). The municipalities in turn, mainly plan management from a socially informed viewpoint by defining green areas foremost as user-areas. This constrains management actions to account for landscape ecological processes and furthermore seems to give rise to homogenous social networks that do not bridge to other actor groups. Although projects exist directed at interacting with actor groups, they lack an overall and long-term strategy.

In Table 2 we have summarized the effects these findings seem to have for the management of Stockholm's green areas, and provided a set of suggestions for how to organize an alternative and improved management system. Figure 3 gives a simplified image of how this transformation could occur. In the following we discuss some of the components of the alternative management system.

### Envisioning an Alternative Urban Ecosystem Management System

The priority of urban ecosystem management should be the provision of ecosystem services, i.e. the capacity of ecosystems to deliver benefits to citizens. This would include to manage for already existing recreational and public space values, but would most crucially strive to facilitate purposeful collective action to monitor and interact with ecological processes. An improved management system would then need to include the following aspects: a holistic landscape view and scale awareness; scale-dependent responsibilities for actors at different ecological scales; and a greater recognition of local actors at all scales (Table 2). These suggestions implicate to open up the current management system mainly built around state agencies, for deliberative partnerships with civil-society thus moving towards shared decision-making and governance (Bierman 2007).

**Table 2.** The table summarizes our findings from the studies in Stockholm and the effects on current management, followed with suggestions for improvements. We believe these suggestions could provide conceptual maps and diagnostic tools for analyzing management systems in other urban landscapes.

*Findings from synthesis*

1. Management is divided between separate sectors and municipalities and based on upholding certain user classified values rather than sustaining ecosystem processes in the landscape.
2. There are at least three separable ecological spatial scales for management: local green areas, city-green networks, and the green infrastructure.
3. Mismatches between ecological processes and planning/management actions exist, both through that one ecological scale is not accounted for (city-green networks) and that cross-scale dynamics are missed due to lack of information flows across scales.
4. Actor groups from civil society with capacities for management and protection of local green areas are not sufficiently acknowledged or engaged with by authorities, or treated on an ad-hoc basis.
5. Some social networks span across space (but tend to stretch only within actor groups).
6. Some candidates for scale-crossing brokers exist.

*Effects on current management system*

1. Low management flexibility for adapting to emergent ecological properties due to rigid sector divisions and strong administrative borders, paralleled with poor communication between most actors.
2. Unawareness of ecological cross-scale dynamics and the lack of setting ecosystem services as management objective.
3. No purposive management at critical ecological scales, especially at the scale of city-green networks.

*Suggestions for improvement of the management system*

1. Introduce the three identified ecological scales (local green areas, city-green networks, regional green infrastructure) to facilitate management of the urban landscape to secure ecosystem services.
2. (a) Include local actors from civil society, and (b) introduce scale-dependent responsibilities for all actors, while (c) appoint a mid-scale actors responsible for the management of city-green networks.
3. Facilitate the emergence of scale-crossing brokers with knowledge of ecological processes and with a holistic landscape view. Their task is to (a) link ecological scales, (b) sustain and support local actors (i.e. sustain network diversity), and (c) coordinate collaborative action across scales.

### *Functioning Ecosystems: Introducing City-Green Networks and Mid-Scale Managers*

The alternative management system should be organized along the three ecological scales we suggested earlier. The actors at the different ecological scales should then be connected so that different actors can both address ecological objectives at their appropriate scales while simultaneously being open for cross-scale coordination of management activities. Scale-crossing brokers will be central in connecting across scales (Figure 2 and Figure 3).

We argue for the need to introduce mid-scale actors responsible for the management of city-green networks. The mid-scale actor should on one hand provide local actors with an ecological context so that the latter could adapt their management practices to strengthen crucial landscape characteristics (cf. Colding 2007). On the other hand, the mid-scale actors should hold a more dynamic view on landscape ecological functions by managing disturbance regimes, i.e. inducing disturbances to create local ecosystem collapses and

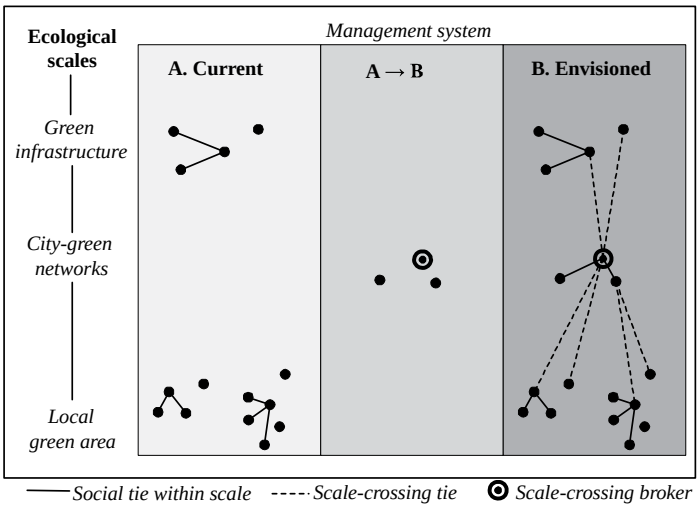



**Figure 3.** In comparison with the ecological scales we suggested for the studied social-ecological system, our results show that in the current management system (A) there are actors active on the lowest and highest ecological scale. By introducing actors responsible for city-green networks while at the same time introducing scale-crossing brokers (A→B), a new management system (B) could emerge that better handle spatial and temporal mismatches between social and ecological processes.

allow for succession, consequently regenerating ecosystems and sustaining spatial resilience (cf. Bengtsson and others 2003). Such practices, e.g. cutting down patches of trees or even using fire, might be opposed by certain neighborhood groups and could therefore be difficult to apply in all local green areas. Thus, areas where such practices could be used should be identified and used to "fine-tune" the landscape matrix in space and time. As mentioned, candidates for mid-scale actors exist

A city-green network consists of a mosaic of local green areas and their ecological linkages. Tools for identifying species specific city-green networks exist that are based on modelling species movement using digital mapping, biodiversity ground truthing and network theory (Löfvenhaft and others 2002; Andersson and Bodin in press; cf. Keitt et al. 1997; cf. Urban and Keitt 2001). In practice however, city-green networks are difficult to define since the landscape is perceived differently by different organisms. Thus the delimitation of the networks will depend on the ecosystem service(s) in focus. For instance, the city-green network relevant for pollination might be different from that of noise reduction and could spatially overlap each other. We leave it to future research to develop criteria for how to define city-green networks, but a promising approach would be to base them either on mobile links, i.e. species supporting ecosystem function through their movement between separate areas (Nyström and Folke 2001; Lundberg and Moberg 2003; Lundberg and others 2008) as advanced by Bodin and others (2006b) in a fragmented forest landscape, in combination with ideas on how to manage sets or "bundles" of ecosystem services in landscapes (Goldman and others 2007; Nelson and others 2008). However, it could also be important to take in to consideration cultural and

social connnections between green areas, as exemplified earlier by the local urban movement that used cultural-historical linkages to 'define' their city-green network (Ernstson and Sörlin 2009).

*Enhancing Flexibility: Introducing Scale-Crossing Brokers*

Management flexibility is thought to increase with a combination of decentralization and higher actor diversity (cf. Crumley 1994; cf. Gunderson 2001; cf. Olsson and Folke 2001). However, the amount of possible ways of collective action in a social network is dependent on the structure of that actor diversity, i.e. the structure of the social network (Leavitt 1951; Diani 2003a; Ernstson and others 2008). Introducing a scale-crossing broker in the management system will in this respect create new and unique pathways for diversity to meet and combine into a greater potential range of purposeful actions (cf. Burt 2003). Since network structures cannot be controlled, but are emergent, the brokers need to work as agents that strive to create and sustain a network structure that in turn facilitates processes to respond to slow and rapid change and processes of social learning about ecosystem services. Manring (2007) talks appropriately of brokers as network "caretakers", and others refer to "bridging organizations" as those actors that create and sustain pursposeful social networks for collaboration (Hahn and others 2006; Olsson and others 2007). From a structural network perspective we can deepen the understanding of these actors. We can divide the strategy to sustain purposeful network structures outlined in Figure 2, in two parts. First, they need to network with *many* actors, with many *different* actors, and finally, with actors at *different ecological scales.* Second, they should strive to sustain and increase actor diversity. Noteworthy is that this strategy coincides with sustaining their own position.

The first part of the strategy will produce systemic effects that benefit the whole management system. By building on especially Burt (2003), we know that network wide information will tend to concentrate to the broker and enhance the ability for the broker to coordinate collective action in four different and essential ways. First, in times of rapid change, the broker can take earlier action and find new collaborative solutions for novel situations. This effect rests upon that the brokerage position grants the broker more diverse and up-to-date information than any other actor in the network. If a pest-outbreak or a new invasive species is recognized by a cemetery or allotment gardener, the broker could find financial means and experts to perform a pilot study to guide further action. Second, through linking actors on different scales, the coordination by the broker could decrease ecological mismatches and improve the functioning of ecosystems. The location of nests of wild bee, to take an example from Stockholm, detected by allotment gardeners can be passed on to municipal employees clearing bush lands. Third, situated in a position where diverse flows of information and knowledge meet that has never met before, including scientific and local experiential knowledge, the broker will have greater ability to create novel understandings and see new innovative opportunities that other actors might never recognize (ibid.). Fourth, and linked to the previous, by getting to know many different actors, the broker will tend to know which actors to connect (and not to connect), how to connect them, and when (ibid.), bringing an ability to navigate a continuously changing social-ecological system which in times of rapid change is critical,

for instance in seizing "windows of opportunities" in the political system to expand ecosystem management (Olsson and others 2004b; Ernstson and others 2008).

The second part of the broker's strategy is to sustain and increase the diversity of actors in the network, both to provide redundancy, but also in recognizing that it is the position between other knowledgeable and resourceful actors at different ecological scales that brings out many of the broker's abilities (cf. Burt 2003). For instance, the task of recognizing slow changes in ecosystem dynamics depends on the existence of diverse actors at different scales – from allotment gardeners and municipal ecologists to regional planning offices – that continuously perform their management practices and generate knowledge. In general, the broker cannot spend too much time (and other resources) on one actor, as this would mean losing connections to others (and its brokerage position).

It is important for the broker to have ecological knowledge sufficient for a holistic landscape view based on ecological processes. This is needed if the broker is to capture and build understanding out of the diverse information received from different actors at different scales, and guide collective action. An important aspect of this is to facilitate social learning (cf. Ashby 2003; Olsson and others 2004a; Fazey and others 2006) and one tool is to initiate and sustain collaborative arenas for ecosystem management (Olsson and Folke 2001; Berkes and others 2003). A broker could nurture and attend several such arenas (Hahn and others 2006). The broker might be more active in the creation of collaborative arenas, inviting user groups and stakeholders, than later on when others might be stewarding the process (cf. Manring 2007). Others practices important for the broker include trust building, social contracting, and facilitation skills as described for bridging organizations (Westley and others 2002; Hahn and others 2006; Olsson and others 2007), communities of practice (Wenger 1998), and net brokers (Manring 2007).

Scale-crossing brokers and the actors responsible of managing city-green networks could appear to have similar positions and might in some instances be the same actor. However, the latter has a clearer spatial responsibility to focus on a particular city-green network and engage more profoundly in ecological issues, while the former should focus on social networking. The brokerage position could be held by both individuals, and organizations from civil-society, as well as municipal agencies (Cash and Moser 2000; Olsson and Folke 2001; Westley and others 2002; Folke and others 2005; Moss and Wissen 2005), and candidates from all categories exist in Stockholm. However, while empirical investigations from non-urban landscapes on how bridging organizations emerge to become brokers are valuable (Olsson and others 2004b; Hahn and others 2006), one should be cautious in making direct comparisons. Urban landscapes are more contested, heterogeneous, administratively complex, and to a higher degree controlled by central planning. Thus it is highly probable that it is more difficult for single actors with or without formal powers to initiate change.

Outlook for the Framework, Robustness of Findings, and Future Reserach

To develop interdisciplinary frameworks and models of management systems such as the one described here can, in the words of Manring (2007), provide "conceptual maps and

diagnostic tools". We like to stress that our model is explicit in identifying suitable ecological scales which have been less rigorously pursued by others (Manring 2007; Olsson and others 2007), but argued as crucial by many (Cumming and others 2006 and see above). In our analysis this also gave rise to the definition of the city-green network which influenced the whole structure of the management system. Furthermore, we stress that the structural social network perspective can help to simultaneously explore both system performance and the behavior of specific actor groups. This can be an advantage to organizational and institutional approaches (e.g. Ostrom 1990; Hanna and others 1996; de la Torre-Castro 2006) or to approaches sensitive to social networks but that neglect their structure (Folke and others 2003; Olsson and others 2004b; Tompkins and Adger 2004; Folke and others 2005; Hahn and others 2006). Important to note is that in synthesizing individual case studies (as we did) they need not to account for social network structure. Nonetheless, the robustness of our findings would increase by a complementary network study either by asking all actors of all their links (Ernstson and others 2008), or more quickly through actors' ego-networks (Wasserman and Faust 1994). It would also be valuable to include private home owners and private garden firms as these were not included here.

A crucial question left unanswered in our analysis is the question of power. The broker will have great influence in the network and could come to co-opt the system and bias coordination towards maintaining some ecosystem services in front of others and favoring a certain actor group (Ernstson forthcoming). This also links to questions of social equity and the distribution of ecosystem services among urban dwellers (Heynen 2003; Ernstson forthcoming), which are important to address to gain accountability and legitimacy for governance founded on this proposed management system (cf. Bierman 2007).

Although the social network perspective can reveal important structural prerequisites and lend ideas for strategic networking, it says less about the knowledge, skills and practices required of different actors to sustain the network and the processes of social learning. This has been addressed more fully in the literature on bridging organizations and net brokers (Hahn and others 2006; Manring 2007; Olsson and others 2007), but less in urban landscapes. Embedded in this are for instance how brokers solve the dilemma between sustaining many ties, which means they are weak and provide less opportunity for trust and social learning, or to invest in stronger ties, which means to lose other ties and thus the brokerage position. A structural solution could be to introduce more brokers, or to develop meeting forums (less demanding than co-management forums) which could serve as "connection arenas" to produce weak ties between actor groups.

## Conclusions

How do we identify management systems and governance processes that can nurture and sustain urban ecosystem services for human wellbeing? In this article we have shown how this pressing question can be addressed through synthesizing a set of case studies of green area management from Stockholm and compare them with a theoretical model

combining ecological scales and social network structure. This combination is important as it searches for fundamental scales in ecological systems, while uncovering patterns of information flows that underpin and influence management processes such as monitoring, social learning and collective action. In our study we revealed a constraining administrative structure, that predominantly views green areas as social spaces defined by their human use, rather than parts of a landscape wide ecological system. This has resulted both in serious scale mismatches between social processes of management and ecological processes, and in the neglect of valuable actor groups that partake in the dynamics behind the generation of ecosystem services. This paper suggests how this diversity of actor groups can be linked across the physical landscape to decrease scale mismatch and increase adaptability and flexibility in relation to uncertainty and change.

We argue that urban ecosystem management should make ecosystem services the main objective as this will draw attention to ecological processes in the landscape (Goldman and others 2007; Goldman and others 2008). For our study we suggest three ecological scales suitable for management, local green areas, city-green networks and the regional green infrastructure. All actors involved in the management system, from municipal agencies to the currently neglected civil society groups, should have scale-dependent responsibilities. Importantly, actors responsible for the management of the unattended mid-scale, the city-green networks, must be introduced. Scale-crossing brokers, similar to what others refer to as bridging organizations and net brokers (Hahn and others 2006; Manring 2007; Olsson and others 2007), are also needed and their main strategy should be to network across ecological scales and sustain actor diversity so as to sustain a conducive network structure that increase monitoring and social learning about ecological processes and the amount of possible collective actions.

Generally, a not too surprising hypothesis is that cities have predominately been viewed as social entities and produced an organizing logic that constrains urban ecosystem management. We therefore believe that our results could be quite general and apply to other cities as well. We therefore hope that our interdisciplinary framework can provide "conceptual maps and diagnostic tools" for other researchers and practitioners (Manring 2007). More discussions are however needed regarding the mechanisms of scale mismatch (Cumming and others 2006), how to identify suitable ecological scales for management, including city-green networks. Questions also arise concerning how to produce a transformation and achieve change (Olsson and others 2004b). This would on one hand probably mean to find enabling policies to create and sustain actor groups in the landscape, while at the same time stimulating the work of brokers or bridging organizations (Folke and others 2005). On the other hand, a transformative process could mean scenario building exercises, including the construction of artifacts and shared narratives that can explain the values of urban ecosystem services and help coordinate emergent management networks (cf. Callon 1986; Wenger 2000; Ernstson and Sörlin 2009).

Rapid urbanization all over the world calls for an appreciation of urban green areas as sites of social-ecological interaction. They should be part of any attempt to envision, as

geographer David Harvey posed it, ways of how to achieve "a just and ecologically sensitive urbanization process under contemporary conditions" (Harvey 1996, p 438).

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## References

Alberti M (2005) The effects of urban patterns on ecosystem function. International regional science review 28(2):168-192

Andersson E, Barthel S, Ahrné K (2007) Measuring Social-Ecological Dynamics Behind the Generation of Ecosystem Services. Ecological Applications 17(5):1267-1278

Andersson E, Bodin Ö (in press) Practical tool for landscape planning? An empirical investigation of network based models of habitat fragmentation. Ecography

Ansell CK (2003) Community Embeddedness and Collaborative Governance in the San Francisco Bay Area Environmental Movement. In: Diani M, McAdam D (eds) Social Movements and Networks - Relational Approaches to Collective Action. Oxford University Press, Oxford, pp 123-144

Ashby J (2003) Introduction: Uniting science and participation in the process of innovation: Research for development. In: Pound B, Snapp S, McDougall C, Braun A (eds) Managing Natural resources for sustainable livelihoods: Uniting Science and Participation. Earthscan Publications Ltd, London, pp 1-19

Bandura A (1977) Social Learning Theory. Prentice Hall, Englewood Cliffs, NJ

Barthel S (2006) Sustaining urban ecosystem services with local stewards participation in Stockholm (Sweden). In: Tress B, Tress G, Fry G, Opdam P (eds) From Landscape Research to Landscape Planning: Aspects of Integration, Education and Application. Springer, pp 434

Barthel S, Colding J, Elmqvist T, Folke C (2005) History and local management of a biodiversity-rich, urban, cultural landscape. Ecology and Society 10(2):10

Barthel S, Colding J, Folke C (in prep.) Social-eclogical memory for management of ecosystem servcies. Human Ecology

Bengtsson J, Angelstam P, Elmqvist T, Emanuelsson U, Folke C, Ihse M, Moberg F, Nyström M (2003) Reserves, Resilience and Dynamic Landscapes. AMBIO: A Journal of the Human Environment 32(6):389–396

Berkes F, Folke C (eds) (1998) Linking Social and Ecological Systems. Cambridge University Press,

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

Bierman F (2007) 'Earth system governance' as a crosscutting theme of global change research. Global Environmental Change 17:326-337

Bodin Ö, Norberg J (2005) Information network topologies for enhanced local adaptive management. Environmental Management 35(2):175-193

Bodin Ö, Crona B, Ernstson H (2006a) Social networks in natural resource management: What is there to learn from a structural perspective? Ecology and Society 11(2):r2

Bodin Ö, Tengö M, Norman A, Lundberg J, Elmqvist T (2006b) The value of small size: loss of forest patches and ecological thresholds in southern Madagascar. Ecological Applications 16(2):440-451

Bolund P, Hunhammar S (1999) Ecosystem services in urban areas. Ecological Economics 29:293-301

Borgatti SP, Everett MG (1999) Models of Core/Periphery Structures. Social Networks 21:375-395

Borgström S, Elmqvist T, Angelstam P, Alfsen-Norodom C (2006) Scale Mismatches in Management of Urban Landscapes. Ecology and Society 11(2):16

Burt R (1992) Structural Holes: The Social Structure of Competiton. Harvard University Press, Cambridge, MA

Burt RS (2003) The Social Capital of Structural Holes. In: Guillen MF, Collins R, England P, Meyer M (eds) The New Economic Sociology: Developments in an Emerging Field. Russell Sage Foundation, New York, pp 148-189

CAB (2007) The Stockholm County Adminstrative Board's webpage URL: www.ab.lst.se, 2007-04-20, 14:30. In:

Cadenasso M, Pickett S, Grove J (2006) Dimensions of ecosystem complexity: Heterogeneity, connectivity, and history. Ecological Complexity 3(1):1-12

Callon M (1986) Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In: Law J (ed) Power, action and belief: a new sociology of knowledge. Routledge, London, pp 196-223

Cash DW, Moser SC (2000) Linking global and local scales: designing dynamic assessment and management processes. Global Environmental Change 10(2):109-120

Colding J (2007) 'Ecological land-use complementation' for building resilience in urban ecosystems. Landscape and Urban Planning 81(1-2):46-55

Colding J, Lundberg J, Folke C (2006) Incorporating Green-area User Groups in Urban Ecosystem Management. Ambio 35(5):237-244

Collins JP, Kinzig AP, Grimm NB, Fagan WF, Hope D, Wu J, Borer ET (2000) A New Urban Ecology - Modeling human communities as integral parts of ecosystems poses special problems for the development and testing of ecological theory. American Scientist 88:416-425

Crona B, Bodin Ö (2006) WHAT you know is WHO you know? Communication patterns among resource users as a prerequisite for co-management. Ecology and Society 11(2):7

Crooks KR, Suarez AV, Bolger DT (2004) Avian assemblages along a gradient of urbanization in a highly fragmented landscape. Biological Conservation 115(451-462)

Crumley LC (1994) The ecology of conquest: contrasting agropastoral and agrocultural societies' adaptation to climate change. In: Crumley LC (ed) Historical Ecology: Cultural knowledge and changing landscapes. School of American research press, Santa Fe

Cumming GS, Cumming DHM, Redman CL (2006) Scale mismatches in social-ecological systems: causes, consequences, and solutions. Ecology and Society 11(1):14

Cundill GNR, Fabricius C, Marti N (2005) Foghorns to the Future: Using Knowledge and Transdisciplinarity to Navigate Complex Systems. Ecology and Society 10(2):8

Daily GC (ed) (1997) Nature's Services: Societal Dependence on Natural Ecosystems. Island Press, Washington D.C.

de la Torre-Castro M (2006) Beyond regulations in fisheries management: the dilemmas of the “beach recorders” Bwana Dikos in Zanzibar, Tanzania. Ecology and Society 11(2):35

Degenne A, Forsé M (1999) Introducing Social Networks. Sage Publications, London

Diani M (1995) Green Networks. Edinburgh University Press, Edinburgh

Diani M (2003a) Introduction: Social Movements, Contentious Actions, and Social Networks: 'From Metaphor to Substance'? In: Diani M, McAdam D (eds) Social Movements and Networks: Relational Approaches to Collective Action. Oxford University Press, Oxford, pp 1-18

Diani M (2003b) Networks and Social Movements: A Reserach Programme. In: Diani M, McAdam D (eds) Social Movements and Networks: Relational Approaches to Collective Action. Oxford University Press, Oxford, pp 299-319

Dunning JB (1992) Ecological processes that affect populations in complex landscapes. Oikos 65:169-175

Ernstson H (forthcoming) Ecological resilience and social equity: the problem of generation and distribution of urban ecosystem services.

