Global Environmental Change 20 (2010) 255–265

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Social–ecological memory in urban gardens—Retaining the capacity for management of ecosystem services

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ARTICLE INFO

Article history:
Received 5 March 2009
Received in revised form 17 December 2009
Accepted 17 January 2010

Keywords:
Ecosystem services
Social and ecological memory
Resilience
Ecosystem management
Urban gardens
Community of practice

ABSTRACT

Many ecosystem services are in decline. Local ecological knowledge and associated practice are essential to sustain and enhance ecosystem services on the ground. Here, we focus on social or collective memory in relation to management practice that sustains ecosystem services, and investigate where and how ecological practices, knowledge and experience are retained and transmitted. We analyze such *social–ecological memory* of allotment gardens in the Stockholm urban area, Sweden. Allotment gardens support ecosystem services such as pollination, seed dispersal and pest regulation in the broader urban landscape. Surveys and interviews were preformed over a four-year period with several hundreds of gardeners. We found that the allotment gardens function as communities-of-practice, where participation and reification interact and social–ecological memory is a shared source of resilience of the community by being both emergent and persistent. Ecological practices and knowledge in allotment gardens are retained and transmitted by imitation of practices, oral communication and collective rituals and habits, as well as by the physical gardens, artifacts, metaphors and rules-in-use (institutions). Finally, a wider social context provides external support through various forms of media, markets, social networks, collaborative organizations, and legal structures. We exemplify the role of urban gardens in generating ecosystem services in times of crisis and change and conclude that stewards of urban green areas and the social memory that they carry may help counteract further decline of critical ecosystem services.

1. Introduction

The Millennium Ecosystem Assessment concluded that many ecosystems services are degrading (MA, 2005; Carpenter and Folke, 2006), reflected, for example, in the worldwide crisis in the pollinator service for agriculture and biodiversity (Buchmann and Nabhan, 1996; Steffan-Dewenter et al., 2005; Klein et al., 2007). How can we sustain and enhance the capacity of social–ecological systems to improve the management of essential ecosystem services, like pollination of crops and other plants? In urban areas, gardening forms part of the urban landscape mosaic and seems to play a significant role in pollination (Kearns et al., 1998; Biesmeijer et al., 2006), as well as for other ecosystem services that spill over to the rest of the landscape, like seed dispersal and pest regulation (Andersson et al., 2007). In this sense, urban gardening constitutes a source of resilience for ecosystem services in the broader landscape (Colding et al., 2006). The services are the result of a cultural landscape shaped by a diversity of management practice, some explicit, some tacit (Berkes and Folke, 1998). Where and how in communities are ecological practices that support ecosystem services, and the knowledge for their regeneration retained and revived? Is there a memory in societies that carries essential experiences of ecosystem management?

Memory above the individual level that stores experiences of living pasts and influence behavior of societies and groups is often referred to as *collective memory* (Halbwachs, 1926 [1950]; Middleton and Edwards, 1990; Coser, 1992; Gongaware, 2003; Rothstein, 2005). This line of thoughts originates from Halbwachs who was a disciple of Durkhiem. The work of Durkheim around the end of 1890s included concepts about "collective excitement" as the fertile ground for cultural creativity (Coser, 1992). Halbwachs' work showed how these lessons where kept alive through transmission between creative periods (Coser, 1992). He argued that even though it is only individuals that remember, individual memory processes derived from social interaction, and is facilitated through supra individual means shared with others, such as language, symbols, events, and cultural contexts (see also Misztal, 2003). Accordingly, social groups construct their own

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doi:10.1016/j.gloenvcha.2010.01.001

images of the world through agreed upon versions of the past-versions constructed through negotiation, not private remembrance. It is in this sense that there exists a *collective memory* (Coser, 1992), and it is the verbal conventions that constitute the most stable social framework for it (Halbwachs (1926) [1950]; Middleton and Edwards, 1990; Misztal, 2003). Anthropologists, archeologists, ecologists and other scholars, often use the concept of *social memory* (Mcintosh, 2000; Climo and Cattell, 2002; Folke et al., 2003), or *cultural memory* (Nazarea, 1998; Misztal, 2003).

The social memory of communities constitutes the variety of forms through which behaviors of people are shaped by the past, and it functions as collectively shared mental maps for dealing with a complex world (Olick and Robbins, 1998; Crumley, 2002; Misztal, 2003; Gongaware, 2003; Rothstein, 2005; North, 2005). Many scholars argue that memories not always represent documentaries of events, but rather constitute interpretations used in narrative constructions, tightly connected to emotions (Misztal, 2003). Memories of everyday experience are therefore frequently distorted. However, traumatic memories, or so called 'light bulb' memories, such as of environmental crises are likely to preserve details (Schacter, 1995; Misztal, 2003). In general the ingredients of social memory are neither a purely social construction, nor historical facts established once and for all, but rather along the line between those two poles (Rothstein, 2005).

According to Wenger (1998) participation in communities over time becomes invested in a shared history (McKenna et al., 2008), and in tools, artifacts and concepts, which tend to outlive the repertoires of practices that first shaped them. Such *communities-of-practice* (Wenger, 1998), involves a continuous learning process (Armitage et al., 2008), with reflexivity and credibility as significant features of interpersonal meaning–making (Lawrence, 2009). Because the world is in constant flux and conditions always change, any practice must be revived and reinvented, even as it remains 'the same practice'. The social memory available to constitute a practice is thus both emergent and persistent, a shared source of resilience of the community in question (Wenger, 1998; Folke et al., 2003).

