The generation of ecosystem services in urban gardens from a socio-ecological systems perspective

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Short report

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Abstract

This report reflects upon my Short-Term Scientific Mission conducted as part of the COST TU1201 on allotment gardens at the Stockholm Resilience Centre, Stockholm University, Sweden, between April 1 and June 30, 2014. In this study, urban gardens are approached as coupled social-ecological systems. Urban gardens provide manifold ecosystem services to gardeners and city inhabitants. to examine both social and ecological garden characteristics favoring the production of ecosystem services. Along a case study of municipal and squatter gardens in Barcelona, Spain, social-ecological garden characteristics were assessed through qualitative research methods. In a second step, gardens were clustered with regard to the ecosystem services they provide. Results show clear differences between the types of ecosystem services provided in different gardens. For example, gardens run with an allotment structure of individually tendered plots are better apt for food supply. In contrast, collectively managed gardens stronger serve individual and social fulfillment and realization. Based on the results I discuss the interplay of social and ecological factors for the production of ecosystem services in urban gardens and generalize our findings. Exemplary, the provision of a wider bundle of property rights may increase the abundance and diversity of flowering plants and thereby enhance habitat and species diversity and pollination (again supporting the production of food). Integrating such holistic perspective of human-nature interrelations into urban green infrastructure policies may allow for an active enhancement of ecosystem services, e.g. through co-management structures. More flexible institutional frameworks might permit and encourage the spontaneous emergence of community-based garden initiatives and the broad bundle of ecosystem services it brings with it.

Cover photo: Hort d'Avi, Barcelona (authors personal photograph)

1 Introduction

Urban gardens have been described as an important source for the provision of ecosystem services in cities (e.g., Hynes & Howe, 2002; Guitart et al. 2012). Beyond the production of food that played an important role at different places in various periods of history (e.g., Barthel & Isendahl 2013; Buchmann et al., 2009), urban gardens provide space for mental recreation (e.g. Kaplan, 1973), education (e.g., Doyle & Krasny, 2003), social cohesion (e.g., Armstrong, 2000) and enhanced place identity and sense of place (e.g., Andersson et al. 2007). A better understanding of dynamics behind the production of these ecosystem services is fundamental to sustain and improve them.

In this study urban gardens are approached as coupled social-ecological systems (Barthel et al. 2010). Under a social-ecological systems approach humans are understood as an integrated part of the ecosystems they act in, and puts emphasis on interrelations and feedbacks between social and ecological processes (Berkes et al. 2000). Applying a social-ecological systems' perspective, we, thus, assume that ecosystem services generated in urban gardens are co-produced by the interplay of social and ecological factors (Andersson et al. 2007).

Ecological factors behind the generation of ecosystem services include, for example, species abundance to guarantee seed dispersal and pollination (Andersson et al. 2007). Social factors include all types of garden practices and other direct human interaction with the garden environment. Further, social factors include formal and informal institutions (Ostrom, 2009: 18) affecting the practices and interactions within urban gardens. In this study a specific focus is put on the *bundle of property rights* gardeners hold in the gardens they tender (Ostrom & Schlager, 1996). Including 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)" (Colding et al. 2013).

The goal of this study is, to identify social-ecological factors favoring the production of ecosystem services in urban gardens. To this end, two specific objectives are pursuit: a. urban gardens are described based on various social-ecological characteristics; b. urban gardens are clustered with regards to the ecosystem services they provide. The study is centered on a case study of urban gardens in Barcelona, Spain.

2 Case Study Barcelona

Barcelona is located in Northeast Spain and one of the most densely populated cities in Europe with about 1.62 million inhabitants (IDESCAT, 2013). As in other cities, urban gardening and agriculture has a long tradition, and until the 20s century large inner urban areas were still under agricultural and horticultural land-uses (Barcelona City Council technician, oral statement). While agricultural activities declined, horticultural gardens kept emerging during the 20s century with a peak in the 1950s and 60s. The creation of these gardens followed a wider European trend of urban gardening by working class people for subsistence food production accompanying Spain's late industrialization. However, urban gardening in Barcelona under the Franco dictatorship did not develop into a larger gardening movement — as described for Northern and Eastern European countries (e.g. Barthel et al., 2005). Horticultural gardening also missed gaining a broader acceptance among larger parts of the urban society (Domene & Saurí, 2007). Nevertheless, many gardens resisted the continuous pressure from urban development and replacements (Huertas et al., 2004) and persisted until the end of the 20th century — geographically centered near the sea-port in the area of Montjuïc (Roca, 2000). Lacking a strong lobby these remaining working class gardens were finally