Ernstson H, Sörlin S (2009) Weaving protective stories: connective strategies to articulate holistic values in Stockholm National Urban Park. Environment and Planning A (in press)

Ernstson H, Sörlin S, Elmqvist T (2008) Social Movements and Ecosystem Services - The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm. Ecology and Society (in press)

Farina A, Belgrano A (2006) The eco-field hypothesis: Toward a cognitive landscape. Landscape Ecology 21:5-17

Fazey I, Fazey JA, Salisbury JA, Lindenmayer DB, Dovers S (2006) The nature and role of experiential knowledge for environmental conservation. Environmental Conservation 33:1-10

Folke C, Colding J, Berkes F (2003) Synthesis: Building Resilience and Adaptive Capacity in Social-Ecological Systems. In: Berkes F, Folke C, Colding J (eds) Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press, pp 352-387

Folke C, Hahn T, Olsson P, Norberg J (2005) Adaptive Governance of Social-Ecological Systems. Annu. Rev. Environ. Resour. 30:441–473

Folke C, Pritchard L, Berkes F, Colding J, Svedin U (1998) The problem of fit between ecosystems and institutions. IHDP working papers. International Human Dimensions Programme on Global Environmental Change, Bonn

Goldman RA, Tallis H, Kareiva P, Daily GC (2008) Field evidence that ecosystem service projects support biodiversity and diversify options. PNAS 105(27):9445-9448

Goldman RA, Thompson BH, Daily GC (2007) Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. Ecological Economics 64:333-343

Granovetter M (1973) The Strength of Weak Ties. American Journal of Sociology 76(6):1360-1380

Grimm NB, Faeth SH, Golubiewski NE, Redman CL, Wu J, Bai X, Briggs JM (2008) Global Change and the Ecology of Cities. Science 319:756-760

Grimm NB, Grove JM, Picket STA, Redman CL (2000) Integrated approaches to long-term studies of urban ecological systems. Bioscience 50(7):571-583

Guenther D, Newig J (manuscript) Network Governance and Collective Learning.

Gunderson LH (2001) Managing surprising ecosystems in southern Florida. Ecological Economics 37(3):371-378

Gunderson LH, Holling CS (eds) (2002) Panarchy: Understanding Transformations in Human and Natural Systems. Island Press, Washington D.C.

Gunderson LH, Light SS, Holling CS (1995) Lessons from the Everglades. Bioscience 45:66-73

Hahn T, Olsson P, Folke C, Johansson K (2006) Trust-building, Knowledge Generation and Organizational Innovations: The Role of a Bridging Organization for Adaptive

Comanagement of a Wetland Landscape around Kristianstad, Sweden. Human Ecology 34:573-592
Hanna SS, Folke C, Mäler K-G (eds) (1996) Rights to Nature - Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment. Island Press, Washington, D.C.
Harvey D (1996) Justice, Nature and the Geography of Difference. Blackwell, Oxford
Heynen NC (2003) The Scalar Production of Injustice within the Urban Forest. Antipode:980-998
Heynen NC, Kaika M, Swyngedouw E (eds) (2006) In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism. Routledge, Oxford
Holling CS (1978) Adaptive environmental assessment and management. John Wiley & Sons, New York
Holling CS, Meffe GK (1996) Command and Control and the Pathology of Natural Resource Management. Conservation Biology 10(2):328-337
Hostetler M, Holling CS (2001) Detecting the scales at which birds respond to structures in urban landscapes. Urban Ecosystems 4:25-54
Keitt TH, Urban DL, Milne BT (1997) Detecting Critical Scales in Fragmented Landscapes. Conservation Ecology 1(1):4
Leavitt H (1951) Some effects of certain communication patterns on group performance. Journal of Abnormal and Social Psychology 46:38-50
Lundberg J, Andersson E, Cleary G, Elmqvist T (2008) Linkages beyond borders: targeting spatial processes in fragmented urban landscapes. Landscape Ecology 23(6):717-726
Lundberg J, Moberg F (2003) Mobile Link Organisms and Ecosystem Functioning: Implications for Ecosystem Resilience and Management. Ecosystems 6(1):87-98
Lundgren Alm E (2001) Stadslandskapets obrukade resurs. Om grönstrukturens potential och synliggörande i en hållbar stadsutveckling (The unused resource of the cityscape. On the potential of the green structure in sustainable urban development). Chalmers University of Technology, Gothenburg
Löfvenhaft K, Björn C, Ihse M (2002) Biotope patterns in urban areas: a conceptual model integrating biodiversity issues in spatial planning. Landscape and Urban Planning 58:223-240
Manring SL (2007) Creating and maintaining interorganizational learning networks to achieve sustainable ecosystem management. Organization and Environment 20(3):325-346
McGranahan G, Marcotullio P, Bai X, Balk D, Braga T, Douglas I, Elmqvist T, Rees W, Satterthwaite D, Songsore J, Zlotnick H, Eades J, Ezcurra E, Whyte A (2005) Urban systems. In: Millennium ecosystem assessment: Conditions and trends assessment. Island Press, Washington, DC, USA., pp 795-825
Miller JR (2005) Biodiversity conservation and the extinction of experience. Trends in Ecology & Evolution 20:430–434
Moss T, Wissen M (2005) Making senses of diversity: A synergy report on an inventory of 113 intermediary organizations of water management in Europe. In. Leibniz-Institute for regional development and structural planning (IRS) http://www.irs.net.de/download/synergyReport.pdf
Mörtberg UM (2001) Resident bird species in urban forest remnants; landscape and habitat perspectives. Landscape Ecology 16:193-203
Nelson E, Polasky S, Lewis DJ, Plantinga AJ, Lonsdorf E, White D, Bael D, Lawler JJ (2008) Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. PNAS 105(28):9471-9476
Newman L, Dale A (2005) Network Structure, Diversity, and Proactive Resilience Builiding: a Response to Tompkins and Adger. Ecology and Society 10(1):r2
Nyström M, Folke C (2001) Spatial Resilience of Coral Reefs. Ecosystems 4:406-417

Oh H, Chung MH, Labianca G (2004) Group social capital and group effectiveness: the role of informal socializing ties. Academy of Management Journal 47(6):860-875

Olsson P, Folke C (2001) Local ecological knowledge and institutional dynamics for ecosystem management: A study of Lake Racken Watershed, Sweden. Ecosystems 4(2):85-104

Olsson P, Folke C, Berkes F (2004a) Adaptive comanagement for building resilience in social-ecological systems. Environmental Management 34(1):75–90

Olsson P, Folke C, Galaz V, Hahn T, Schultz L (2007) Enhancing the Fit through Adaptive Co-management: Creating and Maintaining Bridging Functions for Matching Scales in the Kristianstads Vattenrike Biosphere Reserve, Sweden. Ecology and Society 12(1):28

Olsson P, Folke C, Hahn T (2004b) Social-Ecological Transformation for Ecosystem Management: the Development of Adaptive Co-management of a Wetland Landscape in Southern Sweden. Ecology and Society 9:(4): 2

Ostrom E (1990) Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press

Ostrom E (1998) Scales, polycentricity, and incentives: designing complexity to govern complexity. In: Guruswarmy LD, McNeely JA (eds) Protection of global diversity: converging strategies. Duke University Press, Durham, NC, pp 149-167

Pahl-Wostl C, Craps M, Dewulf A, Mostert E, Tabara D, Taillieu T (2007) Social learning and water resources management. Ecology and Society 12(2):5

Pickett STA, Cadenasso ML (2008) Linking ecological and built components of urban mosaics: an open cycle of ecological design. Journal of Ecology 96(1):8-12

Pickett STA, Cadenasso ML, Grove JM, Groffman PM, Band LE, Boone CG, Burch WR, Grimmond CSB, Hom J, Jenkins JC, Law NL, Nilon CH, Pouyat RV, Szlavecz K, Warren PS, Wilson MA (2008) Beyond urban legends: An emerging framework of urban ecology, as illustrated by the Baltimore Ecosystem Study. Bioscience 58(2):139-150

Pickett STA, Cadenasso ML, Grove JM, Nilon CH, Pouyat RV, Zipperer WC, Costanza R (2001) Urban Ecological Systems: Linking Terrestrial Ecological, Physical, and Socioeconomic Components of Metropolitan Areas. Annual Review of Ecology and Systematics 32:127-157

Prell C, Hubacek K, Reed M (forthcoming) Stakeholder analysis and social network analysis in natural resource management. Society and Natural Resources

Putnam RD, Leonardi RJ, Nanetti RY (1994) Making Democracy Work: Civic Traditions in Modern Italy. University Presses of California, Columbia and Princeton, New Jersey

Reale JA, Blair RB (2005) Nesting Success and Life-History Attributes of Bird Communities Along an Urbanization Gradient. Urban Habitats 3(1)

SCB (2002) Statistiska Meddelanden MI 38 SM 0101, Tätorter 2000 (Statistical messages, urban areas). SCB (Statistics Sweden), Stockholm, Sweden.

Sandström UG, Angelstam P, Khakee A (2006) Urban comprehensive planning: Identifying barriers for the maintenance of functional habitat networks. Landscape and Urban Planning 75:43-57

Schneider M, Scholz J, Lubell M, Mindruta D, Edwardsen M (2003) Building Consensual Institutions: Networks and the National Estuary Program. American Journal of Political Science 47(1):143-158

Scott JC (1988) Seeing Like a State: How certain Schemes to improve the human condition have failed. Yale University Press, New Haven

Stockholm stad (2003) Biologisk utveckling av Stockholm – förslag till åtgärder (Biological development of Stockholm - propositions for action). Miljöförvaltningenn i Stockholm (Environmental dept. of the City of Stockholm), Stockholm

Tompkins EL, Adger NW (2004) Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change. Ecology and Society 9(2):10

UN (2005) World Urbanization Prospects: The 2005 Revision. United Nations Population Division, New York

Urban D, Keitt T (2001) Landscape connectivity: A graph-theoretic perspective. Ecology 82(5):1205-1218

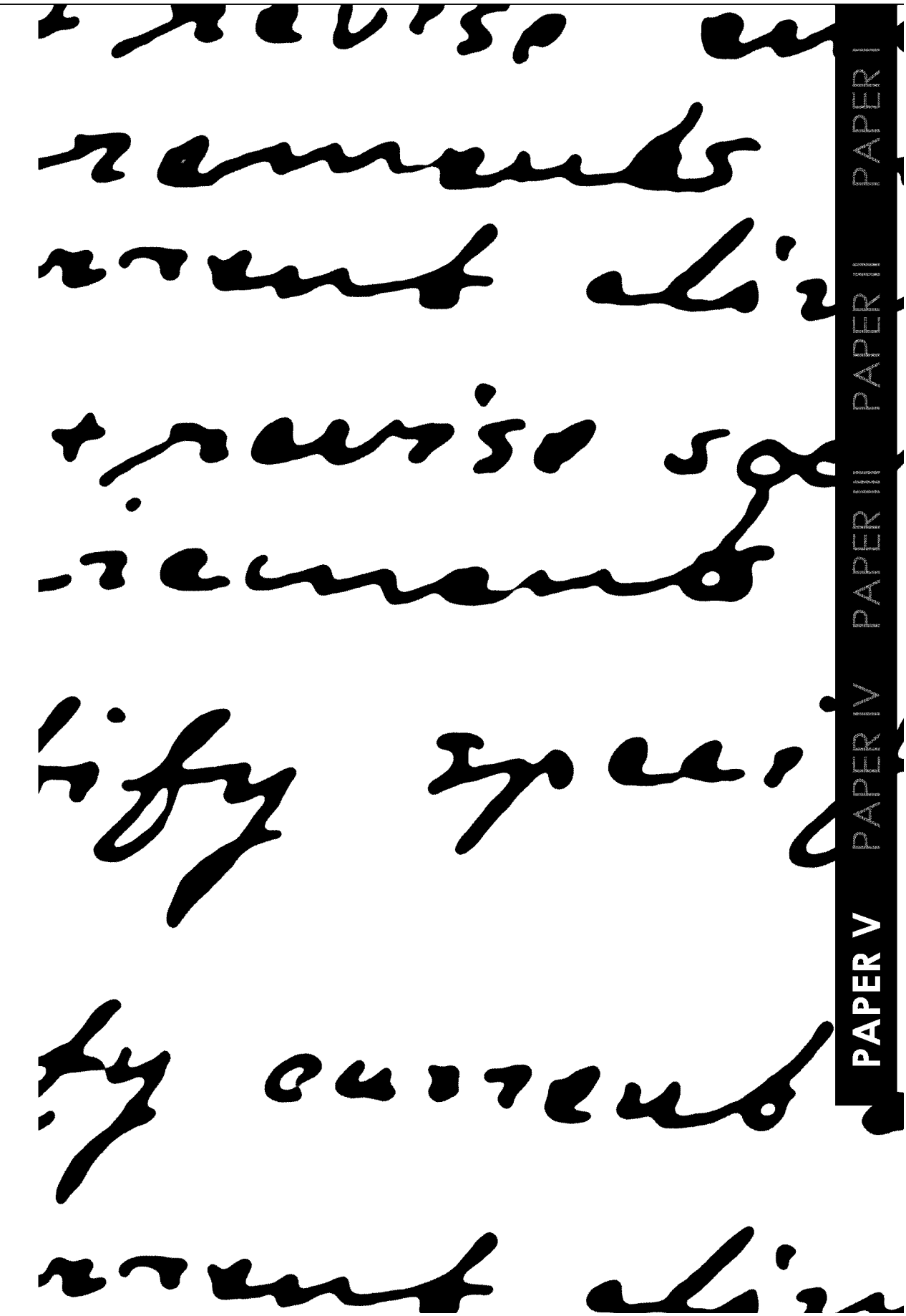
Wasserman S, Faust K (1994) Social Network Analysis - Methods and applications. Cambride University Press, Cambridge

Wenger E (1998) Communities of practice: Learning, meaning, and identity. Cambridge University Press, New York

Wenger E (2000) Communities of Practice and Social Learning Systems. Organization 7(2):225-246

Westley F, Carpenter SR, Brock WA, Holling CS, Gunderson LH (2002) Why Systems of People and Nature Are Not Just Social and Ecological Systems. In: Gunderson LH, Holling CS (eds) Panarchy: Understanding Transformations in Human and Natural Systems, Washington D.C.

Young OR, Lambin EF, Alcock F, Haberl H, Karlsson SI, McConnell WJ, Myint T, Pahl-Wostl C, Polsky C, Ramakrishnan PS, Schroeder H, Schouvart M, Verburg PH (2006) A Portfolio Approach to Analyzing Complex Human-Environment Interactions: Institutions and Land Change. 11 2(31)



PAPER V PAPER IV PAPER III PAPER II PAPER I

*For submission to Human Ecology.*

# The social production of ecosystem services: Lessons from urban resilience research

**Henrik Ernstson**

**Abstract** Recent findings have demonstrated urban nature as a source of ecosystem services benefitting human well being. Importantly, however, urban nature is heavily marked by society, which moderates and decides to a large extent not just the *generation* of ecosystem services but also *who* in society that gets to benefit from them, i.e. the *distribution* of ecosystem services. The article argues that research on urban ecosystem services must develop a deeper understanding of the social factors at play in this *social production* of ecosystem services, without loosing sensitivity for ecological scales and complexity. A framework for how to analyze urban social-ecological systems from both a functional management perspective and a social equity perspective is presented built on two interlinked modes of analysis: spatial social-ecological networks and value creation processes. The framework is discussed with empirical data from urban research in Stockholm, Sweden, and Cape Town, South Africa.

**Key words** Ecosystem services, urban landscapes, ecological networks, actor-networks, equity, resilience

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## Introduction

Ecosystem services, or "nature's services" as it was originally coined, are defined as the goods and services derived from natural processes that benefit human well-being (Daily 1997a; Daily 1997b; Daily and Matson 2008). Since the 1990's through a remarkable turn in the discipline of ecology, this type of research has been applied increasingly in urban landscapes (Kingsland 2005). Urban nature has been 'discovered', both as a site of research, for example in NSF's Long Term Ecological Research projects in Phoenix and

Baltimore (Grimm *et al.* 2000; Pickett *et al.* 2001; Alberti and Marzluff 2004; Grimm *et al.* 2008; Pickett and Cadenasso 2008), and as an object of urban policy for maintaining and enhancing the generation of urban ecosystem services (Bolund and Hunhammar 1999).

A major achievement of this emerging line of research has been the discovery of urban nature as a source of ecosystem services. By directing attention towards urban green and blue areas such as urban forests, parks, and watersheds, a wide range of services generated by urban ecosystems have been identified, from stress relief, improved air quality, to nitrogen retention and many more (ibid.; Jansson and Colding 2007; Table 1). Importantly, however, urban nature is heavily marked by society and human presence moderates and decides to a large extent not just the *generation* of ecosystem services but also *who* in society that gets to benefit from them, i.e. the *distribution* of ecosystem services. This article argues that research on urban ecosystem services must develop a much deeper understanding of the social factors at play. As will be demonstrated below, ecosystem services can only be generated and distributed insofar as social processes and institutions make that possible which can also explain the uneven distribution of ecosystem services across social, temporal and spatial scales. Here the social factors that distribute and make ecosystem services possible are recognized as a *social production of ecosystem services*, which in relation to a one-dimensional "nature's services" approach, could open up new and important research agendas and guide us in the quest to democratize production of urban ecosystem services.

Research in ecology and natural resource management have contributed extensively to our understanding of key ecological processes in generating ecosystem services, and capacity building to sustain the generation of ecosystem services in face of uncertainty and change (Berkes *et al.* 2003; Folke *et al.* 2005 and references therein). From natural resource management, furthermore, planning and governance ideas for how to adaptively manage these services are starting to emerge building on experience from non-urban landscapes (Borgström *et al.* 2006; Colding 2007; Ernstson *et al.* in prep.). However, there has been far less engagement with issues of access and ability to benefit from urban ecosystem services, issues which will be in focus here (cf. Ribot and Peluso 2003). This article centres on *the distribution of ecosystem services*, meaning the temporal and spatial scales, and sites in the landscape, where it is *possible* for humans to benefit from, or access, ecosystem services. Focus is not on the ecology as such but rather on the social factors that condition the production of ecosystem services.