Here, we choose to use the term *social–ecological memory* since we exclusively address memory of groups that engage in ecosystem management. We use allotment gardens in the Stockholm urban landscape, Sweden as a case study to explore the means by which knowledge, experience and practice about how to manage a local ecosystem and its services is retained in a community, and modified, revived and transmitted through time. Metaphorically one may view social–ecological memory as a library (building, people, organisation), in which ecological knowledge and practical advice for management are reflected in how it is built, structured and organized by the people engaged with the library, and in the contents of the books, with new books continuously added. We believe that such memory is a critical subset of any social–ecological system, providing sources of resilience to deal with change (Folke et al., 2003). Social–ecological memory would be part of any community, whether a traditional ecological knowledge system or a contemporary community-based resource management system (Hanna et al., 1996; Berkes and Folke, 1998). For example, elders in traditional societies often serve as stewards of ecological knowledge intermingled with practice and beliefs, including knowledge of long-term and large-scale changes transmitted over generations (Berkes and Folke, 2002). Ceremonies and rituals in both traditional and contemporary societies, which carry ecological practices, represent features of social–ecological memory (Lansing, 1991; Alcorn and Toledo, 1998). Social–ecological memory extends beyond the merely extractive collection of ecological information to a deeply integrated connection between observation and meaning among groups of people (Lawrence, 2009) and their institutions (Olsson and Folke, 2001). There are few studies that focus on social–ecological memory in relation to ecosystem management (but see e.g. Mcintosh et al., 2000), and considerably less related to household gardening. A prominent exception is the studies on social memory conducted by Crumley (1994, 2000) on the vernacular (vegetable) gardens in the Burgundy region of France.

The primary objective of this article is to explore social–ecological memory by analyzing how and where knowledge and practice linked to the production of ecosystem services are socially retained and temporarily transmitted. The findings draw on a four-year fieldwork inventory in allotment gardens in urban Stockholm. Allotment gardens can broadly be described as representing 'legacies' of traditional household gardening practices where the users' knowledge of gardening has been passed on and socially retained for considerable time, often over several generations (Nolin, 2003). Hence, in this sense allotment gardens represent social arenas for present-day household gardening in urban landscapes. We have previously investigated the link between ecosystem services and management practices of allotment gardens (Andersson et al., 2007), where evaluation of local ecological knowledge and practices was made by analyzing the respondent's answers to questions regarding site specific environmental conditions, interplay between organisms and the local environment, and the behavioral characteristics of organisms, including migration, foraging, nesting, and mating. The knowledge revealed by the respondents was compared with the knowledge that the scientific community holds regarding ecosystem dynamics. Here, the focus is on the dynamic 'library', the social–ecological memory that carries the ecological experiences and revises them over time and between people, and its role in supporting the generation of ecosystem services.

The article is organized as follows; the next part begins by providing a background on urban allotment gardening with a focus on Stockholm, Sweden. Part 3 describes the methods used for the four years of fieldwork on allotment gardening in Stockholm. Part 4 presents the results of the fieldwork, where we portray both internal features for the community and external features of social–ecological memory. Part 5 begins with a discussion of the fieldwork results and the role of this novel concept for management of ecosystem services such as pollination and pest regulation, followed by a discussion on its role for governance of ecological resilience. We end this article by synthesizing the major insights generated in this paper in the hope it will stimulate further inquiry into the role of social–ecological memory for carrying ecological knowledge and sustainable management practices of ecosystem services.

2. Background

2.1. Allotment gardening in Stockholm

Stockholm in the end of the 1800s, like many cities of Europe, faced social problems such as mass migration from the country side, overcrowding, unhealthy living conditions, and a loss of identity and values of rural living (Lindhagen, 1916; Lignell, 1995; Lundevall, 1997; Nilsson, 2000). These conditions motivated the social movement of allotment gardening to improve conditions of the landless working class (Nolin, 2003). Various governmental bodies early on promoted and supported the growth and development of allotment areas. Currently Europe holds some 3 million allotment gardens, whereof 10,000 individual plots are found in the city of Stockholm, occupying 210 ha of land and involving about 24,000 people (Björkman, 2000; Moberg, 2003; Nolin, 2003). Allotment areas are reserved for horticulture, containing tiny pieces of garden plots with individual or family

management rights to land. The land is usually owned by a local municipality and located in urban or semi-urban areas (Colding et al., 2006; Andersson et al., 2007).

In Stockholm these are often considerably old (sometimes over one-hundred years), and they appear as lush green, well-managed flower rich areas which differ in size (3450–70,000 m^2) and spatial organization, from proper cultivation plots to more gardenlike plots with small houses and lawns. Management practices performed in these arenas support a diversity and abundance of wild bees and many other pollinators, and the heterogeneity that the gardens have on the urban landscape also increases the overall diversity of insectivorous birds (Andersson et al. 2007). Out of 362 allotment gardeners that responded on the survey (A–D), 93% exclude pesticides, 27% enhance habitats for small birds, and 45% enhance habitats for bumble bees.

3. Methodology

The methodology consisted of (1) a pilot field study for learning about the phenomena of allotment gardening and for choosing areas for deeper studies, (2) a survey for identifying key respondents for interviews and also for sampling quantitative data about management practices, (3) deep interviews with key respondents and analysis of the deep interviews with guidance form literature about social memory (e.g. Halbwachs, 1926 [1950]; Gunn, 1994; Olick and Robbins, 1998; Wenger, 1998; McIntsoch et al., 2000; Misztal, 2003; Rothstein, 2005). At this point some patterns about Social–ecological memory emerged, which were used in, (4) a second survey with the objective to deepen understanding of how management practices are retained and transmitted, followed by triangulation through deep interviews in one of the allotment areas and analyses of documents[1].

3.1. Pilot study and choice of field study sites

We started with a pilot study (Patton, 2002) of 8 allotment gardens during spring 2003. The purpose was to gather primary information about the phenomenon of allotment gardening. We studied maps and scanned the literature and media about allotment gardening, and we observed management practices during field trips. We also engaged in informal talks and interviews with individual allotment holders. We encountered social features of allotment gardening, and how these were retained and transferred within the movement. During this phase, eleven pilot interviews were conducted with allotment holders. The respondents were selected by random sampling, and notes were taken during most of the interviews and some were audio-taped.

Four allotment areas were chosen for this study of social–ecological memory. These were located in Stockholm City, which is the most densely populated area of Sweden with a population of 1.8 million (Barthel et al., 2005). One allotment area is located in the city center (*Barnängen*), another is located just outside the city (*Söderbrunn)* and two are located in suburbs in the proximity of the city (*Kvarnvreten* and *Stora Mossen)*. These areas were chosen after three criteria, age (older than 50 years), physical structure (garden plots with chalets), and location (radius within 10 km from the city center).