demolished in preparation of the Olympic Games in 1992 and replaced by parks, cultural and sports facilities (Roca, 2000). As such, the Olympic Games can be seen as the lower inflection point for urban gardening in Barcelona in the city's younger history. Notwithstanding, the emergence of urban gardens through occupation of waste land kept going on; now, often in form of community-based squatting (Domene & Saurí, 2007). In 1997, a public gardening program was established by Barcelona´s municipality devoting garden plots in shared gardens to retired person (Giacchè & Tóth, 2013). During the data collection to this study in 2013, a new program for interim uses of municipal wasteland started addressing the creation of horticulture gardens for social benefits (*Pla BUITS*; www.bcn.cat/habitaturba/plabuits).

In this study, I focus on 27 multi-beneficiary and multi-purpose urban horticulture gardens within the administrative boundaries of the Municipality of Barcelona. Other types of urban gardens, such as home, school or kitchen gardens, are recognized but excluded from my study due to the rather mono-purpose objectives they serve. After an initial screening, including personal visits, the newly emerging gardens under the *Pla BUITS* were also discarded from the assessment. Due to their embryonic stage they were not expected to provide useful insights to the goal of this study.

3 Research development, methods and material

The research has been developed and conducted during a Short-Term-Scientific-Mission (COST-action TU1201: Allotment gardens) at the Stockholm Resilience Centre, Stockholm University, Sweden, under close supervision of Professor Thomas Elmqvist.

3.1 Conceptualization & Collaborations

The study outline was discussed and adapted in weekly feed-back rounds with Professor Elmqvist. Additionally, I frequently arranged individual meetings with scholars from Stockholm Resilience Centre (SRC) (Dr Erik Andersson, Dr Stephan Barthel and Dr Maria Tengö) and visiting researchers at SRC with high expertise in urban gardens Professor Dr Parwinder Grewal from University of Tennessee, US, and Professor Dr Sarel Cilliers from North-West University, South Africa, and Dr Jakub Kronenberg from University of Lodz, Poland. The discussions with SRC-scholars, but especially with Professor Grewal, Professor Cilliers and Dr Kronenberg amplified my understanding on urban gardens in a European and global context.

Based on the close collaboration with Professor Grewal and Professor Cilliers during the STSM further collaborations are planned for the future (two publications have been proposed: the first as a city comparison for potentials of urban agriculture on green roofs and green walls at a global scale, the second to create a global classification of gardens with regards to the ecosystem services provided). SRC-scholars as well as Professor Grewal and Professor Cilliers stated their strong interest in further collaborations with the COST-action TU1201 on allotment gardens; following our meeting in Stockholm (April 29, 2014), Dr Kronenberg has already become member of the COST-action TU1201.

Besides, informal consultations with local and international scholars, I organized a series of group discussions, workshops and presentations. For example, an SRC-wide presentation on the study the initial outline of the study was held on April 14, 2014 during the institute's weekly stuff-meeting. The methodological as well as theoretical design received in-depth discussion during two PhD-courses that I attended as part of the STSM (a. Ecosystem services and economic

analysis: an introduction from an ecological economics perspective, April 22 – 29, 2014, coordinated by Dr Tom Green; b. Statistics for social-ecological systems approaches, June 12 & 18, 2014, coordinated by Dr Ingo Fetzer). Another presentation during the urban theme meeting June 12, 2014 as well as two group meetings under participation of Professor Cilliers, Professor Grewal and Professor Elmqvist, (June 10, 2014) and Professor Cilliers, Professor Grewal and Dr Barthel (June 16, 2014) were used to discuss the final results and a first outline of a manuscript for scientific publication to be elaborated following the STSM.

Beyond these activities, many other activities contributed to the overarching goal of this STSM (to apply a socio-ecological systems framework to assess the generation of ecosystem services in urban gardens) in a wider sense. For example, I attended a face-to-face discussion (myself and four other PhD students) with Professor Dr Carl Folke on the foundation of ecological economics and social-ecological systems thinking (May 22, 2014), I elaborated and presented a report on the integrated valuation of urban ecosystem services and evaluation of urban green infrastructure planning during an SRC-seminar (June 4, 2014), and I frequently attended other SRC-scholar's presentation to further get hold of the social ecological systems framework.