The distribution of ecosystem services preconditions access and can be used to analyze patterns of inequity in society. The driving idea of the article is that social-ecological systems, i.e. integrated complex systems in which humans are seen as part of nature (Berkes and Folke 1998) need to be analyzed from a functional management perspective (to understand the generation of ecosystem services), jointly with a critical equity perspective (to understand the distribution of ecosystem services), as depicted in Figure 1. The aim of this paper is therefore to discuss a framework capable of analyzing jointly the functional and critical perspectives of urban social-ecological systems, which also contributes to the more general question of resilience for whom and for what as posed by others (Armitage

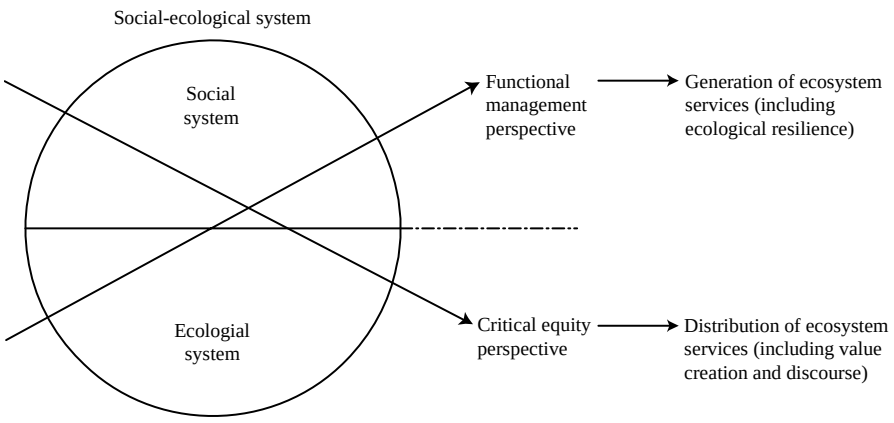


**Figure 1.** The figure outlines two fundamental perspectives of analysis of any social-ecological system. From the functional management perspective, social-ecological processes behind the generation of ecosystem services (i.e. benefits humans derive from ecological processes) are analyzed. From the critical equity perspective the social distribution of and the access to these ecosystem services are analyzed. This article proposes a framework for how to jointly analyze these.

and Johnson 2007 and references therein). This is done by combining landscape ecology with selected relevant theory from the social sciences, and with empirical data from urban landscape research in Stockholm, Sweden, and Cape Town, South Africa.

## The Ecosystem Services Approach in an Urban Landscape

The concept of ecosystem services is increasingly employed in research and policy regarding natural resource management and governance. A new paradigm has emerged which can be called an 'ecosystem services approach' to nature and management. From the early conceptualization by ecologist Gretchen Daily (1997b), through special editions in scientific journals (Costanza and Farber 2002; Daily and Matson 2008), it became a central concept in the recently concluded UN-initiated Millennium Ecosystem Assessment (MA 2005b). Here ecosystem services were described as consisting of four main categories (ibid.: VI): *provisioning services* (products obtained from ecosystems like food and fibre); *regulating services* (benefits obtained from regulation of ecosystem processes like air- and water filtration); *cultural services* (nonmaterial benefits obtained from ecosystems, like spiritual enrichment, cognitive development, recreation, and aesthetic experiences); and finally the *supporting services* (ecological functions such as pollination, nutrient cycling and soil formation) seen as necessary for the production of all other ecosystem services.

Most studies of social-ecological systems have been on systems with a direct linkage at a local scale between resource users and ecological dynamics (see e.g. Berkes *et al.* 2003;

Folke *et al.* 2005). In such systems people depend directly on provisioning services (e.g. crop or fish) which they either eat or sell on a market. They might even be aware of how supporting services, like pollination and soil formation benefit their consumption (ibid.), or institutions, norms or taboos have evolved that seem to sustain those services (Berkes *et al.* 2003). This type of direct and local scale linkage is considerably weaker in urban systems since provisioning services are mainly imported through trade, which instead involves linkages at a regional and global scale abstracted through the market (Deutsch *et al.* 2000)(although urban farming could be essential in many developing countries). Instead the local scale linkage shifts appearance in the urban system as it become dominated by the desire of cultural services, and to some extent regulating services, which address more urgent issues of urban life, like having space for recreation, an English park to contemplate, or improved air quality, all distributed to urban citizens in the form of spatially constrained green space, parks, urban forests and lakes. Since citizens depend less directly on their local ecosystems, the choice of what to do with them becomes more a matter of taste and culturally constructed values, often dominated by those with higher economic, cultural and social capital (Bourdieu 1984).

At the same time, the space of the city is a potential space for profit as described by geographer David Harvey (1996, 2002). Urban landscapes are characterized by the centrality they occupy in contemporary modes of capitalistic production of goods and services (Castells 1989; Harvey 1996; Sassen 2006). A variety of functions, from transport and sewage systems, to housing and offices need to find their space, along with urban parks and greenery, to produce urban services craved by citizens, all in a competition of which space can render highest profit on capital investment, being either private or public capital (Castells 1983; Harvey 1996; Swyngedouw 1997). Consequently, another characteristic of urban social-ecological systems, apart from its decoupling of direct need at the local scale, is its extreme heterogeneity of land use as it concentrates more types and financially stronger interests competing for land. How to use land becomes to a large extent a matter of human choice (often regulated through urban planning) in which the alternative uses for each patch of land are greater than in non-urban landscapes. At the same time, urban ecology has shown how urban development patterns moderates ecological processes and consequently also the generation of ecosystem services (Alberti 2005; Pickett *et al.* 2008). As we move the concept of ecosystem services to the urban landscape, it becomes inscribed in intense political land use struggles and forms part of the trajectory of what historian of technology Thomas P. Hughes has termed the “human built world” (Hughes 2004). The above comprises the foundation upon which we can talk about a social production of ecosystem services, since the human choices (and all the social, cultural, technical and political processes that impinge on these) will moderate both the generation and distribution of urban ecosystem services.

Ecology and natural resource management have contributed to the understanding of the generation of ecosystem services (Daily 1997b; Daily and Matson 2008; Berkes *et al.* 2003). Hypotheses and empirical results point to that management should be organized in collaboration with stake holder and user groups that interact with the ecosystems at various scales since this can build capacity to monitor ecosystems and respond to slow, rapid and unexpected changes (Gunderson 1999; Olsson *et al.* 2004a; Folke *et al.* 2005). The

distribution of ecosystem services, especially for urban landscapes, has received less academic attention. Research has tended to focus on socioeconomic patterns of urban biodiversity (Martin *et al.* 2004; Kinzig *et al.* 2005), or retained a functional management perspective when it has focused on power relations (Adger *et al.* 2005) or trade-offs between ecosystem services (Goldman *et al.* 2007; Goldman *et al.* 2008). In parallel, social scientists, in their analysis of unequal access to benefits of particularly urban nature (or effects of pollution), have tended to miss the complexity of ecosystems and that ecological processes are interlinked across scales, as argued by urban political ecologist Heynen (2003) with reference to Peterson (2000)(but see Walker 2005 for a review of the broader field of political ecology).[1]

The combination of equity and ecological complexity, or scales, comes out as important and less understood matters. How can both scales and equity be addressed in urban case studies? My suggestion builds on two presumptions derived from the literature: on the one hand ecosystem services are generated out of interlinked social-ecological processes at *various* scales (Berkes and Folke 1998; Berkes *et al.* 2003), while on the other, ecosystem services tend to only have benefits at specific scales; some on the local scale and in the present (e.g. recreation in a park), while others at greater scales (e.g. sustaining biodiversity and reducing $CO_2$ in the atmosphere). Given a specific social-ecological system, certain groups will participate in generating ecosystem services, while others, or even the same groups, will not have the potential to access them through the distribution of ecosystem services at different scales. Based on this, the article presents some emergent ideas for a framework for analyzing functional and critical aspects of urban social-ecological systems, which will also provide entry points to understand social mechanisms at the actor level, as well as the systemic effects they produce.

## Generation and Distribution of Urban Ecosystem Services

Research has described various ecosystem services in urban landscapes (Bolund and Hunhammar 1999; Jackson 2003). There are those primarily distributed locally, such as how single trees, urban forests and green areas can reduce noise and wind, while providing shade, clean the air from pollutants and particles and improve health and lower the levels of child asthma (ibid.). Simultaneously, local green areas can lower the levels of human stress, and strengthen community life through providing space for informal meetings (Kuo *et al.* 1998), but also for sports, physical/recreational activity, and for children's play and the hosting of cultural events (Bolund and Hunhammar 1999). Urban wetlands can mitigate both local flooding events while retaining nitrogen of benefit to whole regions (Jansson and Colding 2007). On greater spatial and temporal scales, benefiting a larger but more abstract and even future population, vegetated land with pervious

[1] Some examples of studies that have not engaged with the complexity of ecosystems are: Torras and Boyce (1998); Baland and Platteau (1999); Boyce (2001); Ribot and Peluso (2003). Outside the urban context, however, there exist a long tradition in political ecology of engaging with environmental justice and biophysical processes, and also recently with the "new" ecology of complexity, nonequilibrium and resilience as reviewed by Walker (2005). Especially mentioned are Fairhead and Leach (1995) and Leach and Mearns (1996).

**Table 1.** The table gives a rough and preliminary indication of the scale of distribution of some urban ecosystem services found in literature (based on a compilation with references by Borgström 2003). The list is not exhaustive and more discussions of the scales are needed. Spatial scales are: (L)ocal (or neighbourhood); (C)ity-scale; (R)egional; (G)lobal; followed by temporal scales: (I)mmidate (or short term); and (L)ong term. The category of ecosystem services follows (MA 2005a): (S)upporting; (P)rovisioning; (R)egulating; (C)ultural; († Numbers points to references listed in Appendix).

| *Category* | *Urban ecosystem service* | *Spatial scale* | *Temporal scale* | *†* |
|---|---|---|---|---|
| - R - - | Absorption of pollution and particles in the air (especially through urban trees) lowering for instance levels of (child) asthma. | L - - - | I L | 1 |
| - R - - | Stress reduction | L - - - | I - | 2 |
| - R - - | Improving health | L - - - | I L | 3 |
| - R - - | Shade, wind protection and noise reduction | L - - - | I - | 4 |
| - - C - | Spaces for recreation (e.g. green space and urban forests) and public space | L - - - | I - | 5 |
| - - C - | Opportunities for the formation of neighbourhood social ties | L - - - | I L | 6 |
| - - C - | Pedagogical opportunities for increased understanding about nature and ecosystems | L - - - | I L | 7 |
| - - C - | Aesthetical values in the form of “natural” landscapes | L - - - | I - | 8 |
| - - C - | Creativity inspiring | L - - - | I - | 9 |
| P - - - | Urban agriculture giving food and sellable products | L - - - | I - | 10 |
| - R - - | Erosion and flood control/mitigation (through wetlands) | L C - - | I L | |
| - R - - | Microclimate regulation temperature and moisture (mitigate city heat island effect) | L C - - | - L | 11 |
| - R - - | General air filtering | - C - - | - L | 12 |
| - R - - | Rainwater drainage, water retention (green water) | - C - - | - L | 13 |
| - R - - | Sewage treatment | - C - - | - L | 14 |
| - R - - | Nitrogen abatement filters (through wetlands) | - C R - | - L | 15 |
| P - - - | Water filtering, treatment and storage | - C R - | - L | 16 |
| - - - S | Habitat for species from exploited area | - - R G | - L | |
| - - - S | Substituting habitat for endangered species in other landscapes | - - R G | - L | 17 |
| - - - S | Pollination and seed dispersal underpinning biodiversity | - - R G | - L | 18 |
| - R - - | Biodiversity for potential biological control | - - R G | - L | 19 |
| - R - - | $CO_2$ absorption | - - - G | - L | 20 |

surfaces aid in draining rainwater and sustaining the ground water table (Bolund and Hunhammar 1999), while also absorbing $CO_2$ emissions (Jansson and Nohrstedt 2001). Urban ecosystems have also been shown to sustain biodiversity through providing substitute habitat for endangered species (Sukopp and Weiler 1988), and in creating new biological niches (Savard *et al.* 2000), which also increases the ability of ecosystems at regional and global scale to adapt to environmental and climatic changes (Folke *et al.* 1996). Table 1 list a set of urban ecosystem services from literature and roughly indicate on what

spatial and temporal scales in the urban landscape at which they are primarily distributed, and consequently which sets of human groups that can potentially access them (from the local neighbourhood, city population, regional, to all human kind).

Generation

The generation of ecosystem services are seen as derived from interlinked social-ecological processes at different scales. In an urban context this translates to a dependence on the spatial patterns of spatially defined urban ecosystems of green and blue areas, shaped by urban development (Alberti 2005; Pickett *et al.* 2008), along with management practices carried out by humans on these sites (Barthel *et al.* 2005; Andersson 2006; Colding *et al.* 2006; Andersson *et al.* 2007; Ernstson *et al.* in prep.). It has been shown that fragmentation and isolation of green spaces leads to a general loss of ecosystem services (e.g. Schwartz 1997; Young and Jarvis 2001; Stenhouse 2004). At the same time, day-to-day management practices of allotment gardeners and park and cemetery managers can facilitate the generation of ecosystem services, and they should be drawn upon in ecosystem management (Ernstson *et al.* in prep.). In Stockholm, the practices carried out by for example allotment gardeners facilitate pollination processes (Barthel 2005; Andersson *et al.* 2007), which in turn facilitates larger-scale ecological processes sustaining biodiversity (Colding *et al.* 2006). More generally, and for all landscapes, ecological processes facilitating (or enabling) ecosystem services are moderated through patterns of social structures and of human day-to-day management activities (Alberti 2005; Daily and Matson 2008; Goldman *et al.* 2008).

Distribution

The emergent field of urban political ecology (Keil 2003; 2005; Henen *et al.* 2006b) has been preoccupied with issues of environmental justice and has demonstrated, without using the term, how urban ecosystem services are unequally distributed and accessed. Building on work by geographers such as Harvey (1996) and Erik Swyngedouw (1997), this field views the "urban as a process of socio-ecological *change*" (Heynen *et al.* 2006b: 2) and argues that most polices directed towards urban planners do not address the close relation between capitalist urbanization processes and socio-environmental injustices (ibid.; with reference to Whitehead 2003).

One of the few studies within this field that explicitly addresses the complexity of urban ecosystems, and links this with ecosystem services, is Heynen's study of the uneven pattern of tree cover in the city of Indianapolis, USA (Heynen 2003). Here elite and high income areas were shown to have more and larger stands of trees than lower income areas. Heynen argues that this pattern can be understood through recognizing the use-value and the positive externalities of urban trees, especially those at the local scale, i.e. their local ecosystem services such as shading, noise protection, and air filtration. Through this economic value, urban trees become "commodified" (with reference to Marx 1990) and sucked into the political economy of the city in which stronger economic interests tend to dominate so as to produce uneven spatial tree patterns, either through influencing decisions regarding the planting of new trees in certain areas or through higher protection of

trees in these areas. This shows two things: one, that poorer neighbourhoods have less access to local ecosystem services generated by trees, and two, those patterns of urban trees, and thus their locally distributed ecosystem services, is an outcome of a socio-political process.

However Heynen acknowledges the complexity of ecosystems and notes an important trade off between the generation and distribution of ecosystem services. To sustain large-scale ecosystem services, most particularly biodiversity but also pollination, seed-dispersal and pest control, it is important to plant trees so that larger forest islands become ecologically connected (e.g. Stenhouse 2004; Andersson and Bodin accepted). Given a finite number of trees to plant, it seems better to place them where larger forest islands already exist so as to increase the landscape connectivity of trees, which in the case of Indianapolis correlated with high income neighbourhoods. To spread them out evenly in lower income areas would be a bad option seen from an ecological and functional management perspective (Figure 1). This comes out as a trade off between the distribution of ecosystem services at different scales. Those groups representing the greater and more abstract scale of ecosystem services (often experts, planners and conservation biologists), joined by high-income home owners at the local scale, are supported by the functional management arguments, and pitted against low-income groups that live in areas with no trees and that would benefit more directly with trees in their neighborhood.[2]

My study of the National Urban Park in Stockholm shows a similar example. In spite of large exploitation pressure, an urban movement of civil-society organizations managed to legally protect this large green area, partly facilitated by its royal heritage (Ernstson *et al.* 2008; Ernstson and Sörlin 2009). However, the effect of this protection, securing attractive local ecosystem services for those living close by, might well be that other green areas – where less protection values can be mustered – are lost instead as urban planning often regards green areas as a zero sum game with estimated ratios of green space per unit of area or inhabitant. Furthermore, if those lost green areas are important for spatial ecological processes and the movements of species, large-scale ecological effects can be the outcome here as well (Andersson and Bodin accepted).

Another example comes from the Tokai forest located in the wealthy southern suburbs of Cape Town, South Africa. Once planted with non-indigenous pine trees in an effort to create a productive forest and jobs, the area has since become a popular recreational site. However, recently an accidental fire awoke dormant indigenous fynbos seeds to sprout and grow (Holmes pers.comm. 2007). This re-emergence of fynbos occurred at the same time as public agencies (again using job creation programs), experts and NGOs mobilized in removing non-indigenous plants, now viewed as depleting the water table and as fire risks (cf. Van Wilgen *et al.* 1998). New environmental management plans for the area have been put in place by civil servants and park managers leading to contestation between user groups, with different groups focusing on different ecosystem services operat-

[2] Heynen (2003) interprets this also as dilemma between local and global environmental justice; while those in poor neighbourhoods can gain ecosystem services through planted trees, it contributes less in sustaining global biodiversity and sustainability, thus contributing less to the benefits of future generations on a global scale.

ing at different spatial and temporal scales. Conservation biologists and local "fynbos friends" argue for sustaining biodiversity for long-term adaptation in face of climate change, together with increased fresh water flows on a shorter time scale. Other groups put forward health aspects and the value of recreation, seen as easier in a pine forest with shade and a minimum of underbrush. This is also linked to cultural values of belonging and identity as many have grown up with the forest, and not with fynbos. From a scale perspective, although the story of the Tokai forest is more nuanced than this, a political struggle has emerged over the scales of distribution of ecosystem services that this site should be managed for. Roughly described, you either manage the site for serving present users with mundane desires of recreation, or you manage it as a site to increase city-wide distribution of fresh water and for ensuring ecological safety – through preserving biodiversity – for the whole population in some distant future.

With these examples, and other similar ones (e.g. Diani 1995; Eden *et al.* 2000; Ansell 2003; Brownlow 2006), both the generation and distribution of ecosystem services can be understood as an outcome of social-ecological processes interlinked over a range of scales. However, since the political economy shapes the organization of society and the spatial pattern of land use (especially in urban landscapes) ecological processes and their outcomes can be conceived as a social production of ecosystem services. This could set the field of ecosystem services in communication with other research fields to open new research agendas. To analyze the spatial distribution of societal services, based upon a materialistic understanding that services originate from humanly moderated biophysical processes (e.g. fresh water distributed through cemented pipes running through physical space), forms the premise of critical geography and political ecology (Harvey 1996; Swyngedouw 1997; Harvey 2002; Heynen 2003). Much can be learnt from these fields, but still the terminology and scope of ecosystem services have not been used, which is attempted here.

## Two Modes of Analysis

In the following sections, two interlinked modes of analysis to address the social production of urban ecosystem services will be explicated. Combined these strive to address the general problem under analysis that can now be stated: How does a particular social-ecological system generate and distribute ecosystem services? The two modes of analysis are: (i) spatial social-ecological networks, and (ii) value-creation processes around ecosystem services. A follow-up question relates to how changes in social-ecological systems necessarily alter the generation and distribution of ecosystem services, which here will briefly be related to analyses of transitions towards ecosystem based management (Olsson *et al.* 2004b; Olsson *et al.* 2008). Some suggestions for how to engage with these modes of analysis in empirical research are touched upon in the text, but will need more treatment in future papers.

Spatial Social-Ecological Networks

Using a network approach, it is possible to view the urban landscape as composed of nodes of green and blue areas (i.e. local urban ecosystems) surrounded by human built areas, which are connected through functional ecological links representing species movement or other vital ecological flows like nutrients or water flows. A network approach can capture the structure and dynamics of the ecological system. Social dynamics are introduced in the model as node attributes. To each node, i.e. to each green (or blue) area spread out in space, the attributes of protective capacity and management capacity are attached. The former means roughly the ability to resist exploitation (and degradation/disappearance), while the latter aims to capture the ability to sustain landscape ecological flows through the green area (including the social processes of which ecosystem services that are prioritized within the green area). Of course management and protective capacities can be interlinked, but by keeping them separate analytical insights can be gained. Further, given the complexities of urban landscapes, the network model should at this point primarily be seen as a heuristic model, i.e. as a tool to think about the generation and distribution of urban ecosystem services and help us tease out general characteristics of these interlinked dynamics.

*Ecological connectivity* — Ecosystem services depend heavily on the spatial structure of ecosystems (Alberti 2005; Goldman *et al.* 2007), and spatial ecological networks is an emergent field of study (Keitt *et al.* 1997; Urban and Keitt 2001; Bodin and Norberg 2007). The most valuable study for us is that of Bodin *et al.* (2006). They analyzed, using remote sensing satellite maps, a highly fragmented forest in a farming landscape on Madagascar in which remaining small forest patches (<1 to 95 ha) constituted "islands in a sea of agriculture". A local taboo system, that tended to protect larger patches, had moderated the expansive human land use to create an almost digital use of land, which at least structurally is comparable to urban landscapes as followed up further below.

Bodin *et al.* (2006) selected two ecosystem services, pollination and seed-dispersal, important both for local crop production, and for the regeneration of forest patches and biodiversity on a longer time-scale (Table 2). Focusing on bees (for pollination) and lemurs (for seed-dispersal), their analysis based on digital maps showed that although the forest was fragmented, pollination processes for crop production and seed-dispersal for forest regeneration could be upheld through the movement of species between patches. Roughly 88 percent of the crop production was reached by bees, and 70 percent of the forest patches was linked in one component through the potential movement of lemurs. However, they also encountered clear nonlinearities in the potential of generating ecosystem services. In simulating progressive agricultural development they sequentially removed the smallest patches (with weakest level of taboo), resulting in the ecological network becoming fragmented. Pollination cover dropped some 36 percent, and the largest forest component was down to 15 percent when removing patches less than 3 hectare.[3] In a follow-up paper, Bodin and Norberg (2007) showed that by removing patches that bridged

[3] The figures are based on medium movement distances for bees and lemurs (900 m and 1000 m respectively).