3.2. First survey

The second step was a questionnaire, which was sent out to all gardeners in the four allotment associations, 534 persons in total (Surveys A–D, Table 5). The questionnaire contained 20 questions and the survey was conducted during spring 2004 and spring 2005. Responses were anonymous. The objective with the survey was to get information about management practices and local customs related to gardening, and to identify key informants for the interview study. A key informant was defined as an allotment gardener who had been named by his/her gardening neighbors as especially knowledgeable about gardening and the local ecosystem (Davis and Wagner, 2003). The purpose with identifying key informants for semi-structured interviews was to extract maximum information about Social–ecological memory in relation to gardening from a minimum of respondents (Patton, 2002). More than two thirds (68%) of the allotment holders responded to the questionnaires.

3.3. Open-ended interviews

Twenty-five semi-structured interviews were carried out (Table 4). Drawing on grounded theory (Patton, 2002), sixteen of the interviews were conducted at garden plots of the identified key informants. They took place during spring and summers of 2004 and 2005. The purpose of the interviews was to (1) identify practices and means of communication for the generation, revival and transmission of management practices in relation to ecosystem services within the gardening community and between generations and (2) identify where social–ecological memory that enables management practices is retained and stored, both within the community and externally. Written-down questions were used as a guideline when conversations did not flow. These questions were open-ended (Kvale, 1997) with the possibility to follow-up clues that appeared during the interviews. The dialogues revolved around the following points (i) management practices and ecological knowledge, tacit as well as explicit, in relation to ecosystem services; (ii) retention, modification and transmission of management practice. The interviews ended with walks around the gardens together with the respondents, which gave opportunity to talk about the various objects there. All interviews were recorded and transcribed and the length of the interviews varied between 60 and 90 min. Patterns that emerged out of the transcribed interviews are presented as classes in Table 1 below. The transcribed interviews were analyzed by classifying answers of the respondents related to gardening in the categories of Table 1. One further interview was conducted with the head of the Swedish allotment union for attaining information about organizational structure and history of the movement. Another five interviews were conducted with people outside the allotment movement, including public park managers and the head city gardener of Stockholm to understand perceptions held by management authorities about allotment gardening and its ecological function in the urban landscape.

3.3.1. Data analyses

The patterns that emerged during analyses of the transcribed interviews were put in dialogue with theory developed within

Table 1
Categories of social–ecological memory in the allotment gardening and the criteria for choosing them.

Category	Criteria
Habits/rituals	Imitation of practices, learning-by-doing, repeated collective gatherings, parties
Oral communications	Dialogues, discussions, sharing of experience, learning, teaching
Rules-in-use (institutions)	Norms, regulations and property rights
Physical forms/artifacts	Written material, pictures, places, tools
External sources of support	Features of participation and reification external to individual allotment gardens

[1] Interview and survey questions available from the author S. Barthel on request, Stephan@ecology.su.se.

the fields of collective memory and social memory (e.g. Halbwachs, 1926 [1950]; Gunn, 1994; Olick and Robbins, 1998; Wenger, 1998; McIntsoch et al., 2000; Misztal, 2003; Rothstein, 2005). According to Halbwachs (1926) [1950] collective memory can be divided in two major frameworks (1) autobiographical memory, which is about narratives of identity based on individual experiences and (2) historical memory which includes information stored in institutions, physical forms, place and written accord. Halbwachs work shows similarities with ideas of how social practice evolves in communities, where according to Wenger (1998) practice emanates from the interplay of *participation* (a process of taking part or share with others) and *reification* (making an abstraction into an object that endures). It is first and foremost, a dual process by which we can experience the world and our engagement in it as meaningful (Wenger, 1998). With time shared histories are being built up in *Mnemonic* communities-of-practice (Wertsch, 2002; Misztal, 2003).

Acquisition and transmission of memory can be facilitated through personal experiences of participation (Wenger, 1998). Oral communication is stressed as central for re-producing collective memory and meaning according to almost all of the analyzed literature (e.g. Halbwachs, 1926 [1950]; Middleton and Edwards, 1990; Stein, 1995; Olick and Robbins, 1998; Wenger, 1998; Wertsch, 2002; Misztal, 2003). The fact that memories are often organized around landscapes, suggests that remembering occurs in the physical Earth and is something that involves our senses (Misztal, 2003), which is why participation may modify social memory in relation to a constantly changing environment (Gunn, 1994; Scott, 1998). Some social practices are habits, such as established collective practices that are regularly repeated (Wenger, 1998; Misztal, 2003). Through habits social memory may be passed on, often tacitly, in embodied, non-textual and non-cognitive ways (Misztal, 2003; Nazarea, 2006). This phenomenon is sometimes referred to as *habit memory*, and it is reflected in bodily postures, activities, techniques and gestures, and through practice it brings the past into the present. This is in line with Crumley (2002) and Nazareás (2006) findings, which suggest that non-verbal forms, such as gardening practices, transfer ecological information temporally.

Retention and transmission of social memory can be facilitated through reification processes (Marx and Engels, 1987 [1859]; Wenger, 1998), which both constrain and enable participation as reification provides social cues for interpersonal relations (Hollis, 2002) and for relations to ecosystems (Berkes and Folke, 1998; Nazarea, 2006). Reification includes objects, phrases, metaphors (Wenger, 1998) and institutions or *rules-in use*, including regulations, informal norms and property rights (Ostrom, 1990; North, 1994). Artifacts such as tools, written material, pictures and media are other aspects of reification. Reification also includes places, ruins, landscapes, monuments, and architecture-which all are part of social memory (Halbwachs, 1926 [1950]; Wenger, 1998; Misztal, 2003).

We used the notions of participation and reification as a classification scheme when developing four classes of internal social–ecological memory of allotment gardening, where the first two represent participation and the following two represent reification. Literature also stresses the significance of external reserves of memory for internal social memory (Folke et al., 2003; Nazarea, 2006). Not surprisingly, the empirical data revealed that sources external to allotment gardening retain and transfer social–ecological memory, which is why a fifth class was developed (Table 1).

The next step in our data gathering was to get quantitative triangulation on the credibility of these five classes of social memory. This is why we conducted a second survey.

3.4. Second survey and final interviews

Based on the patterns that emerged about what constitutes social–ecological memory, we conducted the second survey (Survey E, Table 5) on one of the original four allotment gardens. It was conducted during spring 2007. A questionnaire was sent out to all gardeners in *Söderbrunn*, which is the oldest one in Stockholm (established 1904), which also contains a high number of garden plots (190), and which also had the highest response frequency during the first questionnaire (82%). *Söderbrunn* has also recently been under threat of exploitation, but has successfully responded and been able to continue allotment gardening (see Section 5.2). The 23 questions all revolved around the five classes of social–ecological memory presented in Table 1. Respondents were anonymous. The objective with the survey was to deepen understanding of how practices are retained and transmitted. The second questionnaire received a response frequency of 56%. Patterns that emerged from the second survey were triangulated by three follow-up interviews and further text analyses of documents. At this point saturation of information was achieved.