Besides the case study from Barcelona the STSM further embedded the coordination of chapter 5 of the COST TU1201-book on *Ecosystem services of urban gardens* of which I am the lead author. A detailed timetable including daily activities during the STSM is attached in Appendix IV.

3.2 Assessment and valuation of ecosystem services

Underlying to this study are the identification and valuation of ecosystem services provided by urban gardens in Barcelona. Results from the identification and valuation are presented in detail in an unpublished Master thesis by Marta Camps-Calvet. The identification and valuation followed a two-step approach consisting in a series of 44 structured interviews and a survey among 201 gardeners, respectively, in 27 urban gardens in Barcelona.
Interview partners were chosen from all gardens and consisted of experienced gardeners or leading persons in the specific garden project. During the interviews they were asked to determine the benefits co-produced by the social-ecological interactions in the garden, that is, to state the benefits they obtain from the garden and through the activity of gardening and interrelations in the garden. They were further questioned to characterize benefits the garden provides for the urban environment at different scales. Through a coding process, stated benefits were classified into different groups of ecosystem services, guided by the literature on urban ecosystem services (Bolund & Hunhammar, 1999; Gómez-Baggethun & Barton, 2013; TEEB, 2011). Where benefits described by gardeners did not match to established categories new categories for ecosystem services were introduced (Camps-Calvet, unpublished Master thesis).
The resulting classification of 20 ecosystem services is shown in Table 1. It has been used to value ecosystem services on a 5-point Likert-scale (Bernard, 2006) embedded in a survey. Survey participants were chosen across all 27 gardens and asked to indicate the agreement to an affirmative question indicating the importance of each ecosystem service in the garden they are tendering. For example, 'this garden is important to me because it provides high-quality food'.

In this study, values obtained from the survey were used to categorize different urban gardens with regards to the ecosystem services provided (see section 3.3). Coded interviews were used to examine social and ecological factors beneficiaries mentioned in relation to the production of

ecosystem services. This supports the explanation and interpretation of social-ecological interplays in the production of ecosystem services provided in the discussion section.

Table 1: Classification of ecosystem services introduced by TEEB, 2010

Provisioning services	Food Raw Materials Fresh water Medicinal resources
Regulating services	Local climate and air quality regulation Carbon sequestration and storage Moderation of extreme Events Waste-water treatment Erosion prevention and maintenance of soil fertility Pollination Biological control
Habitat or supporting services	Habitats for species Maintenance of genetic diversity
Cultural services	Recreation and mental and physical health Tourism Aesthetic appreciation and inspiration for culture, art and design Spiritual experience and sense of place

3.3 Assessment of urban garden characteristics

All 27 urban gardens were mapped based on orthographic photographs in the solution 1:5000 (obtained from the Catalan Cartographic Institute) using *Miramon* and *ArcGIS.* Mapping helped to determine garden locations and surfaces. Participant and non-participant on-the-ground observations allowed for a further social-ecological characterization gardens. The characterization was conducted along a check-list, including garden surroundings (like highways, parks, residential areas), structural elements (such as trees, compost, benches, shelters and the number of individual parcels), practices (land-uses, composting, plague treatment, joint gardening, educational activities, group activities etc.), institutions (management and governance structure, property, associations), and history (previous land-use, founding year and aim, development). The social-ecological characterization of gardens has been completed through a review of gray literature, such as web-information, newspaper articles, and an in-depth interview with two technicians from the Barcelona City Council's green space department (and in charge of the urban garden program).

3.4 Examining the production of ecosystem services in urban gardens

The statistical testing has been carried out under supervision by SRC-scholars Dr Ingo Fetzer and Dr Marco Campenni. Methods applied are based on the SRC-PhD-course by Dr Fetzer (June 12 & 18, 2014), which I attended as part of this STSM. from Gardens were grouped with regards to perceived importance of ecosystem services resulting from averaged Likert-scale rankings. The screening for groups of gardens included a principal component analysis (PCA), non-metrical dimensional scale (NMDS) approach, and a cluster analysis. All three approaches followed the principal objective to assess similarities and dissimilarities between the gardens in terms of ecosystem services provided. A further objective was the visualization of pairs or bundles of ecosystem services that are provided together or that exclude each other. Through

the superimposition of social-ecological characteristics obtained from observations, factors influencing the generation of ecosystem services were examined. All statistical testing has been carried out in RStudio using the 'vegan'-script developed by Oksanen et al. (2013).