**Table 2.** The general and specific setup of the ecological network model by Bodin *et al.* (2006) in their study of the generation of ecosystem services in a highly fragmented forest landscape in southern Madagascar.

| | *A.* | ← *B.* | ← *C.* | ← *D.* |
|---|---|---|---|---|
| **General setup** | **Human benefits** | **Ecosystem service** | **Representative species carrying out ecological function** (part of a functional group, mobile link species) | **The spatial structure of the ecological network.** This is a measurable unit while a node equals a habitat, i.e. a forest patch on a map; while a link represents species movement between forest patches (dependent of vagility of species and distance between patches). |
| **Pollination** | Beans (essential protein source for local people) | Crop pollination through insects | Bees (wild and semi-domesticated) | Node = forest patches > 0.5 ha; Link = patches within 400 – 1400 m, the mobility of bees |
| **Seed dispersal** | Sustain forest and biodiversity | Seed dispersal (increase capacity for forest regeneration after disturbance; and secures spatial gene flow in the landscape) | Ring-tailed lemur (key seed disperser; the only fruit-eating lemur in the area) | Node = patches ≥ 1ha; Link = patches within 500 – 1500 m, based upon lemur vagility and distance.* |

* Calculations assumed that the rate of movements vs. distance to cover, followed a negative exponential function, which means that if is far to another patch, the lemurs tend not to go there although they physically could.

between greater clusters of patches (i.e. with high network betweenness centrality (Borgatti and Everett 1992)), pollination cover and forest connectivity dropped even more rapidly. These findings point to the value of small size in fragmented landscapes, and that some patches have disproportionally high importance on large-scale processes and the generation of ecosystem services (Bodin *et al.* 2006; Bodin and Norberg 2007).

Andersson and Bodin (accepted) adapted this approach to the urban landscape by analying the connectivity of bird habitat. Although similar, an urban landscape has a less digital land use than what the farming landscape in Madagascar had, but the approach of ecological networks was still found useful by calculating the relative cost of movement for species outside green areas.[4] A similar approach was used for the Cape Town Biodiversity Network where most important green areas and dispersal corridors (i.e. links between

[4] Others have used similar approaches in Stockholm, for instance Zetterberg *et al.* (manuscript) for amphibians on a greater scale, and Colding *et al.* (2006) made rough calculations of spatial bee pollination with allotment gardens as stepping stones.

nodes) for sustaining the biodiverse and highly threatened native fynbos vegetation were identified (City of Cape Town 2007; Oeloefse pers.comm. 2007).

These urban examples have not gone so far as to account for ecosystem services *per se*, but have proven that urban landscapes can be translated as ecological networks. If the networks are based on species that sustain key ecological processes across spatial scales, so called mobile links (for instance pollinators and seed dispersers), then a closer relation can be reached to ecosystem services, (Nyström and Folke 2001; Lundberg and Moberg 2003). Before proceeding, it should be emphasized that the strength of spatial ecological networks reside in that they can be used to account for the interlinkages between ecosystem services at different scales; that systemic effects of the loss of single nodes for instance, can be calculated and accounted for.

*Protective capacity* — The protective capacity of an urban green (or blue) area is its level of resistance to disappear as a node in the ecological network, either by being replaced by built constructions or through complete ecological degradation for some reason. The protective capacity is derived from social processes and structures associated with particular green areas. In the Madagascar case above, a local taboo system brought different levels of protective capacity to different forest patches, which was used to analyze future scenarios of ecosystem service generation (Bodin *et al.* 2006). Our studies in Stockholm (Ernstson *et al.* 2008; Ernstson and Sörlin 2009) analyzed how protective capacity is created and maintained in a modern city. In reaction to heavy exploitation plans, an urban movement of interest organizations and user groups managed to create formal protection for the National Urban Park by articulating the cultural-historical and ecological linkages between a set of green areas. A similar example is the False Bay Ecology Park in Cape Town, in which civil-society organizations have been able to expand a formally protected area through popular protection (Jackson pers.comm. 2007). In both these cases, protective capacity rests upon an active civil society whose organizations and activists are attached, for some reason or another, to a certain green area. Through developing methods and lobbying contacts to politicians and media, these groups can, in face of exploitation or other "disturbance", mobilize in collective action to stop or change decisions, which has been addressed more generally in research on urban social movements (Castells 1983; Diani 1995; Harvey 1996). The density of civil society organizations associated with particular green areas can be an approximate measure of this type of protective capacity (Ernstson and Sörlin 2009 with reference to Putnam *et al.* 1994; Hägerstrand 1996). This also captures at least a part of the cultural dimension of urban landscapes in which physical sites are part of the co-construction of urban identities and places, which could produce motivation triggering collective action (Castells 1983; Massey 1995; cf. Sörlin 1999).

A more "top-down" example of protective capacity is the Cape Town Biodiversity Network mentioned earlier. A computer model constructed by two municipal ecologists was used to mobilize protection of green areas associated, according to the model, with sustaining high biodiversity of the local fynbos vegetation (City of Cape Town 2007; Oeloefse pers.comm. 2007), thus increasing the potential protective capacity of a specific set of green areas of the city (and not others). Partly through printing out maps of the

network and showing them to other civil servants at city hall, the two ecologists could mobilize increased awareness of the value of these sites, which was also facilitated by general increased appreciation of biodiversity in the city (Oeloefse pers.comm. 2007).

Another example of protective capacity is due to biophysical constraints, for instance steep hills or marshes and wetlands on which it is difficult to build (cf. Rompré *et al.* 2008). Also land in between motorways is more or less useless for urban exploitation. Drawing on Harvey (2002) these type of areas could be classified as "non-profit sites" as they hold no potential to generate profit on investment. However, the high protective capacity that this generates at one point in time, could later drop as technological development bring new techniques to more cheaply build on slopes and in water prone areas, which shows just how entangled social processes are with ecological processes and the generation of urban ecosystem services.

*Management capacity* — Many different actors interact intentionally with urban ecosystems, from regional and municipal planners, to local users and managers like allotment gardeners, urban farmers, private home owners and cemetery and park managers (Ernstson *et al.* in prep.). Their day-to-day management practices, embedded in institutions and urban planning decisions, influence individual green areas and their vegetation cover, soil composition and the creation and sustenance of habitats for species (ibid.; Andersson *et al.* 2007). In relation to the ecological network, management capacity is defined primarily as the capacity to carry out management practices that sustain ecological flows through the individual green area. This means to recognize in management that green areas are part of a bigger structure, and not isolated in time or space (Borgström *et al.* 2006; Pickett and Cadenasso 2008). From Stockholm, Andersson *et al.* (2007) could assert that green areas managed by cemetery and park managers have lower levels of management capacity than those managed by allotment gardeners; with the latter showing greater local ecological knowledge and the widest range of management practices that offered protection of species and improved habitat to sustain pollination and seed-dispersal processes (Barthel *et al.* 2005). To further increase overall management capacity of the ecological network, coordination between different actor groups at different ecological scales are needed to facilitate collective management actions and social learning about ecosystem dynamics (Ernstson *et al.* in prep.).

Value-Creation Processes

Interlinked with the first mode of analysis there is a second. Ecosystem management in face of disturbance and change is not just about good organization and "doing the right thing". It is also about choosing (consciously or not) which ecosystem services to prioritize, an aspect interlinked with what was defined above as management capacity. The struggle surrounding the Tokai forest exemplifies this with all clarity. What should be prioritized? Pine or fynbos; "alien" species or indigenous; water ignorant land use or "water wise"; mundane recreational services for present users, or biodiversity as insurance for future human kind?. In natural resource management this has been framed as a problem of finding the right trade-offs between different possible ecosystem services through the use of land (Goldman *et al.* 2007; Nelson *et al.* 2008).

The second mode of analysis strives to un-pack the process of "finding the right trade-off" as a political process of value creation in which different actors, with different and unequal abilities and resources, participate in creating values around different and sometimes opposing ecosystem services (cf. Wilson and Howarth 2002).[5] To return to the Tokai Forest, whatever decisions are taken, to awake more fynbos or keep the pines, a trade-off will have to be made and a particular set of outcomes will have occurred, which calls for ways to analyze these outcomes.

In this mode of analysis ecosystem services are viewed as social and cultural products that have changed over time, and that simultaneously can encompass a multitude of facets depending on which actor's perspective is chosen. Crucially, and drawing on historical and sociological theory, it is recognized that in order for something to be seen as having a value, there needs to be actors that can describe that something and explain that it has a value (Sörlin 1998). Research on how certain objects, landscapes and species have become protected (Sörlin 2001; Adams 2004) point out that important actors in value creating processes are artists, authors, and scientists. They are crucial since they produce artefacts such as paintings, maps, and scientific reports that in turn can be used (by other actors) to construct narratives that can be performed on different social arenas, especially media, public meetings, exhibitions, and in parliament, to explain the phenomenon and its value (Pyne 1998). These artefacts and narratives become part of public discourse, and the material of collective identities and social memory (Halbwachs 1952/1992), while also forming part of cultural production in which schools, museums, media etc. also become actors sustaining ecosystem services (although not necessarily aware of this role). The way which ecosystem services emerged as a concept within science to be established in policy arenas serves as a good example. With the rapid development in the field there are now both actors (especially scientists), artefacts, and practices that can both describe and explain ecosystem services and their value to humans (Daily and Matson 2008); some in direct monetary terms (e.g. Hougner *et al.* 2006), others as "payment for ecosystem services" (Turpie *et al.* 2008), or the amount of physical area (e.g. hectares of forest) needed to produce them in a wider landscape (cf. Goldman *et al.* 2007).[6]

In emphasizing the relational dependence between actors and artefacts in articulating values, actor-network theory provides a compelling framework also applicable in case study

[5] In ecological economics a similar approach called "discourse-based valuation" has convincingly been discussed by Wilson and Howarth (2002). This offers however no framework for analyzing social dynamics, but rather a way to inform democratic decision making. Based on case study literature and theories on deliberative democracy as proposed by Habermas (1981/1987), they argue that discourse-based valuation can better measure and account for the societal and public values of ecosystem services. By setting up focus groups of different stakeholders, deliberative discussions can bring out more viewpoints of ecosystem services, and Wilson and Howarth see this as a complement to contingent valuation based on individual preferences alone.

[6] Some of the scientific knowledge behind ecosystem services of course existed before it was "packaged" as ecosystem services. Before, this knowledge was normally used to define ecosystem functions and biodiversity. However, with the definition of Daily (1997a) and especially the Millennium Ecosystem Assessment (MA 2005a), in many instances these previous "translations of nature" (sensu Callon 1986), have now been framed as part of ecosystem services.

analysis (Callon and Latour 1981; Callon 1986; Castree and MacMillan 2001; Latour 2005). Here value-creating processes can be seen as a *political programme* that gains power as actors "pick up" artefacts produced by other actors and fit them with the programme to give it "weight"; producing what is referred to as actor-networks consisting of associations between humans and non-humans (Latour 2005; or actant-rhizomes ibid.). A scientific report of red-listed species in an area becomes an asset for environmentalists but an obstacle for developers. Callon (1986) refers to a "sociology of translation" whereby actor-networks articulates or translates certain values (as opposed to diffusion theories where actors are passive receivers or transmitters (Coleman *et al.* 1957; Cowan and Jonard 1999)). Such actor-networks do not possess power in any formal sense, but can achieve a lot, i.e. gain power, both as a "community of practice" wielding power and knowledge (Fox, 2000; Wenger, 1998; Foucault 1980), and through mobilizing yet more actors and artefacts into action (Callon 1986; Forsemalm 2007). The protective capacity of the Stockholm National Urban Park was shown as resting heavily on actor-networks, where activists mobilized old maps of English parks and recent maps of biodiversity dispersal corridors to articulate the values of this particular green area (Ernstson and Sörlin 2009). The Capetonian ecologists used their biodiversity maps to mobilize support at city hall for their Biodiversity Network, but such "immutable mobiles" (Latour 1987) can mobilize yet more supporters and hold together emergent actor-networks through being reprinted in newspapers or exhibited at museums and other social arenas.

In relation to the Tokai forest, and also more generally, it can be imagined that different sets of competing actor-networks will emerge that strive to translate values of different sets of ecosystem services. Case study analysis can firstly be directed towards identifying the actors and artefacts involved, the practices used in linking these together, and how values are articulated on social arenas. Secondly, this also allows for analysis of the structural conditions for different social groups to participate in assembling actor-networks. What time, skills and resources do different groups have in participating in assembling actor-networks? What type of artefacts is associated with different green areas and what type of land use and ecosystem services do these artefacts favour? And what access do different groups have to social arenas? All these structural conditions would influence the shape of emergent actor-networks and give analytical tools to understand why certain ecosystem services would be prioritized before others. These two steps of analyzing value creation processes in case study analysis are demonstrated and discussed in a series of papers (Ernstson *et al.* 2008; Ernstson and Sörlin 2009; Ernstson et al. in prep.).

Through analyzing value creation processes around ecosystem services, two fallacies of contemporary thinking on natural resource management (Folke *et al.* 2005; Ostrom 2005; Goldman *et al.* 2007) can be addressed: first an objectivist stance that ecosystem services exist "out there" in the landscape (independent of humans and social articulation); and secondly that the process of "finding the right trade off" between different ecosystem services is often simplified into a consensual process or as a rational choice game between actors with fixed interests that can be steered/guided by economic incentives. These fallacies are grave since the analyses that follow from them will miss the processual and relational dynamics captured in actor-networks and also the value formation as a social process involving social groups, knowledge, and power. Closely associated with this, models

of adaptive management and governance of ecosystems can also be interrogated (Gunderson 1999; Folke *et al.* 2005). In these models, knowledge about specific ecosystems, as held by different actors and users, are predominantly seen as merely useful or ”functional” for building more complete understanding of ecosystem dynamics. This tends to neglect the situatedness of knowledge as a product of social class and cultural processes (Berger and Luckmann 1966; Bourdieu 1984; Shapin 1995: 303ff.). Using actor-networks and value creation as means of analysis, presumes the contested character of knowledge (Foucault 1980), and could open analytical pathways to better come to grips with how different stakeholders can bias management towards certain ecosystem services (instead of others) as argued with empirical data elsewhere (Ernstson *et al.* 2008; Ernstson and Sörlin 2009).

**The Two Modes Together: Analyzing Changes in Social-Ecological Systems**

Taken together the two modes of analysis can be used in analyzing changes in urban social-ecological systems. The second mode of analysis, to analyze value creation processes, aids in comprehending that the generation and distribution of a certain set of ecosystem services, both for a certain urban green area and for a whole landscape, is a result of a nested set of political socio-cultural processes expressed as actor-networks in which certain actors are more influential than others. By interlinking this second mode of analysis with the first mode, that of analyzing social-ecological networks, the scales and complexity of ecosystems can also be accounted for. The changes in the social-ecological network, through the different levels of management and protective capacities, becomes the way in which to understand the effect of how socio-political processes moderate biophysical processes at different scales. The framework consequently serves as an entry point to analyze the social production of urban ecosystem services.

An hypothesis based on this framework, is that the exploitation pressure, driven by socioeconomic processes, will seek out those green areas with lowest protective capacity, and highest profit value. Crucially, if some of these areas have high centrality in the ecological network, their removeal could trigger threshold effects in ecological connectivity and erode not just the production of local ecosystem services, but also the capacity to generate larger-scale ecosystem services and the ability to regenerate after disturbance, also known as spatial ecological resilience (Nyström and Folke 2001). The removal or local green areas could also lead to an uneven distribution of at least local urban ecosystem services, which might be correlated with other uneven spatial patterns of urban service distribution (Harvey 1996), which was observed in Heynen’s study (2003) above. Although less obvious in Stockholm, in Cape Town green areas and urban forests are almost exclusively found in higher income areas. At the same time, while high-income villa gardens in Cape Town have been planted with non-indigenous trees and plants (following colonial traditions), a greater pressure to produce (i.e. conserve) biodiversity as a large-scale ecosystem service has fallen upon poorer areas. In Cape Town this has however partly been turned into opportunities of empowerment of lower income groups and restoration of local green and blue areas in their neighbourhoods (CFN 2006). That activities in one place can effect processes at another indicates that management and protective capacities can

be interlinked across space. Important to note, and one of the key findings from studies in Stockholm (Andersson *et al.* 2007; Ernstson *et al.* 2008; Ernstson and Sörlin 2009; Ernstson *et al.* in prep.) is that an active civil society, in which individuals, activists, and associations engage in green and blue areas, is an important factor behind both protective and management capacities, and consequently that civil society plays an important role in the social production of urban ecosystem services. Suggestively, this could generally benefit middle- and high-income neighbourhoods that traditionally have been more interested in environmental issues (Diani 1995; della Porta and Diani 2006), and that have more social, human and cultural capital (Bourdieu 1984).

In relation to the more general field of studying transformational change in social-ecological systems, or transitions towards adaptive ecosystem management and governance, as defined and studied by Olsson and colleagues (Olsson *et al.* 2004b; Olsson *et al.* 2006; Olsson *et al.* 2008), the framework can also be helpful both for studies in urban and non-urban landscapes. First, by stressing the analytical approach of value creation and actor-networks, a deeper analysis of observed transition dynamics and collective action can be reached. Especially the analytical categories of leaders, key stewards, and visions, which are often used in explaining social dynamics, can be taken further by also searching for the artefacts and social arenas that underpin this type of collective action to enrich our understanding of these important transition processes. What is the nature of artefacts that seem to facilitate transitions towards ecosystem based management? Who produces these and who can "pick them up" and use them as weights to create change? Are useful artefacts and associated actors spread out unevenly in space and could such differences help to explain why transition is happening for that particular wetland, or that particular urban green area, and not for another? Second, although some preoccupation has been with analyzing critical equity perspectives that such transitions create, less detailed analysis has been made concerning alterations of the distribution of ecosystem services. Even if it is true that transitions towards ecosystem based management could in some cases benefit everybody in so called "win-win" situations (Hahn *et al.* 2006), it would still be interesting to see who benefits more than others. Not least since inequalities in for example the access to fishing rights or user rights that transitions might produce, can feedback to change both social and ecological dynamics (cf. Boyce 1994).

The conceptual framework of social production of ecosystem services acknowledge that biophysical processes – and their often unequal benefits to humans – are mediated through political processes (Harvey 1996; Heynen *et al.* 2006a). However, it maintains, within the framework, the issues of scales and ecosystem complexity. Ecosystem services are treated not just as the outcome of (non-human) biological/ecological processes, nor as outcomes of managing or navigating social-ecological systems, but also as a result of human perception, articulation, and political struggle. Moreover, in a world in which all landscapes are becoming increasingly human-dominated (UN 2005; MA 2005), the framework developed here for urban landscapes might become, with modifications, increasingly useful for all landscapes.

**Concluding Remarks**

This article has articulated a framework for analyzing urban social-ecological systems from both a functional management and a critical equity perspective that maintain sensitive to the scales and complexity of ecosystems. This was based on a presumption that viewed social-ecological systems as generating and distributing urban ecosystem services, i.e. the benefits humans derive from ecological processes (Daily 1997a). The main differences between urban and non-urban social-ecological systems have also been highlighted, along with some social mechanisms behind the generation and distribution of urban ecosystem services. Here follow some concluding remarks.

First, although questions remain on how to empirically use the framework in case study analysis, for instance how to determine protective capacity and management capacity, some notions on how to go about has been touched upon in the text. In Stockholm, analysis of allotment gardeners and cemetery and park managers have shown how management capacity can be analyzed (Barthel *et al.* 2005; Borgström *et al.* 2006; Andersson *et al.* 2007), which parallels studies of how civil society actors and civil servants engaged in value creation processes both in Stockholm and Cape Town to increase protection capacity (Ernstson *et al.* 2008; Ernstson and Sörlin 2009). How to determine relevant ecological networks for urban landscapes have been briefed, which based on digital maps and ecological modelling of functional species and mobile links can translate from structural change to changes in ecosystem services (Andersson and Bodin accepted). Together, this assembles a first set of methods to start analyzing the social production of urban ecosystem services, which through iteration and trial-and-error could be refined and expanded.

Second, and linked to the first. The critical equity perspective that serves to analyze the distribution of ecosystem services needs to be developed further both theoretically and methodologically in order to fully address issues of equity. Here one can build on Ribot and Peluso (2003) that present a theory of access to natural resources viewed as "the *ability* to derive benefits from things" (in contrast to merely the *rights* to benefits, as in property theory (ibid.)). Although, they do not acknowledge the scales and complexity of ecosystems, which was important in this article, their theory of access points out that there is on more crucial step to fully address equity. The framework developed here analyzed at which scales ecosystem services were distributed (seen as a precondition to access), but nothing was said about the additional power practices involved in constraining and facilitating the access to ecosystem services. At the local scale, a green area could be surrounded by a high wall excluding recreation for a certain group, thus constraining their access to this type of ecosystem service. However, on the other hand, the same group might still benefit from improved air quality that the green area generates. Building on Ribot and Peluso (ibid.), a theory of access to ecosystem services could probably be developed to extend the framework.