4. Social–ecological memory in relation to allotment gardening

Social–ecological memory in the investigated allotment gardens in urban Stockholm retains and transmits ecological practices and knowledge by different forms of participation, such as imitation of practices, oral communication and collective gatherings, as well as by reification processes. Reification processes is an outcome of participation (Wenger, 1998), used here as creating points of focus around which gardeners organize negotiation of meaning, and it includes physical objects such as chalets and fruit tress designed or planted by the gardeners, as well as artifacts (such as booklets and tools) and rules-in-use. Finally, a wider social context provides external memory support through e.g. media, books, garden markets, various social networks, unions and legal frameworks (Table 2).

4.1. Participation

Participation involves acquisition, transmission and modification of ecological practices and knowledge. It refers to a process of taking part and sharing and also to the relations with others that reflect such practice (Wenger, 1998; Murdoch, 2006). Hence, it suggests both action and connection and mutual recognition. It goes beyond collaboration and involves all sorts of relations, including conflicts (Bourdieu (1978) [1972]; Ortner, 1984). Participation shapes our experience of meaning, and it also shapes communities (Wenger, 1998).

In concordance with the literature on social memory (see Section 3) both interviews and questionnaires revealed that oral communication is the most important means of transmission of ecological practices and knowledge in allotment gardening.

The first survey revealed that 57% learn about management practices during daily talks with other gardeners within the allotment garden, and 18% learn about gardening primarily by talking with external experts (Surveys A–D, see references). Newcomers tap into the community of practice primal through conversations with experienced neighbors, and through teaching by appointed mentors. Among allotment gardeners, 57% think that learning from older and more experienced gardeners is the most important mean for transmission of garden related knowledge and practices (Survey E).

> "I talk to older gardeners, especially my 85 year old neighbor, who has the longest experience from growing plants here"

Table 2
Social–ecological memory identified in the study than retain and transmit practices, knowledge and experiences for managing ecosystem services in allotment gardening.

Participation		Reification		External sources
Rituals/habits	Oral communications	Rules-in-use/metaphors	Physical forms/artifacts	Artifacts, laws, social networks
Management of the commons (spring/fall)	Conversations with relatives	Property rights	Architecture of chalets	Magazine *"Kolonisten"*
Childhood experience of imitating adults	Daily small talk in the gardens	Norms of justice and democracy	Form, plants and size of garden plots	Other garden magazines
Parties	Coffee breaks	Choice of traditional plants	Form, plants and size of commons	Garden-books
Trial-and-error gardening	Negotiations	Proportion of vegetables and fruits	Booklets	Internet
Mimicking practices of neighbors	Dialogues	Informally protected species	composts	TV-shows
Exchange of seeds and plants	Listening to people with experience	Exclusion of pesticides	Nesting-boxes, bird-baths, bee-hives, etc.	Organizing into unions
Funeral-rituals	Board meetings (internal)	Organic soil fertilization	Documented meetings	Social networks of individuals
	Active teaching of less experienced neighbors	Internal rules of conduct	Instruments/tools	Legal frameworks
		Phrases/sayings		Garden trade fairs
		Sense of place		Garden courses
				External board meetings

(Respondent 3)

Participation also includes sharing of seeds, plants and recipes. The study revealed that 56% of the respondents share seeds with their neighbors (Survey E).

"We acquire many of the plant species through exchange with each other"

(Respondent 8)

Imitation of practices is another important habit for transmission of practices related to gardening. Results of the second survey (E) reveal that 86% of the respondents have personal childhood memories of watching adults as they were tending gardens.

"I learned it during the 50 s. There was no one special that thought me. I just came a long and imitated what others where doing, and sometimes I just asked"

(Respondent 15)

Imitations of practices continue as people develop into knowledgeable allotment gardeners. People are observing and mimicking each other as a way of developing new skills (Respondents 1–16).

"One of my neighbors had an enormous amount of lice on a plant and he went around the garden to collect ladybirds which he placed on the plant. The ladybirds started to feed on the lice at once"

(Respondent 4)

As participation in allotment gardens includes inter-relational processes not only between people, but also between people and other organisms and the land, individual trial-and-error practices generate experiences in individuals and modify ecological practices, which may or may not be transmitted via mimicking or oral means to others. Gardeners monitor how local ecological processes, plants and various organisms respond to their management practices (Respondents 1–16).

"I learn about how the garden changes by daily trial-and error practices"

(Respondent 3)

"It is not possible to grow potatoes on the same plot every year. You have to shift every 3-4 years to avoid soil-fungus. To re-generate the soil I shift with peas of different varieties."

(Respondent 5)

Participation is also reflected in self-organized collective meetings, rituals, parties and other repeated social gatherings (see Table 2). Democratically elected boards of allotment gardens hold on-going meetings during the year. They negotiate about how to run the association, such as how to handle rule breakers, or how to distribute labor of the commons, about water issues and how to deal with landholders. There are yearly compulsory collective rituals for all gardeners. Included is the compulsory spring/fall management of the commons (Respondents 1–16; Survey E).

4.2. Reification

Participation organizes itself around *reification* because it always involves artifacts, phrases, objects and concepts that allow it to proceed (Wenger, 1998). Reification is abstractions conceived as *things* and functions as shortcuts to communication. It carries memory beyond participation, for instance through phrases or metaphores used among allotment gardeners to recollect local ecological dynamics (Respondents 1–20).

"I wait to plant the one-year's tilĺ after *The Iron Nights*" [2]

(Respondent 11)

In allotment gardens reification processes load the place with shared histories of on-going learning and negotiation about meaning, and results with time in an emotional attraction to place. Continued labor and participation deepen the sense of place further (Norton and Hannon, 1997; Andersson et al., 2007). Sense of place is often expressed as emotions and coherence linked to the allotment garden (Interviews 1–16).

[2] '*The Iron nights*' according to Swedish folklore, is nights in the beginning and the end of the summer, which is particularly exposed to night frost. According to sayings, they occur at different dates in different parts of the country (Nordisk, 1910).