Third, if the guiding rule of analysis and application of ecosystem management is to sustain social-ecological resilience, interpreted as the ability to maintain the generation of ecosystem services, then it could be argued that resilience can be sustained by maintaining an unjust social system, i.e. in which the distribution of (and access to) ecosystem

services falls unevenly among the present and future population (cf. Carpenter *et al.* 2001; Armitage and Johnson 2007). With a two-fold perspective on social-ecological systems – both distribution and generation are equally appearing – this kind of functionalistic arguments can be scrutinized and challenged, and instead invite to creative and radical thinking on political actions to transform the system towards both increased ecological resilience and social justice. For this, I offer a more critically formulated definition of resilience:

> Resilience is the capacity of a social-ecological system to sustain a certain set of ecosystem services, in face of uncertainty and change, for a certain set of humans.

Applying this definition to practical research begs the researcher to analyze not just how ecosystems are managed (as in most natural resource management literature), but also which ecosystem services that are prioritized (as in recent literature on trade offs) — but, and on top of that, who benefit from these services. This cracks open the social-ecological system and the concept of ecosystem services for political and critical analysis, without loosing the analysis of how to manage and interact with complex ecosystems in uncertainty and change. It also avoids the circular reference of definitions that include the hypothetical solution to sustain resilience (capacity to reorganize and innovate as in Berkes *et al.* 2003), or too normative suggestions that ecosystem services should benefit everybody, which, like the fate of "sustainability", precludes radical critique since nobody can be against it (cf. Harvey 1996: 148). Instead, my definition follows the original spirit of Buzz Holling's resilience definition from 1973, while it merely treats resilience as a property of a system (Holling 1973). How that system operates to sustain resilience is left for analysis. This means that system resilience is not just good or bad, but that it can be good for some and bad for others. This makes this definition more useful in analyzing the question of "resilience for whom and for what" (Armitage and Johnson 2006 and references therein).

Fourth, the social production of ecosystem services might be seen as a seeming paradox. Ecosystems, as would be argued by an ecologist, have an inherent uncertainty and no matter how society is organized, humans cannot control the generation of ecosystem services but merely uphold a "fragile dominion over Earth's resources" (Levin 1998: 206). Against this can be said on one hand that ecosystem services is partly a social construction resting upon social articulation and actor-networks that can translate biophysical processes to be perceived as ecosystem services. On the other hand, and in spite that ecosystems are complex, human decision making and organization constrains real biophysical and ecological processes in urban landscapes (through urban development and the built environment for example). But they actually also facilitates ecological processes through day-to-day management activities (as exemplified by allotment gardens). If there were no humans, there would not be any benefits for humans, or these benefits would be different. Ecologists have dominated the field of ecosystem services until now, which can explain the analytical bias towards 'ecosystems'. However, by stressing the 'services', which includes the distribution of services, opens for other fields to engage productively in analyzing the broader process of the social production of ecosystem services.

A literal parallel is found in political ecology and geography in the expression "production of nature" (Smith 1984; Heynen *et al.* 2006a) in which social labour processes and the modes of production in society are seen as base for the human relation to nature (see also "social nature" in Castree and Braun (2001). Building on this would, fourthly and finally, direct research towards longer-term historical processes of discourse formation (Foucault 1963) as shaped by dominating paradigms and "particular kind of socio-ecological order (capitalism)" as framed by David Harvey (1996: 12). In *Justice, Nature and the Geography of Difference*, Harvey critiqued the scientific fields of natural resource management and political economy. While the standard view, he holds, is that natural resources (which would include ecosystem services) have limits and can become scarce, he offers "a relational definition" in which natural resources are seen "as a 'cultural, technical and economic appraisal of elements and processes in nature that can be applied to fulfil social objectives and goals through specific material practices'" (Harvey 1996: 147). This definition recognizes social labour and that resources are part-and-parcel of society. It is, to take one example, not until recently that the ability of vegetation to absorb carbon dioxide molecules is considered an "ecosystem service". The biophysical mechanism of photosynthesis has of course existed for long, but due to the historical fossil-fuel industrial production of the West, this mechanism is now translated in policy arenas as an ecosystem service with a market-based monetary value. Cape Town, as a second example, is considered to be located in a "water-scarce" region, but a great part of this scarcity is due to that some groups in society use much more water than others (because they can afford it), while others are left with much less. Society produces scarcity, and in its wake, society produces services.

The critical resilience definition from above, combined with the framework for analyzing generation and distribution of ecosystem services at different scales, is designed to invite for systemic critique of current social order, while maintaining ecological sensitivity. Hopefully it can also aid in working out material political practices towards democratizing urban change and increase social justice.

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## References

Adams W. N. (2004). *Against extinction: The story of conservation*. Earthscan, London.

Adger N. W., Brown K., and Tompkins E. L. (2005). The political economy of cross-scale networks in resource co-management. *Ecology and Society* 10(2):9.

Alberti M. (2005). The effects of urban patterns on ecosystem function. *International regional science review* 28(2):168-192.

Alberti M., and Marzluff J. M. (2004). Ecological resilience in urban ecosystems: Linking urban patterns to human and ecological functions. *Urban Ecosystems* 7:241-265.

Andersson E. (2006). Urban landscapes and sustainable cities. *Ecology and Society* 11(1):34.

Andersson E., Barthel S., and Ahrné K. (2007). Measuring Social-Ecological Dynamics Behind the Generation of Ecosystem Services. *Ecological Applications* 17(5):1267-1278.

Andersson E., and Bodin Ö. (accepted). Testing network based models of habitat fragmentation in complex landscapes - implications for management. *Ecography*

Ansell C. K. (2003). Community Embeddedness and Collaborative Governance in the San Francisco Bay Area Environmental Movement. In Diani M., and McAdam D. (eds), *Social Movements and Networks - Relational Approaches to Collective Action*. Oxford University Press, Oxford, pp. 123-144

Armitage D. R., and Johnson D. (2006). Can resilience be reconciled with globalization and the increasingly complex conditions of resource degradation in Asian coastal regions? *Ecology and Society* 11(1):2.

Baland J.-M., and Platteau J.-P. (1999). The Ambiguous Impact of Inequality on Local Resource Management. *World Development* 27(5):773-788.

Barthel S. (2005). Sustaining urban ecosystem services with local stewards participation in Stockholm (Sweden). In Tress B., Tress G., Fry G., and Opdam P. (eds), *From Landscape Research to Landscape Planning: Aspects of Integration, Education and Application*. Springer, pp. 305-320

Barthel S., Colding J., Elmqvist T., and Folke C. (2005). History and local management of a biodiversity-rich, urban, cultural landscape. *Ecology and Society* 10(2):10.

Berger P., and Luckmann T. (1966). *The Social Construction of Reality - A Treatise in the Sociology of Knowledge*. Penguin Books, London.

Berkes F., and Folke C. (eds), (1998). *Linking Social and Ecological Systems*. Cambridge University Press, Cambridge.

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

Bodin Ö., and Norberg J. (2007). A network approach for analyzing spatially structured populations in fragmented landscape. *Landscape Ecology* 22:31-44.

Bodin Ö., Tengö M., Norman A., Lundberg J., and Elmqvist T. (2006). The value of small size: loss of forest patches and ecological thresholds in southern Madagascar. *Ecological Applications* 16(2):440-451.

Bolund P., and Hunhammar S. (1999). Ecosystem services in urban areas. *Ecological Economics* 29:293-301.

Borgatti S. P., and Everett M. G. (1992). Notions of Positions in Social Network Analysis. *Sociological Methodology* 22:1-35.

Borgström S. (2003). Management of urban green areas in the Stockholm County. Master thesis. Stockholm University, Stockholm

Borgström S., Elmqvist T., Angelstam P., and Alfsen-Norodom C. (2006). Scale Mismatches in Management of Urban Landscapes. *Ecology and Society* 11(2):16.

Bourdieu P. (1984). *Distinction: A Social Critique of the Judgement of Taste*. Harvard University Press, Cambridge.

Boyce J. K. (1994). Inequality as a cause of environmental degradation. *Ecological Economics* 11(3):169-178.

Boyce J. K. (2001). Power inequalities and the political economy of environmental protection. In: *Conference on Inequality, Collective Action, and Environmental Sustainability*, Santa Fe Institute

Brownlow A. (2006). Inherited fragmentations and narratives of environmental control in entrepreneurial Philadelphia. In Heynen N. C., Kaika M., and Swyngedouw E. (eds), *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. Routledge, London

Callon M. (1986). Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In Law J. (ed), *Power, action and belief: a new sociology of knowledge*. Routledge, London, pp. 196-223

Callon M., and Latour B. (1981). Unscrewing the Big Leviathan: how actors macrostructure reality and how sociologists help them to do so. In Knorr Cetina K., and Cicourel A. (eds), *Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro-Sociologies*. Routledge & Kegan Paul, London

Carpenter S., Walker B., Anderies J. M., and Abel N. (2001). From Metaphor to Measurement: Resilience of What to What? *Ecosystems* 4(8):765-781.

Castells M. (1983). *The City and the Grassroots*. E. Arnold, London.

Castells M. (1989). *The Informational City*. Blackwell, Oxford.

Castree N., and Braun B. (eds), (2001). *Social Nature: Theory, Practice, and Politics*. Blackwell, Oxford.

Castree N., and MacMillan T. (2001). Dissolving Dualisms: Actor-networks and the Reimagnitation of Nature. In Castree N., and Braun B. (eds), *Social Nature: Theory, Practice, and Politics*. Blackwell, Oxford, pp. 208-224

CFN (2006). Networking people and nature in the city: Inspiration, issues and challenges. Cape Flats Nature (CFN), c/o SA National Biodiversity Institute (SANBI), Urban Conservation Unit, Kirstenbosch, Private Bag X7, Claremont 7735, South Africa. Homepage: www.capeflatsnature.org, Cape Town

City of Cape Town (2007). The identification and prioritisation of a biodiversity netweork for the City of Cape Town: Final report. City of Cape Town, Cape Town

Colding J. (2007). 'Ecological land-use complementation' for building resilience in urban ecosystems. *Landscape and Urban Planning* 81(1-2):46-55.

Colding J., Lundberg J., and Folke C. (2006). Incorporating Green-area User Groups in Urban Ecosystem Management. *Ambio* 35(5):237-244.

Coleman J., Katz E., and Menzel H. (1957). The Diffusion of an Innovation Among Physicians. *Sociometry* 20(4):253-270.

Costanza R., and Farber S. (2002). Introduction to the special issue on the dynamics and value of ecosystem services: integrating economic and ecological perspectives. *Ecological Economics* 41(3):367-373.

Cowan R., and Jonard N. (1999). Network structure and the diffusion of knowledge. *Journal of Economic Dynamics and Control* 28(8):1557-1575.

Daily G. (1997a). What are ecosystem services? In Daily G. (ed), *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington D.C.

Daily G. C. (ed) (1997b). *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington D.C.

Daily G. C., and Matson P. A. (2008). Ecosystem services: From theory to implementation. *PNAS* 105(28):9455-9456.

della Porta D., and Diani M. (2006). *Social Movements: An Introduction*. Blackwell Publishing, Oxford.

Deutsch L., Jansson A., Troell M., Ronnback P., Folke C., and Kautsky N. (2000). The 'ecological footprint': communicating human dependence on nature's work. *Ecological Economics* 32(3):351-355.

Diani M. (1995). *Green Networks*. Edinburgh University Press, Edinburgh.

Eden S., Tunstall S., and Tapstell S. (2000). Translating Nature: River Restoration as Nature-Culture. *Environment and Planning D: Society and Space* 18(2):257-273.

Ernstson H., Barthel S., Andersson E., and Borgström S. T. (in prep.). Ecological scales and social network structure in urban landscapes: management and governance of urban ecosystem services in Stockholm, Sweden. *Environmental Management*

Ernstson H., and Sörlin S. (2009). Weaving protective stories: Connective practices to articulate holistic values in Stockholm National Urban Park. *Environment and Planning A* (in press)

Ernstson H., and Sörlin S. (in prep.). A framework for studying transformative capacity in sustaining urban ecosystems linking social network structure and actor-network framings. *Environment and Planning A*

Ernstson H., Sörlin S., and Elmqvist T. (2008). Social Movements and Ecosystem Services - The Role of Social Network Structure in Protecting and Managing Urban Green Areas in Stockholm. *Ecology and Society* (in press)

Fairhead, J., and M. Leach. 1995. False history, complicit social analysis: rethinking some West African environmental narratives. World Development **23**:1023-1035.

Folke C., Hahn T., Olsson P., and Norberg J. (2005). Adaptive Governance of Social-Ecological Systems. *Annu. Rev. Environ. Resour.* 30:441–473.

Folke C., Holling C. S., and Perrings C. (1996). Biological diversity, ecosystems, and the human scale. *Ecological Applications* 6(10):1018-1024.

Forsemalm J. (2007). Bodies, Bricks and Black Boxes: Power Practices in City Conversion. PhD dissertation in European Ethnology. Gothenburg University, Gothenburg

Foucault M. (1963). *Naissance de la clinique. Une archéologie des sciences humaines*. Presses Universitaires de France, Paris (The Birth of the Clinic. New York: Vintage 1973.).

Foucault M. (1980). *Power/Knowledge: Selected Interviews and Other Writings 1972-1977*. Harvester, Hempsted.

Goldman R. A., Tallis H., Kareiva P., and Daily G. C. (2008). Field evidence that ecosystem service projects support biodiversity and diversify options. *PNAS* 105(27):9445-9448.

Goldman R. A., Thompson B. H., and Daily G. C. (2007). Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. *Ecological Economics* 64:333-343.

Grimm N. B., Faeth S. H., Golubiewski N. E., Redman C. L., Wu J., Bai X., and Briggs J. M. (2008). Global Change and the Ecology of Cities. *Science* 319:756-760.

Grimm N. B., Grove J. M., Pickett S. T. A., and Redman C. L. (2000). Integrated approaches to long-term studies of urban ecological systems. *Bioscience* 50(7):571-583.

Gunderson L. H. (1999). Resilience, flexibility and adaptive management - Antidotes for spurious certitude? *Conservation Ecology* 3(1):7.

Habermas J. (1981/1987). *The Theory of Communicative Action*. Beacon Press

Hahn T., Olsson P., Folke C., and Johansson K. (2006). Trust-building, Knowledge Generation and Organizational Innovations: The Role of a Bridging Organization for Adaptive Comanagement of a Wetland Landscape around Kristianstad, Sweden. *Human Ecology* 34:573-592.

Halbwachs M. (1952/1992). *On Collective Memory*. University of Chicago Press, Chicago.

Harvey D. (1996). *Justice, Nature and the Geography of Difference*. Blackwell, Oxford.

Harvey D. (2002). *Spaces of Capital: Towards a Critical Geography*. Routledge, New York.

Heynen N. C. (2003). The Scalar Production of Injustice within the Urban Forest. *Antipode* :980-998.

Heynen N. C., Kaika M., and Swyngedouw E. (eds), (2006a). *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. Routledge, Oxford.

Heynen N. C., Kaika M., and Swyngedouw E. (2006b). Urban political ecology: Politicizing the production of urban natures. In Heynen N. C., Kaika M., and Swyngedouw E. (eds), *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. Routledge, Oxford, pp. 1-20

Holling C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecological Systems* 4:1-23.

Holmes P. (pers.comm. 2007). Conservation Biologist, Environmental Resource Management, City of Cape Town, November 2007. Interview.

Hougner C., Colding J., and Söderqvist T. (2006). Economic valuation of a seed dispersal service Stockholm National Urban Park, Sweden. *Ecological Economics* 59:364-374.

Hughes T. P. (2004). *Human-Built World: How to Think about Technology and Culture*. The University of Chicago Press, Chicago.

Hägerstrand T. (1996). Resandet och den sociala väven (Travelling and the social web). In, *Farande och fraktande (Travelling and Carrying)*. Kommunikationsforskningsberedningen, Stockholm

Jackson J. (pers.comm. 2007). Conservation Manager, City of Cape Town, South Africa; December 2007.

Jackson L. E. (2003). The relationship of urban design to human health and condition. *Landscape and Urban Planning* 64:191-200.

Jansson Å., and Colding J. (2007). Urban Development: The Case of Nitrogen Load from the Stockholm County to the Baltic Sea. *Ambio* 36(8):650-656.

Jansson Å., and Nohrstedt P. (2001). Carbon sinks and human freshwater dependence in Stockholm County. *Ecological Economics* 39(3):361-370.

Keil, R. 2003. Progress Report: Urban Political Ecology. Urban Geography **24**:723-738.

Keil, R. 2005. Progress Report: Urban Political Ecology. Urban Geography **26**:640-651.
Keitt T. H., Urban D. L., and Milne B. T. (1997). Detecting Critical Scales in Fragmented Landscapes. *Conservation Ecology* 1(1):4.
Kingsland S. E. (2005). *The Evolution of American Ecology*. The John's Hopkins University Press, Baltimore.
Kinzig A. P., Warren P., Martin C., Hope D., and Katti M. (2005). The effects of human socioeconomic status and cultural characteristics on urban patterns of biodiversity. *Ecology and Society* 10(1)
Kuo F. E., Sullivan W. C., Levine Coley R., and Brunson L. (1998). Fertile Ground for Community: Inner-City Neighborhood Common Spaces. *American Journal of Community Psychology* 26(6):823-851.
Latour B. (1987). *Science In Action: How to Follow Scientists and Engineers Through Society*. Harvard University Press, Cambridge.
Latour B. (2005). *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford University Press, Oxford.
Leach, M., and R. Mearns. 1996. The lie of the land: challenging received wisdom on the African environment. James Currey, London.
Levin S. A. (1998). Ecosystems and the Biosphere as Complex Adaptive Systems. *Ecosystems* 1(5):431-436.
Lundberg J., and Moberg F. (2003). Mobile Link Organisms and Ecosystem Functioning: Implications for Ecosystem Resilience and Management. *Ecosystems* 6(1):87-98.
MA (2005a). *Millenium Ecosystem Assessment: Biodiversity Synthesis*. World Resources Institute, Washington D.C.
MA (2005b). *Millenium Ecosystem Assessment: Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.
Martin C. A., Warren P. S., and Kinzig A. P. (2004). Neighborhood socioeconomic status is a useful predictor of perennial landscape vegetation in residential neighborhoods and embedded small parks of Phoenix, AZ. *Landscape and Urban Planning* 69(4):355-368.
Marx K. (1990). *Capital*. Penguin Books, London.
Massey D. (1995). Places and their pasts. *History Workshop Journal*:182-192.
McGranahan G., Marcotullio P., Bai X., Balk D., Braga T., Douglas I., Elmqvist T., Rees W., Satterthwaite D., Songsore J., Zlotnick H., Eades J., Ezcurra E., and Whyte A. (2005). Urban systems. In, *Millennium ecosystem assessment: Conditions and trends assessment*. Island Press, Washington, DC, USA., pp. 795-825
Nelson E., Polasky S., Lewis D. J., Plantinga A. J., Lonsdorf E., White D., Bael D., and Lawler J. J. (2008). Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. *PNAS* 105(28):9471-9476.
Nyström M., and Folke C. (2001). Spatial Resilience of Coral Reefs. *Ecosystems* 4:406-417.
Oeloefse G. (pers.comm. 2007). Conservation Biologist, Environmental Resource Management, City of Cape Town, 13 December 2007. Interview.
Olsson P., Folke C., and Berkes F. (2004a). Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management* 34(1):75–90.

Olsson P., Folke C., and Hahn T. (2004b). Social-Ecological Transformation for Ecosystem Management: the Development of Adaptive Co-management of a Wetland Landscape in Southern Sweden. *Ecology and Society* 9:(4): 2.

Olsson P., Folke C., and Hughes T. P. (2008). Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *PNAS* 105(28):9489-9494.

Olsson P., Gunderson L. H., Carpenter S. R., Ryan P., Lebel L., Folke C., and Holling C. S. (2006). Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems. *Ecology and Society* 11(1):18.

Ostrom E. (2005). *Understanding Insitutional Diversity*. Princeton University Press

Peterson G. (2000). Political ecology and ecological resilience: An integration of human and ecological dynamics. *Ecological Economics* 35(3):323-336.

Pickett S. T. A., and Cadenasso M. L. (2008). Linking ecological and built components of urban mosaics: an open cycle of ecological design. *Journal of Ecology* 96(1):8-12.

Pickett S. T. A., Cadenasso M. L., Grove J. M., Groffman P. M., Band L. E., Boone C. G., Burch W. R., Grimmond C. S. B., Hom J., Jenkins J. C., Law N. L., Nilon C. H., Pouyat R. V., Szlavecz K., Warren P. S., and Wilson M. A. (2008). Beyond urban legends: An emerging framework of urban ecology, as illustrated by the Baltimore Ecosystem Study. *Bioscience* 58(2):139-150.

Pickett S. T. A., Cadenasso M. L., Grove J. M., Nilon C. H., Pouyat R. V., Zipperer W. C., and Costanza R. (2001). Urban Ecological Systems: Linking Terrestrial Ecological, Physical, and Socioeconomic Components of Metropolitan Areas. *Annual Review of Ecology and Systematics* 32:127-157.

Putnam R. D., Leonardi R. J., and Nanetti R. Y. (1994). *Making Democracy Work: Civic Traditions in Modern Italy*. University Presses of California, Columbia and Princeton, New Jersey.

Pyne S. (1998). *How the Canyon became Grand: A Short History*. Viking Penguin, New York.

Ribot J. C., and Peluso N. L. (2003). A Theory of Access. *Rural Sociology* 68(2):153-181.

Rompré G., Robinson W. D., and Desrochers A. (2008). Causes of habitat loss in a Neotropical landscape: The Panama Canal corridor. *Landscape and Urban Planning* 87:129-139.

Sassen S. (2006). *Cities in a World Economy*. Pine Forge Press, London.

Savard J.-P., Clergeau P., and Mennechez G. (2000). Biodiversity concepts and urban ecosystems. *Landscape and Urban Planning* 48:131-142.

Schwartz M. W. (ed) (1997). *Conservation in Highly Fragmented Landscapes*. Chapman and Hall, New York.

Shapin S. (1995). Here and Everywhere: Sociology of Scientific Knowledge. *Annual Review of Sociology* 21:289-321.

Smith N. (1984). *Uneven Development: Nature, Capital and the Production of Space*. Blackwell, Basil.

Stenhouse R. N. (2004). Fragmentation and internal disturbance of native vegetation reserves in the Perth metropolitan area, Western Australia. *Landscape and Urban Planning* 68:389–401.

Sukopp H., and Weiler S. (1988). Biotope mapping and nature conservation strategies in urban areas of the Federal Republic of Germany. *Landscape and Urban Planning* 15:39-58.

Swyngedouw E. (1997). Power, nature, and the city. The conquest of water and the political ecology of urbanization in Guayaquil, Ecuador: 1880 - 1990. *Environment and Planning A* 29(2):311-332.

Sörlin S. (1998). Monument and Memory: Landscape Imagery and the Articulation of Territory. *Worldviews: Environment, Culture, Religion* 2:269-279.

Sörlin S. (1999). The Articulation of Territory: Landscape and the Constitution of Regional and National Identity. *Norsk Geografisk Tidsskrift* 53(1999):103-112.

Sörlin S. (2001). On the Trading Zone between Articulation and Preservation: The Production of Meaning in Landscape History and the Problems of Heritage Decision-making. In Baer N. S., and Snickars F. (eds), *Rational Decision-making in the Preservation of Cultural Property*. Dahlem University Press, Berlin, pp. 47-59

Torras M., and Boyce J. K. (1998). Income, inequality, and pollution: a reassessment of the environmental Kuznets Curve. *Ecological Economics* 25:147-160.

Turpie J. K., Marais C., and Blignaut J. N. (2008). The working or water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics*:788-798.

UN (2005). World Urbanization Prospects: The 2005 Revision. United Nations Population Division, New York

Urban D., and Keitt T. (2001). Landscape connectivity: A graph-theoretic perspective. *Ecology* 82(5):1205-1218.

Van Wilgen B. W., Le Maitre D. C., and Cowling R. M. (1998). Ecosystems services, efficiency, sustainability and equity: South Africa's working for water programme. *Trends in Ecology and Evolution* 13:378.

Walker, P. 2005. Political ecology: where is the ecology? Progress in Human Geography **29**:73-83.

Wilson M. A., and Howarth R. B. (2002). Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics* 41(3):431-443.

Young C. H., and Jarvis J. (2001). A Simple Method for Predicting the Consequences of Land Management in Urban Habitats. *Environmental Management* 28(3):375-387.

## Appendix

**References to Table 1.**

1. Beckett *et al.* 1998.
2. Kaplan 1989; Hartig *et al.* 1991; Ulrich 1991; Grahn and Stigsdotter 2003; Hartig *et al.* 2003; Jackson 2003
3. Ulrich 1984; Jackson 2003
4. Sukopp and Weiler 1988; Bolund and Hunhammar 1999; Gidlöf-Gunnarsson 2005
5. Ward Thompson 2002
6. Kuo *et al.* 1998; Coley *et al.* 1997
7. Kahn and Friedman 1995; Schultz 2000; Turner *et al.* 2004
8. Grahn and Ottosson 1998
9. Grahn and Ottosson 1998
10. Madaleno 2000; Howorth *et al.* 2001; Bryld 2003
11. Bolund and Hunhammar 1999; Martines-Arroyo and Jauregui 2000; McPherson *et al.* 1997; McPherson and Simpson 2003
12. McPherson *et al.* 1997; Bolund and Hunhammar 1999; Yang *et al.* 2005
13. Bolund and Huhhammar 1999; Jansson and Nohrstedt 2001; Xiao and McPherson 2002
14. Bolund and Hunhammar 1999
15. Jansson and Colding 2007
16. Jansson and Nohrstedt 2001
17. Schwartz *et al.* 2002; Sukopp and Weiler 1998
18. Colding *et al.* 2006; Lundberg *et al.* 2008
19. Andersson *et al.* 2007
20. Jo and McPherson 1995; McPherson *et al.* 1997; Jansson and Nohrstedt 2001; Yang *et al.* 2005

**List of references**

Andersson, E., S. Barthel, and K. Ahrné. 2007. Measuring Social-Ecological Dynamics Behind the Generation of Ecosystem Services. Ecological Applications **17**:1267-1278.

Beckett KP., PH. Freer-Smith and G. Taylor. 1998. Urban woodlands: their role in reducing the effects of particulate pollution. Environmental pollution 99:347-360.

Bolund, P., and S. Hunhammar. 1999. Ecosystem services in urban areas. Ecological Economics **29**:293-301.

Bryld E. 2003. Potentials, problems, and policy implications for urban agriculture in developing countries. Agriculture and human values 20:79-86.

Colding, J., J. Lundberg, and C. Folke. 2006. Incorporating Green-area User Groups in Urban Ecosystem Management. Ambio **35**:237-244.

Coley R., F. Kuo and W. Sullivan. 1997. Where does community grow? The social context created by nature in urban public housing. Journal of environment and behavior 29:468-494.

Gidlöf Gunnarsson A. and E. Öhrström. 2005. Noise and general well-being in urban environments: The potential of nearby natural areas. Conference paper for Life in the urban landscape 2005.

Grahn P. and J. Ottosson 1998. Utemiljöns betydelse för äldre med stort vårdbehov “Med ögon känsliga för grönt” . Stad och Land nr 44. Movium. Alnarp.

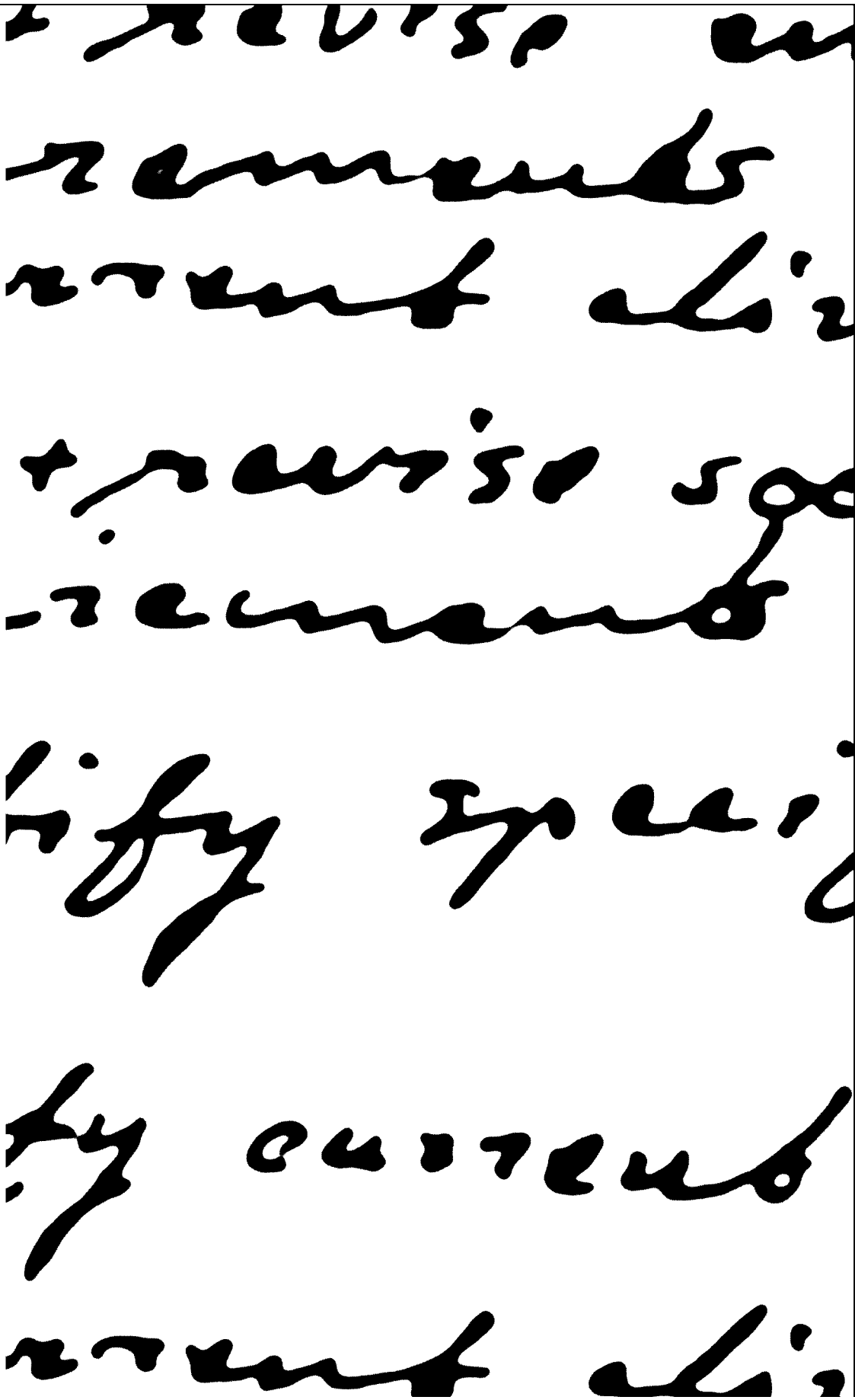
Grahn P. and UA. Stigsdotter. 2003. Landscape planning and stress. Urban forestry and urban greening 2:1-18.

Hartig T., M. Mang and G. Evans. 1991. Restorative effects of natural environments experiments. Journal of environment and behavior 23:3-26.

Hartig T., GW. Evans, LD. Jamner, DS. Davis and T. Gärling. 2003. Tracking restoration in natural and urban field settings. Journal of environmental psychology 23:109-123.

Howorth C., I Convery and P O’Keefe. 2001. gardening to reduce hazard: Urban agriculture in Tanzania. Land degradation and development 12:285-291.

Jackson LE: 2003. The relationship of urban design to human helaht and condition. Landscape and urban planning 64: 191-200.
Jansson, Å., and J. Colding. 2007. Urban Development: The Case of Nitrogen Load from the Stockholm County to the Baltic Sea. Ambio **36**:650-656.
Jansson, Å., and P. Nohrstedt. 2001. Carbon sinks and human freshwater dependence in Stockholm County. Ecological Economics **39**:361-370.
Jo H-K and EG. McPherson. 1995. Carbon storage and flux in urban residential greenspace. Journal of environmental management 45:109-133.
Kahn PH. and B. Friedman. 1995. Environmental views and values of children in an inner-city Black community. Child development 66:1403-1417.
Kaplan, R. and S. Kaplan. 1989. The experience of nature: A psychological perspective. New York. Cambridge University Press.
Kuo FE., M. Bacaioca and WC Sullivan. 1998. Transforming inner city landscapes: trees, sense of safety, and preferences. Journal of environment and behavior 30:28-59.
Lundberg, J., E. Andersson, G. Cleary, and T. Elmqvist. 2008. Linkages beyond borders: targeting spatial processes in fragmented urban landscapes. Landscape Ecology.
Madaleno I. 2000. Urban agriculture in Belém, Brazil. Cities 17:73-77.
Martinez-Arroyo A. and E. Jauregui. 2000. On the environmental role of urban lakes in Mexico City. Urban ecosystems 4:145-166.
McPherson E.G., D. Nowak, G. Heisler, S. Grimmond, C. Souch, R. Grant and R. Rowntree. 1997. Quantifying urban forest structure, function and value; the Chicago urban forest climate project. Urban ecosystems 1:49-61
McPherson EG. and JR. Simpson. 2003. Potential energy savings in buildings by an urban tree planting programme in California. Urban forestry and urban greening 2:73-86.
Schultz PW. 2000. Empathizing with nature: The effects of Perspective Taking on concern for environmental issues. Journal of Social Issues 56:391-406.
Schwartz MW., NL. Jurjacic and JM. O'Brien. 2002. Conservation's disenfranchised urban poor. BioScience 52:601-606.
Sukopp H. and S. Weiler. 1988. Biotope mapping and nature conservation strategies in urban areas of the Federal Republic of Germany. Landscape and urban planning 15:39-58.
Turner WR., T. Nakamura and M. Dinetti. 2004. Global urbanization and the separation of humans from nature. BioScience 54:585-590.
Ulrich R. 1984. View from a window may influence recovery from surgery. Science 224:420-421.
Ulrich R. 1991. Stress recovery during exposure to natural and urban environments. Journal of environmental psychology 11:201-230.
Ward Thompson C. 2002. Urban open space in the 21st century. Landscape and urban planning 60:59-72.
Xiao Q. and EG. McPherson. 2002. Rainfall interception by Santa Monica's municipal urban forest. Urban ecosystems 6:291-302.
Yang J., J. McBride, J. Zhou and Z. Sun. 2005. The urban forest in Beijin and its role in air pollution reduction. Urban forestry and urban greening 3:65-78.



# Appendix

This Appendix gathers complementary data to Paper II and Paper III from the case study of the National Urban Park and the Ecopark movement. Figure A1 displays the cluster diagram from the Girvan-Newman community analysis mentioned at the end of the results section of Paper II. Figure A2 and Figure A3 give an overview of the great diversity of the Ecopark movement through the distribution of attributes. Table A1 displays raw data for movement organizations as generated from the network survey. Network data could be requested by mailing the author (henrik@ecology.su.se). Furthermore, Box A1 gives two vignettes of a how typically the social network structure of the Ecopark movement facilitates purposeful collective action to protect the National Urban Park from exploitation. Finally, Table A2 displays the impressive array of artefacts from the arts, sciences and architecture associated with the National Urban Park as discussed in Paper III. The appendix finalizes with a reference list, which includes many of the field documents used in the case study of the Ecopark movement in Paper II and Paper III.

**COMMUNITY:** Cluster diagramme for Main Component (Girwan-Newman algorithm)

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                                            * * * * * *
            4 2 4 4 2 3 3 5 1   1   4 1 2 5 3 3 2 1   6 1 2 3 5 4 5 3 1 1 3 4 5   2 2 4 4 6 4 4 2 5
Level 6 7 1 1 4 2 3 0 5 6 5 5 2 1 5 0 2 3 7 7 1 5 6 9 0 0 7 9 4 9 3 8 8 3 4 7 1 3 8 9 4 6 2 5 8 2 2
    0 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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  1.5 XXX XXXXXXX . . . . . . . . . . . . XXXXXXXXXXXXX . . . . . . . . . . XXX . . . . . . . . XXX
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    2 XXX XXXXXXX . . XXXXX . . . . . . . XXXXXXXXXXXXXXX . . . . . . . . . XXX XXXXX . . . . . XXX
    8 XXX XXXXXXX . . XXXXX . . . . . . XXXXXXXXXXXXXXXXX . . . . . . . . . XXX XXXXX . . . . . XXX
  4.5 XXX XXXXXXX . . XXXXX . . . . . . XXXXXXXXXXXXXXXXXXX . . . . . . . . XXX XXXXX . . . . . XXX
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**Figure A1.** The figure displays how tightly linked different groups of social movement organizations are to each other through direct links in the Main Component (i.e. not structural equivalence). In comparison to Figure 3 in Paper II (Ernstson et al. 2008) both the Boating Cluster and the dense social arena of core and semi-core actors come out clearly. The algorithm used was Girvan-Newman (Girvan and Newman 2002) as tightly linked to each other.

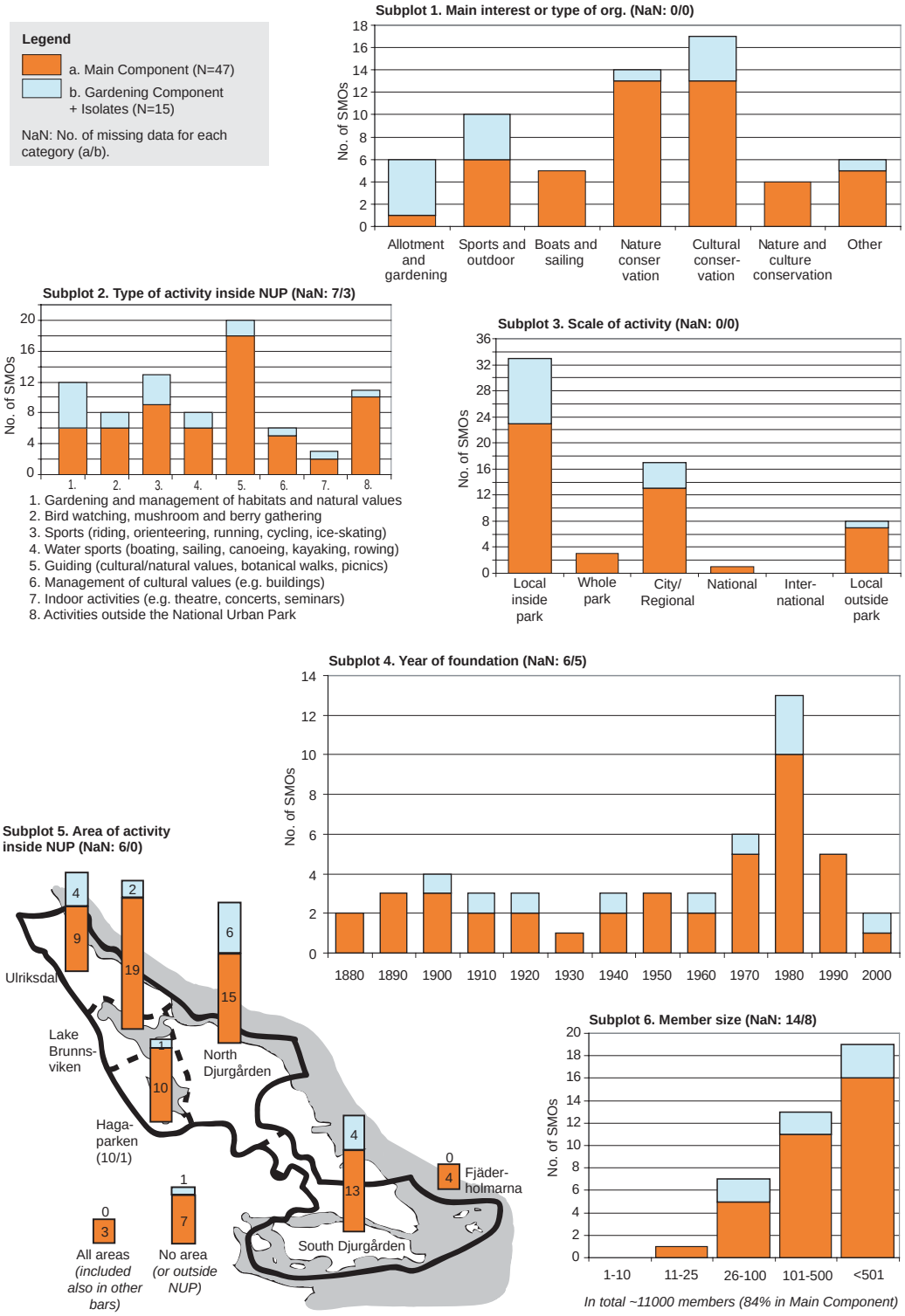


**Figure A2.** Subplot 1-6 shows the distribution of organizational attributes across the 62 social movement organizations (SMOs).