"This place is like an oasis for my soul"

(Respondent 13)

Artifacts, such as documented board meetings and booklets with photographs are other examples of reification processes in allotment gardens. Moreover, physical forms such as cottages, hedges, nesting-boxes, vegetable plots, fruit trees as well as flowers are all central for retaining ecological practices and knowledge (Table 2).

"The value of putting up nesting-boxes is that the small-birds, mainly Great tits and Blue tits, feed on the insects in the apple-trees".

(Respondent 7)

The second survey (E) revealed that 40% of the respondents have plants in their garden that originate from family members or friends that have passed away.

"These wild strawberries are from the garden of my father. It is wonderful to have something like that to remind me of him"

(Respondent 8)

Rules-in-use or institutions (Ostrom, 1990; North, 1994; Colding and Folke, 2001) are points of focus around which gardeners can organize negotiation of meaning. For instance, the spatial size and form of cottages as well as the appearance of garden plots are determined by strict self-organized rules.

"About the gardening rules, it is the board of this association that sets them. Once a year the board surveys all garden plots and if rules have been broken the garden holder may ultimately be thrown out"

(Respondent 7).

The rules-in-use provides social structure for participation, including norms for cooperation and decision-making. The gardeners themselves decide on how to organize management of allotment gardens, and allotment associations commonly enforce their own rules. Individual allotment holders are organized in associations, with elected chairmen and committees, and the individual plot holders share obligations and regulations for the management of the whole area (commons), but manage their own plot relatively independently within the rules-in-use. Members have equally sized plots and property values are determined by educated and appointed members[3] of the allotment union[4].

There are also rules-in-use that guide behavior towards the ecosystem. For example, informal norms to exclude pesticides and synthetic manure are strong, and 93% of the gardeners follow this ethic (Surveys A–D). Plants can be chosen freely, with exceptions of few plants that are prohibited by law. However, there are norms that urge garden holders to grow vegetables, fruits, berries and traditional flowers (e.g. Respondents 6, 9, 12, and 13). These norms are evident since 91% of the gardeners *feel* that their neighbors want them to act in accordance with these norms (Surveys A–D).

"One third of the garden should be used to grow vegetables...you can not use pesticides that could harm bees, bumblebees or other pollinators"

(Respondent 9)

There are also rules-in-use that include protection of pollinator species and small birds, as well as many other species (Respondents 1–16).

We have also identified sources of social–ecological memory (Table 2) related to gardening that we choose to characterize as 'external sources of support', since they exist outside the borders of individual allotment gardens. Social networks, written accord and laws are examples that will be elaborated on below.

4.3. External sources of social–ecological memory

Historically, the allotment movement mobilized its members to organize into unions with the aim gain power relative to state officials and private entrepreneurs. Until 1920 the allotment movement was dependent on voluntary work by small number of champions. 1921 City officials intended to cut down the number of allotments in Stockholm with 80%, so as to free land for modernization. The response of the allotment gardeners was the formation of a nation wide network of allotment associations and politicians, which successively gained power. The organization was named the Swedish Allotment Union, and it has been aiding individual allotment associations ever since (http://www.koloni.org/pdf/01.pdf).

The Swedish allotment union[5] (www.koloni.org), and its regional compartment, the allotment union of Stockholm[6] (www.fssk.se) are considered the most important external organizations for keeping the allotment movement going (Survey E). Most allotment associations are members (Respondent 17) and the unions provide garden courses, print and distribute a magazine on gardening, and facilitate relations with authorities.

The magazine called "The allotment garden"[7] is published by the Swedish allotment union, and is an example of written accord and media as part of social–ecological memory (Table 2). This magazine has a circulation of 30,000 and focus is on gardening, on environmental issues and related science, and on what is going on in this social movement (www.koloni.org). It has five editions yearly and it is used by 77% of the gardeners when reading about horticulture.

"I read '*The allotment garden*' and many books about horticulture"

(Respondent 9)

Gardeners also read other garden- and horticulture-related magazines and books (Respondents 1–16, Survey E). Besides retaining and modifying garden practices, it is reasonable to think that books and magazines, TV-shows, and articles in newspapers about allotment gardening provide both social support and a broadened public acceptance.

External support lies also to a large degree in individual relations to people in other organizations, e.g. through social networks (Lin, 1999; Bodin and Crona, 2009). For instance, board members are directly engaged with boards of other allotment gardens (Table 2), with which they attend regular meetings on a yearly basis (Respondent 6; Survey E), and our study reveals that some individual gardeners are prepared to use contacts in their personal networks in politics and media for creating support and public acceptance for allotment gardening (Survey E, Respondents 18–20).

Such personal relationships and experiences from organizations outside allotment associations constitute weak links in social networks (Granovetter, 1973), which are important for assessing various kinds of resources for communities, including social capital (Lin, 1999; Bodin et al., 2006a,b). An example of the importance of mobilizing social networks was when the National Railway Company planned to expropriate land on one allotment garden.

[3] [*Swe.* Värderingsmän].
[4] [*Swe.* Föreningen Storstockholms Koloniträdgårdar].
[5] [*Swe.* Svenska förbundet för koloniträdgårdar och fritidsbyar].
[6] [*swe.* Föreningen Storstockholms koloniträdgårdar].
[7] [*swe.* Koloniträdgården].

Table 3

Rights	Owner	Proprietor	Claimant	authorized user	Authorized entrant
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X		
Exclusion	X	X			
Alienation	X				

Then weak network links that extended far beyond the borders of the allotment garden were proven essential. The Railway got legal permission to construct in and around the allotment garden despite that this area is situated within the boarders of a protected urban park of national interest (the National Urban Park). Over 100 trees were cut down in a nearby wetland, which was also drained. The protective law was obviously not followed in practice, which indicated that a number of individual garden plots in the allotment area were threatened at this point. One key individual, who also was the head of the allotment board, then used her personal contacts and experiences of media to respond to this crisis. Articles were written and opinion was created and the tiny little allotment garden finally won the struggle against the National Railway Company (Respondents 18–20). This example illustrates that personal contacts are important for protection of urban green space and that there potentially are a vast diversity in responses to challenges imposed by external driving forces (Survey E).