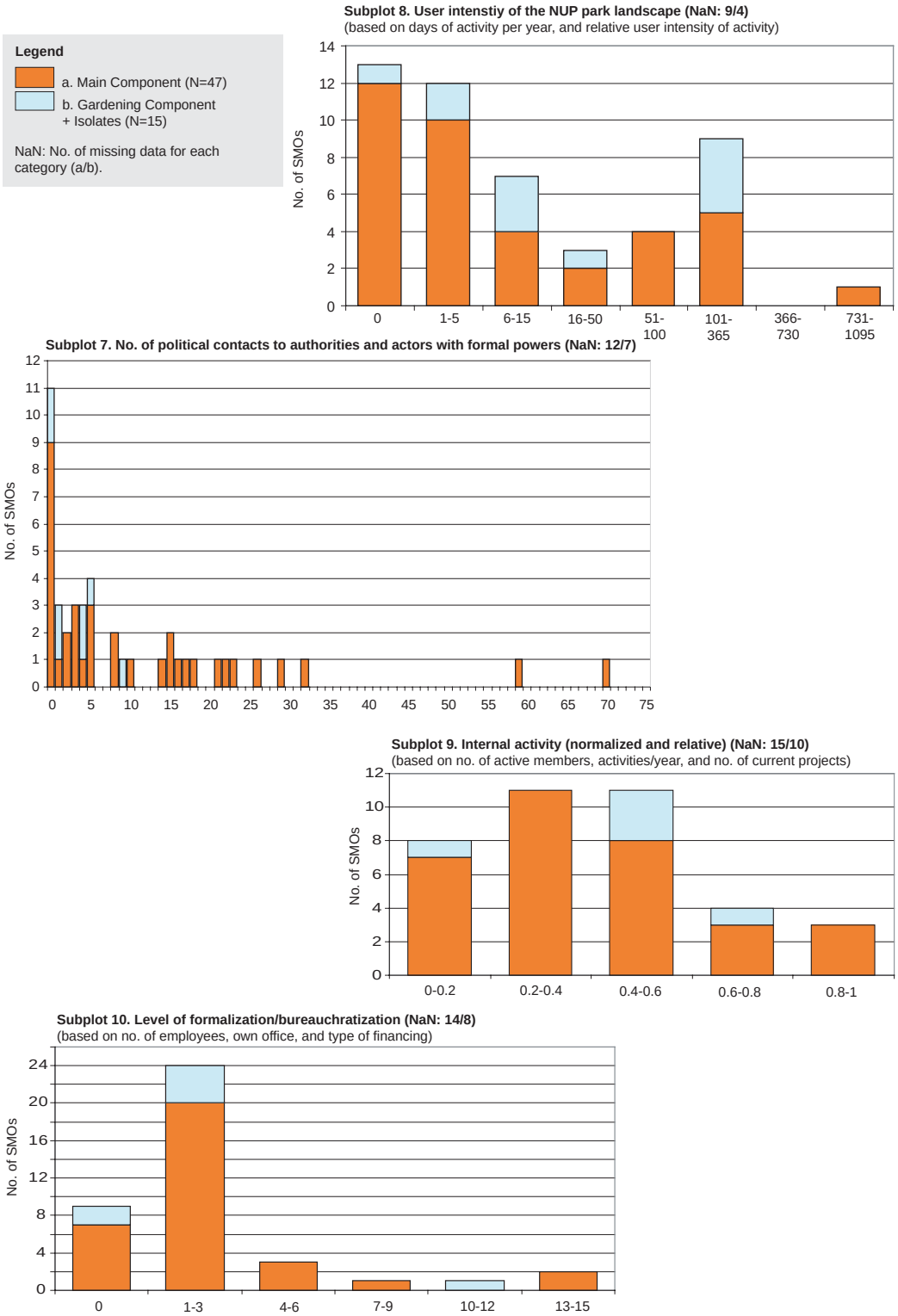


**Figure A3.** Subplot 7-10 shows the distribution of organizational attributes across the 62 social movement organizations (SMOs). Together Figure A2 and Figure A3 displays the great diversity of the movement.

**Table A1.** Raw data for the social movement organizations (SMOs) of the Ecopark movement from Paper II (Ernstson et al. 2008).

| SMO id.no. (N.) | Abbreviation | Name of organization | Component number | Position (structural equivalence: B1-B3) | Block (B1-B4) | Member of Boating Cluster | Out-degree (Dout: active in networking) [V] | In-degree (Din: power/influence) [V] | Degree Centrality (Din+Dout) [V] | Degreee Centrality (symmetrical network) [S] | Betweeness Centrality [S] | Type of organisation | Affirmations of being active |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *A. Network measurements* | | | | | | | | | *B. Organizational attributes and calculated attributes* | |
| 16 | FFE | Förbundet för ekoparken | 1 | 1 | 1 | 0 | 73 | 67 | 140 | 26 | 0,353 | Nature & culture conserv. | 32 |
| 37 | SNF | Naturskyddsföreningen i Stockholms län | 1 | 1 | 1 | 0 | 86 | 42 | 128 | 29 | 0,427 | Nature conservation | 18 |
| 60 | WWF | Ekoparksfonden WWF | 1 | 1 | 1 | 0 | 67 | 18 | 85 | 17 | 0,065 | Nature conservation | 18 |
| 9 | DLV | Djurgården-Lilla Värtan miljöskyddsförening | 1 | 2 | 2 | 0 | 24 | 27 | 51 | 8 | 0,019 | Nature & culture conserv. | 21 |
| 31 | KGP | Kommitén för Gustavianska parken | 1 | 2 | 2 | 0 | 18 | 23 | 41 | 9 | 0,013 | Culture conservation | 16 |
| 25 | HBV | Haga-Brunnsvikens vänner | 1 | 2 | 2 | 0 | 6 | 32 | 38 | 11 | 0,137 | Culture conservation | 20 |
| 2 | | Beckholmens vänförening | 1 | 3 | 3 | 0 | 0 | 5 | 5 | 2 | 0,001 | Culture conservation | 2 |
| 3 | | Bellevueförbundet | 1 | 3 | 3 | 0 | 0 | 5 | 5 | 2 | 0,001 | Culture conservation | 13 |
| 5 | | Bergianska trädgårdens vänner | 1 | 3 | 3 | 0 | 14 | 2 | 16 | 3 | 0 | Nature & culture conserv. | 5 |
| 6 | | Bergshamra för alla [1] | 1 | 3 | 3 | 0 | 0 | 5 | 5 | 1 | 0 | Culture conservation | 4 |
| 10 | | Djurgårdens hembygdsförening | 1 | 3 | 3 | 0 | 8 | 22 | 30 | 7 | 0,009 | Culture conservation | 16 |
| 11 | | FolkkulturCentrum | 1 | 3 | 3 | 0 | 0 | 5 | 5 | 2 | 0 | Culture conservation | 3 |
| 12 | | Friluftsfrämjandet Norra Järva [2] | 1 | 3 | 3 | 0 | 19 | 13 | 32 | 7 | 0,01 | Nature conservation | 10 |
| 13 | | Friluftsfrämjandet Stockholm | 1 | 3 | 3 | 0 | 4 | 11 | 15 | 3 | 0,001 | Nature conservation | 13 |
| 15 | | Fältbiologerna i Stockholm Uppland Gotland | 1 | 3 | 3 | 0 | 4 | 0 | 4 | 2 | 0 | Nature conservation | 6 |
| 18 | | Föreningen Järva Folkets Park | 1 | 3 | 3 | 0 | 7 | 12 | 19 | 5 | 0,004 | Culture conservation | 4 |
| 23 | | Föreningen natur och samhälle i Norden | 1 | 3 | 3 | 0 | 17 | 10 | 27 | 7 | 0,047 | Nature & culture conserv. | 9 |
| 20 | | Föreningen Stockholms auktoriserade guider | 1 | 3 | 3 | 0 | 0 | 2 | 2 | 1 | 0 | Other | 5 |
| 27 | | Hembygdsföreningen å Norrmalm | 1 | 3 | 3 | 0 | 14 | 7 | 21 | 7 | 0,012 | Culture conservation | 12 |
| 28 | | Hyresgästföreningen Norrmalmsavdelningen | 1 | 3 | 3 | 0 | 15 | 9 | 24 | 5 | 0,011 | Other | 7 |
| 29 | | Hyresgästföreningen på Östermalm | 1 | 3 | 3 | 0 | 10 | 10 | 20 | 3 | 0 | Other | 6 |
| 35 | | Naturskyddsföreningen i Saltsjöbaden | 1 | 3 | 3 | 0 | 10 | 4 | 14 | 5 | 0,003 | Nature conservation | 2 |
| 36 | | Naturskyddsföreningen i Solna-Sundbyberg | 1 | 3 | 3 | 0 | 0 | 6 | 6 | 2 | 0 | Nature conservation | 7 |
| 34 | | Naturskyddsföreningen Sollentuna | 1 | 3 | 3 | 0 | 0 | 10 | 10 | 3 | 0,004 | Nature conservation | 2 |
| 38 | | Norra Djurgårdens vänner [2] | 1 | 3 | 3 | 0 | 9 | 14 | 23 | 5 | 0,005 | Culture conservation | 14 |
| 39 | | Norra Järva hembygdsförening [2] | 1 | 3 | 3 | 0 | 15 | 20 | 35 | 6 | 0,002 | Culture conservation | 9 |
| 40 | | Samfundet St Erik | 1 | 3 | 3 | 0 | 8 | 10 | 18 | 4 | 0 | Culture conservation | 10 |
| 47 | | Stockholms naturskyddsförening | 1 | 3 | 3 | 0 | 0 | 20 | 20 | 6 | 0,005 | Nature conservation | 16 |
| 48 | | Stockholms orienteringsförbund | 1 | 3 | 3 | 0 | 0 | 4 | 4 | 1 | 0 | Sports and outdoor | 2 |
| 49 | | Stockholms ornitologiska förening | 1 | 3 | 3 | 0 | 5 | 12 | 17 | 3 | 0 | Nature conservation | 10 |
| 45 | | Stockholms Scoutdistrikt | 1 | 3 | 3 | 0 | 0 | 4 | 4 | 1 | 0 | Sports and outdoor | 2 |
| 53 | | Svenska cykelsällskapet | 1 | 3 | 3 | 0 | 4 | 6 | 10 | 3 | 0 | Sports and outdoor | 4 |
| 54 | | Svenska turistföreningen Stockholmskretsen | 1 | 3 | 3 | 0 | 0 | 18 | 18 | 5 | 0,003 | Other | 13 |
| 55 | | Symbios | 1 | 3 | 3 | 0 | 0 | 6 | 6 | 2 | 0 | Nature conservation | 3 |
| 57 | | Södermalmsparkernas vänner | 1 | 3 | 3 | 0 | 20 | 14 | 34 | 6 | 0,003 | Nature conservation | 6 |
| 62 | | Vårt Stockholm | 1 | 3 | 3 | 0 | 0 | 4 | 4 | 1 | 0 | Culture conservation | 5 |
| 7 | | Bergshamra koloniförening | 1 | 3 | 4 | 0 | 6 | 0 | 6 | 2 | 0,043 | Allotment garden/gardening | 4 |
| 22 | | Föreningen Stora Skuggan | 1 | 3 | 4 | 0 | 6 | 3 | 9 | 2 | 0,043 | Nature conservation | 10 |
| 44 | | Stiftelsen Rosendals trädgårdar | 1 | 3 | 4 | 0 | 4 | 0 | 4 | 2 | 0 | Other | 7 |
| 46 | | Stockholms fältrittklubb | 1 | 3 | 4 | 0 | 0 | 4 | 4 | 1 | 0 | Sports and outdoor | 5 |
| 51 | | Stockholms vandrarförening | 1 | 3 | 4 | 0 | 13 | 5 | 18 | 3 | 0,002 | Sports and outdoor | 5 |
| 52 | | Stora skuggans 4-H Gård | 1 | 3 | 4 | 0 | 2 | 2 | 4 | 1 | 0 | Sports and outdoor | 7 |
| 1 | | Albano båtklubb | 1 | 3 | 4 | 1 | 11 | 2 | 13 | 4 | 0,044 | Boats and sailing | 2 |
| 24 | | Haga båtklubb | 1 | 3 | 4 | 1 | 8 | 8 | 16 | 5 | 0,073 | Boats and sailing | 5 |
| 41 | | Segelsällskapet Brunnsviken | 1 | 3 | 4 | 1 | 0 | 6 | 6 | 3 | 0,001 | Boats and sailing | 6 |
| 42 | | Segelsällskapet Vega | 1 | 3 | 4 | 1 | 6 | 2 | 8 | 4 | 0,05 | Boats and sailing | 2 |
| 43 | | Stallmästaregårdens båtsällskap | 1 | 3 | 4 | 1 | 0 | 2 | 2 | 1 | 0 | Boats and sailing | 4 |
| 33 | | Lilla Frescati koloniförening | 2 | | | | | | | | | Allotment garden/gardening | 5 |
| 56 | | Söderbrunns koloniförening | 2 | | | | | | | | | Allotment garden/gardening | 3 |
| 21 | | Föreningen Stor-Stockholms koloniträdgårdar | 2 | | | | | | | | | Allotment garden/gardening | 6 |
| 8 | | Confidencen Redivia | 2 | | | | | | | | | Culture conservation | 2 |
| 30 | | Jakobsdals koloniområde | 0 | | | | | | | | | Allotment garden/gardening | 2 |
| 32 | | Kvarnvreten koloniområde | 0 | | | | | | | | | Allotment garden/gardening | 2 |
| 4 | | Bellmanstafetten | 0 | | | | | | | | | Sports and outdoor | 2 |
| 14 | | Friskis och Svettis | 0 | | | | | | | | | Sports and outdoor | 3 |
| 17 | | Föreningen Ekhagen | 0 | | | | | | | | | Other | 11 |
| 19 | | Föreningen Rädda Järvafältet | 0 | | | | | | | | | Nature conservation | 2 |
| 26 | | Hembygdsföreningen Östermalm | 0 | | | | | | | | | Culture conservation | 6 |
| 50 | | Stockholms sjögård | 0 | | | | | | | | | Culture conservation | 3 |
| 58 | | Tjejmilen | 0 | | | | | | | | | Sports and outdoor | 2 |
| 59 | | Ulriksdals hembygdsförening | 0 | | | | | | | | | Culture conservation | 5 |
| 61 | | Vårruset | 0 | | | | | | | | | Sports and outdoor | 2 |
| | | Missing data (N=62) | | | | | | | | | | | 0 |
| | | Missing data (N=47) | | | | | 0 | 0 | 0 | | 0 | | 0 |
| | | Missing data (Others) | | | | | | | | | | | 0 |

**Table A1.** *(continued)* **NB!** Legend for Table A1 on next page.

| SMO id.no. (N.) | Year of foundation | Affiliation popular movements [C] | Scale of activity and interest [B, 3] | Open membership | Voluntary based | No. of registrated members (min) | Member of umbrella org. FFE | Selected as respondents | Returned questionnaire | --- No. of active members (min) | --- No. of member activities per year (min) | --- No. of current projects (min) | **Internal activity** (normalized) [4] | --- Own office | --- No. of employees (min) | --- Forms of finanziation [D] | **Level of formalization** [4] | --- Type of activity inside NUP [E] | --- Area of activity [F] | --- Relative user intensity of activities | --- Days of activity in NUP per year (min) | **User intensity** of park [4] | **Political contacts** [4] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (continued) | | | | | | | | D. Other | | \|----------\> | | | | \|----------\> | | | | \|----------\> | | | | | |
| 16 | 1992 | 0 | 3 | 1 | 1 | | 1 | 1 | 1 | 0 | 3 | 6 | **0,23** | 1 | 0 | 0 | **1** | 5 | 7 | 1 | 5 | **5** | **26** |
| 37 | 1975 | 6 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 6 | 11 | **0,82** | 1 | 3 | 0,1,2,3 | **5** | 5 | 4,5 | 1 | 15 | **15** | **70** |
| 60 | 1991 | 0 | 3 | 1 | 0 | | 1 | 1 | 1 | | | | | 0 | 1 | 2,3 | **2** | 6 | 7 | 3 | 100 | **300** | **59** |
| 9 | 1984 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 0 | 1 | 11 | **0,4** | 0 | 0 | 0 | **0** | 6 | 5 | 1 | 5 | **5** | **32** |
| 31 | 1991 | 0 | 1 | 0 | 1 | 11 | 0 | 1 | 1 | 0 | 3 | 6 | **0,23** | 0 | 0 | 0,2,3 | **1** | 7 | 1,2,3,4 | 0 | 100 | **0** | **22** |
| 25 | 1988 | 0 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 0 | 6 | 1 | **0,07** | 0 | 0 | 0 | **0** | 5 | 1,2,3 | 1 | 5 | **5** | **8** |
| 2 | 2001 | 0 | 1 | 1 | 1 | | 0 | 0 | | | 0 | | | | | | | | | 0 | | | |
| 3 | 1988 | 0 | 1 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | | 2 | 0 | | | |
| 5 | 1993 | 0 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 11 | 6 | 1 | **0,23** | 0 | 0 | 0 | **0** | 1,5,6 | 2 | 3 | 5 | **15** | **8** |
| 6 | 1992 | 0 | 1 | 1 | 1 | | 1 | 1 | 1 | 0 | | | | | | | | | 4 | 0 | 5 | **0** | |
| 10 | 1947 | 4 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 0 | 3 | 3 | **0,12** | 1 | 0 | 0 | **2** | 8 | 4,5 | 0 | 5 | **0** | **29** |
| 11 | 1984 | 0 | 1 | 1 | 0 | 101 | 1 | 1 | 1 | 26 | | | | 1 | 3 | 0 | **5** | 7 | 5 | 0 | 365 | **0** | **5** |
| 12 | 1898 | 2 | 2 | 1 | 1 | 101 | 1 | 1 | 1 | 11 | 0 | 0 | **0,17** | 0 | 0 | 0,5 | **1** | 5 | 2 | 1 | 5 | **5** | |
| 13 | 1892 | 2 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 75 | 6 | **1** | 1 | 5 | 0 | **7** | 2,3,5 | 1,2,3 | 2 | 5 | **10** | **15** |
| 15 | 1947 | 3 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 1 | 1 | **0,43** | 1 | 1 | 3 | **3** | 8 | 5 | 0 | 5 | **0** | **0** |
| 18 | 1977 | 1 | 2 | 1 | 1 | 26 | 1 | 1 | 1 | 11 | 75 | 1 | **0,59** | 1 | 3 | 1,3 | **5** | 5 | 8 | 1 | 0 | **0** | **16** |
| 23 | 1973 | 0 | 3 | 1 | 1 | 101 | 1 | 1 | 1 | 11 | 6 | 0 | **0,2** | 0 | 0 | 0 | **0** | 5 | 1,2 | 1 | 5 | **5** | **0** |
| 20 | | 0 | 4 | 0 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | | | 0 | | | |
| 27 | 1985 | 4 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 0 | 6 | 0 | **0,03** | 0 | 0 | 0 | **0** | 5,6 | 2 | 1 | 5 | **5** | **10** |
| 28 | | 5 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 0 | 1 | 3 | **0,11** | 1 | 0 | 0 | **1** | 5 | 2,3 | 1 | 5 | **5** | **21** |
| 29 | 1970 | 5 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 3 | 1 | **0,44** | 1 | 0 | 0 | **2** | 8 | 4,5 | 0 | 5 | **0** | **0** |
| 35 | 1973 | 6 | 2 | 1 | 1 | 501 | 1 | 1 | 1 | 11 | 6 | 3 | **0,3** | 0 | | 0,2 | | 8 | 8 | 0 | 0 | **0** | **3** |
| 36 | | 6 | 2 | 1 | 1 | | 0 | 1 | 0 | 0 | | | | | | | | 8 | 8 | 0 | 0 | **0** | |
| 34 | | 6 | 2 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | 8 | 8 | 0 | 0 | **0** | |
| 38 | 1989 | 0 | 1 | 1 | 1 | 26 | 1 | 1 | 1 | 0 | 0 | 0 | **0** | 0 | 0 | 0 | **0** | 8 | 4 | 0 | | | **0** |
| 39 | 1986 | 4 | 2 | 1 | 1 | 101 | 1 | 1 | 1 | 11 | 6 | 3 | **0,3** | 1 | 0 | 0,1,5 | **2** | 5,6 | 2,3 | 1 | 5 | **5** | **0** |
| 40 | 1901 | 0 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 11 | 3 | 3 | **0,29** | 1 | 1 | 0,2 | **3** | 8 | 8 | 0 | 0 | **0** | **3** |
| 47 | 1951 | 6 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 6 | 1 | **0,46** | 1 | 1 | 0,3 | **3** | 8 | 8 | 0 | 0 | **0** | **0** |
| 48 | 1953 | 0 | 4 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | 3 | | 1 | | | |
| 49 | 1959 | 0 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 26 | 3 | **0,64** | 0 | 0 | 0,2 | **1** | 2,5 | 2,3,5,6 | 2 | 5 | **10** | **14** |
| 45 | 1908 | 7 | 4 | 1 | 1 | | 0 | 0 | | | | | | | | | | | | 0 | | | |
| 53 | 1979 | 0 | 5 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 6 | 3 | **0,53** | 1 | 1 | 0,1 | **3** | 3,5 | 7 | 1 | 5 | **5** | **1** |
| 54 | 1885 | 8 | 4 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | | | 0 | | | |
| 55 | 1968 | 6 | 4 | 1 | 1 | 26 | 1 | 1 | 1 | 11 | 6 | 3 | **0,3** | 0 | 0 | 0,3 | **1** | 5 | 4 | 1 | 5 | **5** | **0** |
| 57 | 1989 | 0 | 2 | 1 | 1 | 26 | 1 | 1 | 1 | 11 | 3 | 3 | **0,29** | 0 | 0 | 0 | **0** | 8 | 8 | 0 | | | **2** |
| 62 | | 0 | 4 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | | | 0 | | | |
| 7 | 1932 | 0 | 1 | 1 | 1 | 26 | 1 | 1 | 1 | 26 | 3 | 3 | **0,52** | 1 | 0 | 0 | **1** | 1,2,3 | 1 | 3 | 100 | **300** | **17** |
| 22 | 1983 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 26 | 3 | 0 | **0,41** | | 0 | 0 | | 1 | 4 | 3 | 50 | **150** | **2** |
| 44 | 1983 | 0 | 1 | 1 | 0 | | 1 | 1 | 1 | 0 | 6 | 6 | **0,25** | 1 | 11 | 4 | **13** | 1,3,5 | 5 | 3 | 365 | **1095** | **5** |
| 46 | 1886 | 0 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 26 | 3 | **0,64** | 1 | 1 | 0,3 | **3** | 3 | 4,5 | 1 | 365 | **365** | **5** |
| 51 | 1913 | 0 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 75 | 0 | **0,79** | 0 | 0 | 0,2 | **1** | 2,3 | 1,2,3,4 | 2 | 15 | **30** | **4** |
| 52 | 1903 | 9 | 1 | 1 | 1 | 101 | 0 | 1 | 1 | 26 | 75 | 1 | **0,82** | 1 | 11 | 0,1,2,3 | **13** | 1,2,3,5 | 4 | 3 | 50 | **150** | **17** |
| 1 | 1921 | 0 | 1 | 1 | 1 | | 1 | 1 | 1 | 0 | | | | 1 | | | | 4 | 2 | 1 | 100 | **100** | **23** |
| 24 | 1923 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 26 | 6 | 0 | **0,42** | 1 | 0 | 0 | **1** | 4,5 | 3 | 1 | 100 | **100** | **3** |
| 41 | 1898 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 26 | | | | 1 | 0 | 0 | **1** | 4 | 2 | 1 | 100 | **100** | **0** |
| 42 | 1915 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 11 | 6 | 1 | **0,23** | 1 | 0 | 0,4 | **2** | 4 | 4,5 | 1 | 50 | **50** | **18** |
| 43 | | 0 | 1 | 1 | 1 | | 1 | 1 | 0 | 0 | | | | | | | | 4 | 2 | 1 | 100 | **100** | |
| 33 | 1918 | 0 | 1 | 1 | 1 | 26 | 0 | 1 | 1 | 26 | 3 | 1 | **0,44** | 0 | 0 | 0 | **0** | 1,2 | 2 | 3 | 100 | **300** | **1** |
| 56 | 1905 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 26 | 3 | 0 | **0,41** | 0 | 0 | 0 | **0** | 1 | 4 | 3 | 100 | **300** | **9** |
| 21 | 1924 | 0 | 4 | 1 | 1 | 501 | 0 | 1 | 1 | 26 | 1 | | | 1 | 1 | 0 | **2** | 1,6 | 2,4,5 | 3 | | | **4** |
| 8 | 1970 | 0 | 1 | 1 | 1 | 501 | 1 | 1 | 1 | 0 | | | | 1 | 1 | 0,3 | **3** | 7 | 1 | 0 | 365 | **0** | **5** |
| 30 | | 0 | 1 | 1 | 1 | | 0 | 1 | 0 | 0 | | | | | | | | | 1 | 3 | 100 | **300** | |
| 32 | | 0 | 1 | 1 | 1 | | 0 | 1 | 0 | 0 | | | | | | | | | 1 | 3 | 100 | **300** | |
| 4 | 1984 | 0 | 1 | 1 | 1 | | 0 | 0 | | | 0 | | | | | | | 3 | 4 | 1 | 5 | **5** | |
| 14 | 1979 | 10 | 4 | 1 | 1 | 501 | 1 | 1 | 1 | 26 | 75 | 0 | **0,79** | 1 | 11 | 0,5 | **13** | 3,4,5 | 3 | 1 | 30 | **30** | **1** |
| 17 | 1944 | 0 | 1 | 1 | 1 | 101 | 1 | 1 | 1 | 3 | 6 | 0 | **0,08** | 1 | 0 | 0 | **2** | 1,2 | 4 | 3 | 5 | **15** | **0** |
| 19 | | 0 | 2 | 1 | 1 | | 0 | 0 | | | 0 | | | | | | | 8 | 8 | 0 | | | |
| 26 | | 4 | 1 | 1 | 1 | | 1 | 1 | 1 | 0 | | | | | | | | | 5,6 | 0 | | | **0** |
| 50 | 2002 | 0 | 1 | 1 | 1 | | 0 | 0 | | | | | | | | | | 4 | 5 | 1 | | | |
| 58 | 1984 | 0 | 4 | 1 | 1 | | 0 | 0 | | | | | | | | | | 3 | 5 | 1 | 15 | **15** | |
| 59 | 1989 | 4 | 1 | 1 | 1 | 26 | 1 | 1 | 1 | 26 | 3 | 1 | **0,44** | 0 | 0 | 0,3 | **1** | 5 | 1 | 1 | 5 | **5** | **4** |
| 61 | | 0 | 4 | 1 | 1 | | 0 | 0 | | | | | | | | | | 3 | 4 | 1 | 15 | **15** | |
| | 11 | 0 | 0 | 0 | 0 | 23 | 0 | 7 | 17 | 8 | 21 | 25 | 25 | 20 | 21 | 20 | 22 | 10 | 6 | 0 | 13 | 13 | 19 |
| | 6 | 0 | 0 | 0 | 0 | 15 | 0 | 2 | 10 | 3 | 14 | 15 | 15 | 12 | 13 | 12 | 14 | 7 | 6 | 0 | 9 | 9 | 12 |
| | 5 | 0 | 0 | 0 | 0 | 8 | 0 | 5 | 7 | 5 | 7 | 10 | 10 | 8 | 8 | 8 | 8 | 3 | 0 | 0 | 4 | 4 | 7 |

**Legend for Table A1.** *(previous pages)*

**NB!** *Empty cells means there is no valid data (NaN), either because there is no respondent or because the respondent choosed not to answer the particular question.*

**Remarks**

[1] Data genereted through telephone interview.
[2] Only reciprocated ties kept for these three organisations since their out-degree was much higher than their in-degree (ranging from 6.5-7.3 times as high), indicating over-estimation of their own links to others.
[3] Measuerment based on secondary data (e.g. homepages), i.e. not generated through the questionnaire.
[4] Calculated attributes (see Appendix)
[V] Measurements based on valued and bi-directional network.
[S] Measurements based on dichotomized and symmetrical network.

**A. Main interest (type of org.)**

1. Allotment and gardening
2. Sports and outdoor
3. Boats and sailing
4. Nature conservation
5. Cultural conservation
6. Nature and culture conservation
7. Other

**B. Scale of activity and interest**

1. Local area inside park
2. Local area outside park
3. Whole park
4. City/Regional level
5. National level
6. International level
7. Undefined

**C. Affiliation to Swedish popular movements**

1. *Folkparkerna.* Amusement parks created by the working class movement in Sweden in the early 1900's.
2. *Friluftsfrämjandet.* Swedish popular movement for outdoor life activities that started in the late 1800's.
3. *Fältbiologerna.* A Swedish youth movement for those interested in nature and environment, started 1947.
4. *Hembygdsrörelsen.* Swedish movement from the early 1900's in reaction to industrialization aiming to protect local folk traditions.
5. *Hyresgästföreningen.* National tenant association that organize demands towards landlords.
6. *Naturskyddsföreningen.* The Swedish natural protection agency, a Swedish popular movement from 1909.
7. *Scouterna.* International scout movement for outdoor life activities, started in Sweden in the early 1900's.
8. *Turistföreningen.* Swedish tourist association started in the late 1800's to enhance tourism in Sweden.
9. *4H-rörelsen.* International youth movement for farming and cultivation, came to Sweden 1920.
10. *Friskis och Svettis.* Swedish sport and health organisation that started in the late 1970's.

**D. Forms of finanization**

0. Member fees (or have no expenses)
1. Paid missions
2. Donations
3. Income from project applications
4. Other formal way (foundation etc.)
5. Other

**E. Type of activity inside NUP**

1. Gardening and management of natural values
2. Bird watching and mushroom and berry gathering
3. Sports
4. Water sports
5. Botanical walks, guiding of natural and cultural values and picnics
6. Management of cultural values such as buildings

**F. Area of activity** *(see also map)*

1. Ulriksdal
2. Brunnsviken
3. Hagaparken
4. North Djurgården
5. South Djurgården
6. Fjäderholmarna (islands)
7. All areas
8. No areas

**Box A1.** Two vignettes illustrating how social network structure affects movement dynamics and protective capacity.

**Husarviken.**[1] The municipality of Stockholm were planning to build a new town district with 3-5000 apartments in Husarviken (Stockholm 2006). During 2004 the Royal Administration of Djurgården (KDF), contacts core and semi-core members in order to mobilize resistance. Together with the umbrella organization FFE, along with KGP, DLV, and HBV they form a task-group that stride to action (id-numbers: N16, N31, N9, N25). KGP and HBV re-use a method they developed in the 1990's. Together with the same landscape architect as back then, they work out a so called "citizen plan", i.e. an alternative plan for the area. In their plan, sports and cultural activities are stressed instead of apartments in order to increase the ecological connection in the area and preserve the cultural-historical landscape. They arrange, as in the 1990's, a debate in the prestigious Royal Academy of Arts in the centre of Stockholm and invite top-politicians and city officers which also attend the debate. Decision-makers are challenged in a "confrontational dialogue" (Abrahamsson 2003) about different possible futures of the area. At the end of this meeting, the chairman of FFE, threatens the city planners to start a lengthy juridical process if the plans are not revised. DLV, on the other hand, with a long record of activities in this particular area of the park, and thus with good contacts with both local community groups and nearby residents, co-organize an open information meeting in the local church. They inform how the exploitation plans will negatively – according to them – affect the local residents. At the same meeting, KGP and HBV are given the opportunity to present their alternative plan for the area. The task-group (including KDF) engages in a row of lobbying meetings with decision-makers, both at the municipality of Stockholm and at the County Administrative Board. In December of 2006, the County Administrative Board decides not to grant the city's detailed building plans. Instead it is called for new plans in which the municipality needs to meet the demands of increased ecological connection in the area and decrease the impact on the cultural-historical landscape of the NUP. This most necessarily means fewer and lower apartment buildings. The movement seems to have won a partial victory.

The core-periphery structure operates in several aspects here. Firstly, KDF chooses to work with the core and semi-core members; not with peripheral members of the movement. This is probably because of already established contacts with these SMOs (since they have been active before), and since they are perceived as the informal leaders of the movement (due to their structural position). Thus, the core and semi-core are the ones receiving new and early information. They use their developed methods (alternative plans, meetings, lobbying) and coordination ability (find local resident's groups, joint lobbying) to influence the decision-making process, both through direct interaction with decision-makers (political contacts, debates) and through mobilizing local residents in the area. Their success and information advantage after yet another fight strengthens their position as core-members. The core-periphery structure is enforced (positive feedback).

**Tre Vapen.**[2] In the case of the exploitation plans at *Tre Vapen* in 2005, a core activist was present during the public meeting. Concerns were raised by neighbours to the exploitation site and the activist, together with concerned neighbours, could form a group, raise a complaint and put pressure on decision-makers and exploitation was delayed. Structurally interpreted, the core activist lent the agency of his position to the group; his skills, contacts, arguments and framing of the park so that a stronger case could be built. This local "NIMBY"-protest (not-in-my-back-yard) was weaved into a grander narrative of up-holding a park of national interest, and at the same time a new periphery member to the movement was added.

[1] This vignette is based on interviews, participatory observations and newspaper articles according to the tables in Paper III (Ernstson and Sörlin 2009): interviews with top-cited activists in KGP, HBV and DLV (1, 7, and 9); participatory observations (3 and 5): KGP's and HBV's debate at Royal Academy of Arts (2005-09-07), and DLV's open meeting in Hjorthagen Church (2005-10-20); newspaper articles: (Sundström 2005-12-13, DN 2006-10-12).

[2] Based on conversations with an activist and a represent of the new group that was formed, together with local newspaper articles (Melin 2005-03-15) and one debate article (Dittrich 2005-03-08).

**Table A2. Artefacts linked to the National Urban Park.** *The list is not exhaustive.*

| |
|---|
| *Cultural-historical artefacts* |
| **Royal buildings:** Haga Castle, Rosendal Castle, Ulriksdal Castle, Confidencen (theatre), Gustav III's pavilion, *Koppartälten*, *Ekotemplet*, *Karl XI:s fiskartorp*, Chinese Pagoda, |
| **Planned parks:** Haga Park, Tivoli, Bellevue and Piper's park (romantic English gardens), Ulriksdal garden (baroque park), Nobel Park |
| **Burial sites:** Burial site of the royal family, grave of composer J.M. Kraus, Family Ling's Graves, Stone and Bronze Ages graves |
| **Lyrics and paintings:** Songs and lyrics by e.g. the national poet C-M. Bellman (e.g. Fredmans Epistel Nr. 32, 71, 80 about places in the park area, *Lill-Jansskogen*, *Fiskartorpet* and *Roslagstull*, respectively) and the writings by for example Blanche and the internationally renowned August Strindberg who lived in the area. Landscape paintings, lithographies, and sketches by e.g. Hillerström, Martin, Linnerhielm, Ehrensvärd, GW Palm, CJ Billmark and Prince Eugen. |
| **Nationally recognized museums:** The Swedish Museum of Natural History, Ethnographic Museum, Biological Museum, Aquaria Water Museum, *Fjärilshuset* (tropical butterflies), *Junibacken* (children), Liljevalchs (art) *Thielska galleriet* (art), *Waldemars udde* (art), Sea Historical Museum, Nordic musuem, *Skansen* (open-air), Technical Museum, Vasa Museum, *Bergianska trädgården* (botanical garden), *Carl Eldhs ateljé* (art), and more. |
| **Other renowned buildings:** *Gasverket*, *Gröna Lund*, *Kaknästornet* |
| **Sculptures:** C-M Bellman (national poet), August Strindberg by Carl Eldh, and sculptures by Carl Milles. |
| |
| *Scientific artefacts* |
| **Landscape ecology:** *Reports from authorities:* (Mörtberg and Ihse 2006), (Löfvenhaft and Wikberger 1996, Stadsbyggnadskontoret 1997, 1998, Löfvenhaft and Lannek 2002); *Peer-reviewed articles:* (Löfvenhaft et al. 2002, Löfvenhaft et al. 2004); Andersson and Bodin 2007; *Theses:* (Löfvenhaft 2002b, Andersson 2003, Lundberg 2006); *Books:* (Löfvenhaft 2002a) |
| **Management:** Edelcrantz 1817, (Länsstyrelsen 1999, Wirén 2002, Borgström 2003, Bråvander and Jacobson 2005) |
| **Ecosystem services:** (Bolund and Hunhammar 1999, Elmqvist et al. 2004, Barthel et al. 2005, Hougner et al. 2006), The United Nations Millennium Ecosystems Assessment, (Colding et al. 2003, MA 2005), (Barthel et al. 2005, Borgström et al. 2006). |
| **Other:** Mårald and Pettersson 19965 *(record of environmental history)* |
| |
| *Other* |
| **Lavish hard-cover books** with four-coloured photos and text: (Waldenström 1991, Brusewitz and Ekman 1995, Hallerdt 1995, Lundevall 1997, Waldenström 2001, Holm and Schantz 2002, Norrby 2002, Utgren and Hammarström 2004) |

## References and field documents


Abrahamsson, H. 2003. Det gyllene tillfället, 1 edition. Leopard förlag, Stockholm.

Andersson, E. 2003. Composition of territories and breeding success of Eurasian Jays (Garrulus glandarius) in the National City Park of Stockholm. Master thesis. Stockholm University, Stockholm.

Barthel, S., J. Colding, T. Elmqvist, and C. Folke. 2005. History and local management of a biodiversity-rich, urban, cultural landscape. Ecology and Society **10**:10.

Bolund, P., and S. Hunhammar. 1999. Ecosystem services in urban areas. Ecological Economics **29**:293-301.

Borgström, S. 2003. Management of urban green areas in the Stockholm County. Master thesis. Stockholm University, Stockholm.

Borgström, S., T. Elmqvist, P. Angelstam, and C. Alfsen-Norodom. 2006. Scale Mismatches in Management of Urban Landscapes. Ecology and Society **11**:16.

Brusewitz, G., and H. Ekman. 1995. Ekoparken: Djurgården - Haga - Ulriksdal. Wahlström & Widstrand, Stockholm.

Bråvander, L.-G., and R. Jacobson. 2005. Skötselplan Nationalstadsparken. Kungliga Djurgårdens förvaltning, Stockholm.

Colding, J., T. Elmqvist, J. Lundberg, K. Ahrné, E. Andersson, S. Barthel, S. Borgström, A. Duit, H. Ernstson, and M. Tengö. 2003. The Stockholm Urban Assessment (SUA-Sweden): Millennium Ecosystem Assessment Sub-Global Summary Report 9 December 2003. Beijer Institute

of Ecological Economics and the Departement of Systems Ecology, Stockholm University, Stockholm.
Dittrich, M. 2005-03-08. Exploatera inte Ladugårdsgärde. *in* Mitt-i-Östermalm, Stockholm.
DN. 2006-10-12. Parkvänner vill inte se nya bostäder. *in* Dagens Nyheter, Stockholm.
Elmqvist, T., J. Colding, S. Barthel, S. Borgström, A. Duit, J. Lundberg, E. Andersson, K. Ahrné, H. Ernstson, C. Folke, and J. Bengtsson. 2004. The Dynamics of Social-Ecological Systems in Urban Landscapes: Stockholm and the National Urban Park, Sweden. Annual New York Academy of Science **1023**:308-322.
Girvan, M., and M. E. J. Newman. 2002. Community structure in social and biological networks. PNAS **99**:7821-7826.
Hallerdt, B., editor. 1995. Ekoparken-Nationalstadsparken: Ulriksdal-Haga-Brunnsviken-Djurgården. Samfundet S:t Erik Stockholm, Stockholm.
Holm, L., and P. Schantz, editors. 2002. Nationalstadsparken: ett experiment i hållbar utveckling (The National Urban Park: an experiment in sustainable development). Formas, Stockholm.
Hougner, C., J. Colding, and T. Söderqvist. 2006. Economic valuation of a seed dispersal service Stockholm National Urban Park, Sweden. Ecological Economics **59**:364-374.
Lundberg, J. 2006. Rethinking Urban Nature: Maintaining Capacity for Ecosystem Service Generation in a Human Dominated World. Doctoral thesis. Stockholm University, Stockholm.
Lundevall, P. 1997. Djurgården - Kungens och folkets park. Stadsbyggnadskontoret, Västervik.
Länsstyrelsen. 1999. Nationalstadsparken: Mål och riktlinjer för skötsel av park och natur. Länstyrelsen i Stockholms län, Miljö- och planeringsavdelningen, nr 18. www.ab.lst.se, Stockholm.
Löfvenhaft, K. 2002a. Biologisk mångfald i urban miljö (Biological diversity in urban environments). *in* L. Holm and P. Schantz, editors. Nationalstadsparken - ett experiment i hållbar utveckling (The National Urban Park - An experiment in sustainable development). Formas, Stockholm.
Löfvenhaft, K. 2002b. Spatial and temporal perspectives on biodiversity for physical planning: examples from urban Stockholm, Sweden. Doctoral thesis. Stockholm University, Stockholm.
Löfvenhaft, K., C. Björn, and M. Ihse. 2002. Biotope patterns in urban areas: a conceptual model integrating biodiversity issues in spatial planning. Landscape and Urban Planning **58**:223-240.
Löfvenhaft, K., and J. Lannek. 2002. Biotope map of Stockholm. Älvsby Tryck, Älvsby.
Löfvenhaft, K., S. Runborg, and P. Sjögren-Gulve. 2004. Biotope patterns and amphibian distribution as assessment tools in urban landscape planning. Landscape and Urban Planning **68**:403-427.
Löfvenhaft, K., and C. Wikberger. 1996. Biotope and historical land-use map. *in* Nationalstadsparkens ekologiska infrastruktur. SBK 1997:98, Stockholm.
MA. 2005. Ecosystems and Human Well-Beeing: Multiscale Assessments - Findings of the Sub-global Assessments Working Group Millennium Ecosystem Assessment Series. Island Press, Washington, D.C.
Melin, K. 2005-03-15. Gräsrötter tar upp kampen om Gärdet. Pages 5 *in* Mitt-i-Östermalm, Stockholm.
Mörtberg, U., and M. Ihse. 2006. Rapport 2006:13 - Landskapsekologisk analys av Nationalstadsparken (Landscape ecological analysis of the National Urban Park). Länsstyrelsen i Stockholms Län (The County Administrative Board of Stockholm), Stockholm.
Norrby, E. 2002. Nationalstadsparkens många ansikten. *in* Kungliga vetenskapsakademin och Nationalstadsparken, Stockholm.
Stadsbyggnadskontoret. 1997. Nationalstadsparkens ekologiska infrastruktur. Stockholms stadsbyggnadskontor, Strategiska avdelningen, Stockholm.
Stadsbyggnadskontoret. 1998. Natur och kulturmark i Nationalstadsparken:
Brunnsviken-Haga-Brunnsviken-Djurgården. Stockholms stadsbyggnadskontor, Strategiska avdelningen, Stockholm.
Stockholm. 2006. Hjorthagen - Värthamnen - Frihamnen - Loudden. *in*. Stadsbyggnadskontoret and Gatu- och fastighetskontoret, www.stockholm.se/hjorthagenvartan, 2006-10-11, 11:15, Stockholm.
Sundström, A. 2005-12-13. Nej till bostäder vid Husarviken. *in* Dagens Nyheter, Stockholm.
Utgren, L., and T. Hammarström. 2004. Ekoparken - kunglig mark: Djurgården, Haga, Ulriksdal. Gullers förlag, Örebro.
Waldenström, H. 1991. Ekoparken - sammanhängande natur- och kulturpark i storstad. Kungliga Djurgårdens förvaltning, Stockholm.
Waldenström, H. 2001. Guide till Ekoparken: Världens första Nationalstadspark. Birka energi, Stockholm.
Wirén, L. 2002. Dynamik i urbana nätverk - sociala och ekologiska perspektiv på förvaltningen av Nationalstadsparken, Stockholm. Masters thesis. Stockholm, Stockholm.

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