Another type of external support is the law (Table 2). In Stockholm, the legal framework that allows allotment gardening is leasehold from municipalities. Land used for allotment gardening represent *proprietorship* (Table 3), a property right where management rights to land and/or natural resource(s) are in the hands of an identifiable community or group of users that may craft their own *rules-in-use* for management of land within given legislations (Ostrom and Schlager, 1996). Allotment areas may also be embedded in other protective laws, as two allotment gardens in our study area are located within the borders of the National urban park (Barthel et al., 2005). Some allotment areas in Stockholm also receive protection in law because they are contained within the borders of nature reserves (Colding et al., 2006).

Table 4
Interviews.

Respondents	Date	Area
1. Female gardener	2003/05/28	Allotment of Söderbrunn
2. Female gardener	2004/06/16	Allotment of Söderbrunn
3. Male gardener	2003/05/28	Allotment of Söderbrunn
4. Female gardener	2004/07/01	Allotment of Söderbrunn
5. Male gardener	2004/08/30	Allotment of Söderbrunn
6. Female gardener	2003/09/18	Allotment of Barnängen
7. Male gardener	2004/05/11	Allotment of Barnängen
8. Female gardener	2004/05/11	Allotment of Barnängen
9. Female gardener	2004/05/27	Allotment of Barnängen
10. Male gardener	2004/06/22	Allotment of Kvarnvreten
11. Female gardener	2004/06/22	Allotment of Kvarnvreten
12. Male gardener	2004/06/22	Allotment of Kvarnvreten
13. Female gardener	2004/06/17	Allotment of Kvarnvreten
14. Male gardener	2005/09/05	Allotment of Stora Mossen
15. Female gardener	2005/09/06	Allotment of Stora Mossen
16. Female gardener	2005/10/09	Allotment of Stora Mossen
17 Female gardener [telephone]	2005/10/24	Föreningen stor stockholms koloniförening FSSK
18. Female gardener	2007/06/04	Allotment of Söderbrunn
19. Female gardener	2007/06/13	Allotment of Söderbrunn
20. Male gardener	2007/09/16	Allotment of Söderbrunn
21. Female employee	2005/05/16	City Park of Vanadislunden
22. Male employee	2005/05/20	City Park of Humlegården
23. Male employee	2005/04/27	City Park of Enskedeparken
24. Male employee	2005/05/18	City Park of Rålambshovsparken
25. Woman	2005/06/20	Head city gardener of Stockholm

Table 5
Surveys.

Survey	Date	Place	Nb. respondents	Response freq (%)
Survey A	2004/04	Allotment of Söderbrunn	190	82
Survey B	2004/04	Allotment of Barnängen	42	67
Survey C	2004/04	Allotment of Kvarnvreten	110	54
Survey D	2005/05	Allotment of Stora mossen	192	69
Survey E	2007/03	Allotment of Söderbrunn	190	56

(Table 3). Bundles of property rights associated with positions (Ostrom and Schlager, 1996). The five property rights in the table are independent of one another, but are frequently held in the cumulative manner arranged as shown. They include the rights of *access, withdrawal, management* (the right to transform the resource by making improvements); *exclusion* (the right to determine who will have an access right, and how that right may be transferred); and *alienation* (the right to sell or lease) (Tables 4 and 5).

5. Discussion

The results reflect that social–ecological memory related to allotment gardening in the Stockholm urban area is an emergent process that emanates from communities-of-practice and place, and that memory of such communities is embedded in a wider social milieu.

5.1. The dynamics of social–ecological memory in allotment gardens

Allotment gardens hold most of the characteristics described for communities-of-practice (Wenger, 1998), such as mutual engagement, shared jargon, enterprise and repertoire, which includes routines, words, tools and stories by which members create meaningful statements about the world. They constitute social arenas for local on-going processes of learning and negotiation, which continually create shared histories. Participation here is a source of collective remembering, as described in the result section, and also of building identities, trust and social networks. Participation that carries ecological practices and knowledge is about engagement not only with people, but also with place, objects and ecosystems (Murdoch, 2006), which generate depth and horizons of lived experience of place. Participation in urban allotment gardens includes oral communication, which corresponds to findings in rural community-based conservation where convincing points are made about the role that oral communication plays for transferring ecologically sound practices (Berkes, 1999; Berkes and Turner, 2006; Pilgrim et al., 2007). But in addition to this literature our study shows that participation also includes designing and tendering the garden, and which results in reification processes, the production of things (at least these are perceived as things), which persist such as trees, cottages as well as booklets and metaphors (Wenger, 1998). These things carry practices and knowledge about gardening, and thus are part of social–ecological memory.

How does such 'things' carry knowledge and practices? In allotment gardens, physical objects are products of past participation. This includes sizes and forms of the individual gardens; chalets and garden landscapes, and it influences on-going practices and relations. For instance, the open character of the allotment gardens, with few hedges or fences enables gardeners to engage in spontaneous daily conversations and mimicking of management practices. Chalets are incentives for gardeners also to garden on rainy days. Fruit trees, raspberry hedges and flowers inherited

from relatives all demands special treatment. In this way the garden transfers practices. The gardeners tend to hold on to the spatial characteristics of their places since these give them opportunities to engage and bond (Respondents 1–16). Moreover, this spatial form also directly influences ecological processes, such as pollination, since informal rules also constrain choice and design of plants. In Stockholm, gardeners often tender hedge-plants that increase the quality of habitats for pollinating insects, such as raspberry hedges (Surveys A–D). These examples illustrate that part of the social–ecological memory are to be found in the gardens as physical objects.

Rules-in-use are also perceived as things, and feed back on participation. In allotments there are both rules-in-use concerning social conduct, as well as those concerning practices towards the ecosystem. The rules-in-use of social conduct seem to originate from the establishment of the social movement of allotment gardening (Lindhagen, 1916), while those concerning engagement with garden ecosystems in general seem to originate from the millennia old Eurasian garden culture (Crumley, 1994, 2000), but perhaps modified during centuries of allotment gardening (Respondents 8, 14 and 15; Lindhagen, 1916). Examples of rules-in-use concerning engagement with ecosystems are protection of wild bees and small birds. For instance, on all allotment areas in this study, gardeners chose some flowers with the only intent to feed pollinators and many improve nesting opportunities for wild bees. Unknown by management authorities in Stockholm (Respondents 21–25), these informal rules support the abundance of wild bees and the ecosystem service of pollination (Andersson et al., 2007), not only within individual gardens, but also over much larger areas of the urban landscape (Osborne et al., 2001; Greenleaf et al., 2007). The enhanced pollination service feeds back to the gardeners, since pollination underlies the generative capacity of flowers, fruits and many vegetables, which are of prime concern for gardeners. It becomes a positive feedback cycle as continued participation in these gardens reproduces these rules, via oral means (Knight, 1997; Mahoney, 2000), and ecological practices are hence carried through time by rules-in-use.

New types of information are dynamically interwoven with social–ecological memory, and there are potentials for combining and recombining it, adding and filtering influences, as well as transferring it in time and space (Folke et al., 2003). Although social–ecological memory may be rather inert as described above, it is simultaneously constantly metamorphosed (Nazarea, 2006), not only because we forget and remember partially, but also because our forms of participation change, our perspectives change, and we experience life in new ways. Participation with local ecosystems is constantly modified. Practitioners adjust to everyday multiple subtly differing situations and incorporate, by monitoring ecological feedbacks, many small, almost imperceptible variations that a constantly changing context creates (Scott, 1998; Agrawal, 2002). As a result any practice must be revived and reinvented, even as it remains 'the same practice'. Also, fast-acting external carriers of information (e.g. media and gardening magazines, including scientific knowledge), continuously modify ecological practices and knowledge.

Reification and participation function as distinct but interrelated modes, as a dual process, which with time generate a 'living library' that retains and creates ecological practices and knowledge. Social–ecological memory allows gardeners to proceed without needing to know everything, and it helps newcomers to join the community by linking into retained practices, reviving and reinventing them (Wenger, 1998; Stein, 1995; Berkes and Folke, 2002; Nazarea, 2006).

Based on the findings we propose that the social–ecological memory is a resilient and evolving feature of the urban garden communities that is both emergent and persistent (Wenger, 1998; Folke et al., 2003). Part of the ecological knowledge and practices embedded in this garden memory seem to be tacit knowledge expressed in habits and behavior to fit particular environmental situations (Freeman and Ray, 2001). According to Leonard and Sensiper (1998), tacit knowledge is not passive knowledge but an essential feature of group creativity. Collective tacit knowledge is developed communally, over time, in interactions among individuals in the group, cultivating informal shared use of behavioral norms and implicit ways of working and learning together. Furthermore, Leonard and Sensiper (1998) stress that a firm's success depends not only on the skills and knowledge at any given point in time, but also on "*memories*," the intangibles of collective business experience, triumphs and failures, culture and vision. We propose also that in urban allotments, the success of gardening partly lies on features that carry, transmit and revive tacit knowledge, namely on social-ecological memory.

Most urban landscapes today are characterized by traffic congestion, population growth and the privatization of public domains (Harvey, 1996; Carley et al., 2001; Fyfe and Kenny, 2005; Lee and Webster, 2006). These processes pose tremendous pressure on urban ecosystems (Collins et al., 2000; Grimm et al., 2000; Kinzig and Grove, 2001; Alberti et al., 2003; May, 2004), and contest for open space is intensifying. This development poses a major threat to allotment gardens in Stockholm, which in isolation would be powerless spectators in relation to the strong driving forces of urbanization. Since social–ecological memory partly lies in the gardens themselves, as described above, it could dissolve from urban landscapes. Therefore, external sources of support are paramount for empowering individual allotment gardens as part of social–ecological memory in urban landscapes.

In contrast to the situation for many so called 'community gardens' in the U.S. where leaseholds usually only are on one-year basis, leaseholds of allotment gardens in Stockholm are usually written on long-term basis. Renewable leaseholds up to 25 years between a local allotment association and the local municipality are common in Stockholm. These long-term leaseholds enables allotment gardens to freely self-organize, and to invest in physical structures and in perennials, such as fruit trees. Fruit trees are not found in gardens with short term leaseholds (Colding *In press*.), which illuminates the role of property rights for investing in physical objects that may carry with them ecological practices, as described previously, and hence the role of property rights for the emergence of social–ecological memory. Long-term engagement in local ecosystems is crucial for addressing ecosystem processes underlying the generation of many services, as discussed in the coming section.

5.2. General aspects of social–ecological memory for management of ecosystem services

Social scientists emphasize the role of social memory in relation to meaning and identity of individuals and groups (Halbwachs, 1926 [1950]; Misztal, 2003), as well as its role for promoting trust between people (Rothstein, 2005). Hence, social memory has got bearing as concept for explaining collective action in groups and movements (Gongaware, 2003). It has been suggested that sustainable management and governance of social–ecological systems call for a complexity approach, and that the time for "blue-print management" is over (Holling and Meffe, 1996; Ostrom et al., 2007). This paper agrees by suggesting that time is ripe for illuminating the role of social–ecological memory, as carrier of knowledge and practice, in co-evolutionary processes between people and nature (Norgaard, 1994).

A sustainable flow of desirable ecosystem services depends on the resilience of social–ecological systems (Berkes et al., 2003), referring to the capability to absorb change and surprise, utilize it,

reorganize and continue to develop without tipping over critical threshold to alternative trajectories, where desired ecosystem services no longer are produced (Carpenter and Folke, 2006). According to Carpenter et al. (2001) management needs to address slow changing ecosystem processes, for instance nutrient content in soil or water, because those are of significance in relation to thresholds. In this context, social–ecological memory as carrier of practices and knowledge becomes important, since memory also is a slow moving feature in social–ecological systems and it has potential to carry experiences from the distant past. Scholars have up to this point largely been unable to understand the role of social memory for carrying traditional- or local-ecological knowledge (Berkes and Folke, 1998; Olsson and Folke, 2001; Pilgrim et al., 2007), and its role to carry practices that addresses place specific and slow changing ecological processes (Tengö and Hammer, 2003). Muchagata and Brown (2000) touch upon the role of time depth when they describe that newly arrived colonists in eastern Amazonia rapidly develop detailed knowledge about resources, but remain ignorant of ecological processes underlying these resources. Knowledge about such processes is related to the length of settlement, they argue. Ballard and Huntsinger (2006) arrive at a similar conclusion, as they detect time dependent differences in relation to knowledge about ecological processes among forest harvesters in the Pacific Northwest. People's interpretation of how ecosystem processes respond to their practices seems dependent on the length of the retained experiences. This is interesting, but what these authors miss are the ways that social–ecological memory store and transmit experiential knowledge and practices between people and forward in time.

However, we are not proposing social memory as a 'panacea' for ecosystem management since history has shown that social memory also can be mal-adaptive to local and regional ecosystem dynamics (McGovern, 1994; Holling and Meffe, 1996). Mal-adaptive social memory may lead into dire straits, since individuals have a tendency to lock into one of several interpretations of reality, and to the same behavior as peers in the same group. Historically this has led to increased rigidity and to clinging on to mal-adaptive structures and habits as a response to crises, reducing the chance for innovative change (Scheffer and Westley, 2007). Horticulture has however slowly co-evolved with regional circumstances in Europe for thousands of years (Crumley, 1994). Drawing on the notion that acquisition of practices typically follows resource crises (Folke et al., 2003; Berkes and Turner, 2006) in combination with the dynamic learning of communities-of-practice (Wenger, 1998), it is reasonable to hypothesize that traces of experiences about slow changing ecosystem variables and critical thresholds are retained in social–ecological memory of horticulturalists, including allotment gardeners. Our results indicate, however, that gardeners often seem ignorant of the ecological significance of some of their practices (Respondents 1–16). Examples are the protection of- and the habitat improvement for insectivorous birds, which is common in allotment gardens. These practices increase abundance of many bird species and support the ecosystem service of pest regulation (Franz, 1961; Mols and Visser, 2002; Sekercioglu et al., 2004; Ellis et al., 2005; Andersson et al., 2007). In so called habit memory (Misztal, 2003; Nazarea, 2006) these management practices are tacitly carried forward in time, supporting small birds that regulate disturbances acting on longer time scales than those perceived by most gardeners, which are a couple of decades at the most (Andersson et al., 2007). These aspects of social–ecological memory are ecologically important particularly during times of disturbance events, such as pest outbreaks. It seems like allotment gardeners engage in reducing risk and preparing for up-coming disturbances even though it lies in the subconscious, beyond the cognitive and rational. This tacit aspect of social–ecological memory embodied in habits and linked to social–ecological resilience demands further investigation in relation to ecosystem services. It may well be as important for management of ecosystem services as the parts of memory that managers are aware of and rationally discuss (Smith and Wishnie, 2000; Berkes, 2007).

6. Conclusion

Civilization is entering an urban millennium (Annan, 2000). Within decades about 2/3 of the global population will live in cities (UN, 2008). Broad-based public support for dealing with global environmental challenges requires that people connect to their interdependence with nature. Studies in environmental psychology have shown that ecologically impoverished metropolitan areas add to an increasing 'environmental generational amnesia' among city dwellers (Kaplan et al., 1998; Miller, 2005). Urban people that do not experience nature early and regularly are less likely to develop sentiments to motivate stewardship of ecosystem services (Kaplan et al., 1998; Rosenzweig, 2003).

In this context, planning for sustainability needs to take green spaces seriously into account in urban landscape designs (Colding, 2007) and consider that the places where urban people live and work should offer meaningful opportunities for interacting with nature (Theodori et al., 1998; McDaniel and Alley, 2005). Urban gardens managed collectively, such as allotment gardens or community gardens, are examples of such places. For instance, studies in Britain have showed that citizens monitor and learn about climate change by recording seasonal events in their gardens (Lawrence, 2009), and in rural France gardens serve as learning places about local ecology (Crumley, 2002). In urban Stockholm, we have found that allotment gardens are like dynamic libraries of social–ecological interactions that provide fertile soils, flowers and vegetables, and also ecosystem services like pollination and pest regulation that spill over into the broader urban landscape.

In this study we have focused on the social–ecological memory of such gardens and shown its significance to the capacity for managing ecosystem services. We have investigated where and how ecological practices and knowledge are retained and transmitted by the garden communities, and their associated reification processes that results in artifacts, rules-in-use and the structures of the gardens themselves. Based on our results, we propose that allotment gardens serve as "pockets" of social–ecological memory in urban landscapes, contribute to the generation of ecosystem services and counteract ecological illiteracy. Without such physical sites forgetting ensues and social–ecological memory (Halbwachs, 1926 [1950]; Misztal, 2003) and with it the experiences of stewardship of ecosystem services could easily dissolve.

Urban history teaches us that allotment gardens have been sources of local resilience during periods of crisis. For example, during World War I allotments played a crucial part in supplying city people in Britain with vegetables. The number of allotment gardens surged from 600,000 to 1,500,000. By 1918 allotment gardens had provided 2,000,000 tons of vegetables (House of Commons, 1998). Allotment gardens were planted in parks and sports fields, and even Buckingham Palace turned up the earth near the Queen Victoria monument to grow vegetables as part of the *Every Man a Gardener Campaign* (Crouch and Ward, 1988; House of Commons, 1998). After the war the number of allotments declined abruptly. World War II sparked a new explosion in the numbers of allotment gardens, very similar to the campaign of World War I. Such boom and bust cycles of

urban allotment gardening in relation to the world wars provided relief to people in urban areas all over the western world (Basset, 1979; Gröning, 1996; http://www.koloni.org/pdf/01.pdf). A recent example of urban gardens as sources of resilience is found in Cuba. The collapse of the Soviet Union caused a catastrophic shortfall of food availability, especially among urban populations. Ten years after the collapse 400 horticulture clubs were found in Havana alone, and these produced 8500 tons of vegetables, 7, 5 million eggs and 3650 tons of meat by ways of organic farming practices (Altieri et al., 1999).

Here, we have found that allotment gardens in Stockholm operate as communities-of-practice, where participation and reification interact and social–ecological memory is a shared source of resilience of the community by being both emergent and persistent. It is in this context that the social–ecological memory of urban gardens is of significance, as it carries experiences of practice and local knowledge contributing to ecosystem services in the broader urban context. The memory of ecosystem stewardship is a reflection of the interactions of the community with the places in which the gardening is performed. We conclude that stewards of urban green areas, like those engaged in allotment gardens, and the social memory that they carry may help counteract further decline of critical ecosystem services.

Acknowledgments

We would especially like to thank Carole Crumley and Francis Westley for pointing out directions of explorations into the human domain. We also thank The Swedish Research Council Formas for funding this research.

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