4 Findings

Following the specific objectives, firstly, our findings provide a social-ecological characterization of urban gardens in Barcelona. Secondly, urban gardens are grouped with regards to the specific ecosystem services they provide.

4.1 Characteristics of urban gardens in Barcelona

The study focused on 27 urban gardens, distributed around the different districts of the city (Figure 2), the total surface of these urban gardens is approximately 48000 m^2, which means 0.047% of the total surface of the city. A main institutional differentiation of urban gardens is given by the "bundle of property rights" gardeners hold (Colding et al. 2013; Ostrom & Schlager, 1996). I identified 13 municipal gardens, administered and managed by Barcelona's municipality (*Ajuntament de Barcelona*) where gardeners hold a small bundle of property rights including the rights of *access*, and *withdrawal*. 13 gardens in our assessment are community-based squatted gardens and organized through loose (often informal) institutions and flat hierarchical structures. In these gardens, the bundle of property rights held by gardeners included *access* and *withdrawal*, among *management* rights and the right of *exclusion* (*cf.* Colding et al. 2013; Ostrom & Schlager, 1996). A singular case is *L'hort de l'Antic Jardí Botànic* that belongs to the Cultural Institute (*Institut de la Cultura*) and mainly is meant to serve the reproduction of autochthonous horticulture varieties. The garden is run by voluntaries organized in a formal association under professional guidance. The bundle of property rights held by the 20 gardeners includes *access, withdrawal*, and limited *management* rights. Table 2 shows important characteristics of all 27 urban gardens assessed in Barcelona.

4.1.1 Municipal gardens

Municipal gardens range in size between 443 and 9125 m^2 and are distributed across all districts of Barcelona. They are designed and managed as allotment gardens, i.e. each garden is divided into plots and each plot is tendered individually. The plot's surfaces range from 25 to 40 m^2 given between 7 to 51 plots per garden. Plots are exclusively provided to retired people above an age of 65 years, with the exception of one or two plots per garden reserved as shared gardens for associations and schools working with people or students at risk of social exclusion. Overall 384 beneficiaries are estimated to directly benefit from municipal gardens.

In general, common horticulture plants are cultivated, including tomato, lettuce, pepper, eggplant, carrot, cabbage, onion, strawberry, spinach, cauliflower, beans, and potatoes. Differences in varieties are small since seeds and seedlings are mostly obtained from commercial distributers. Some exceptions observed included varieties of potatoes, beans and tomatoes, introduced by migrant gardeners from their regions of origin (most gardeners are migrants from other regions of Spain, who migrated to Barcelona between 1940 and 1980).

A common rule is the prevention of pesticide, herbicide and chemical fertilizer uses and the implementation of organic horticulture practices. Although there no formal sanction mechanism is given, the rule is widely followed and enforced through informal control mechanisms between gardeners. Although common activities, such as joint work, fests, and assemblies are rare, a continuous exchange of practices (e.g., in the use of manure), and varieties (e.g., a succesfully

introduced pea-variety was quickly adopted in the neighboring plots) takes place between gardeners.

The garden management is undertaken by the municipal green space department creating strong similarities between the garden's built facilities, including individual composts for each plot, relaxation areas with tables, benches and chairs, lockers, bathroom, tools, water dispensers and water supply. The green space department shows also responsible for all green patches not included in the horticultural plots. They mainly consisting of small patches with highly managed shrubs and lawns, in some gardens complemented by fruit trees, herbal or flower beds.

The foundation of gardens by the Municipality started with *Masia Can Mestre* in 1997. It followed the example of the long-term tolerated garden *Hort de l'Avi*, resulting from a community-based occupation. The *Hort de l'Avi* is, to our knowledge, the only horticultural garden in Barcelona that persisted urban transformations in the course of the Olympic Games in 1992. Today, it is fully integrated into the red of Barcelona's publicly managed urban gardens, with a slightly broader bundle of property rights for the garden founders.

Figure 1: Map of multi-functional urban gardens in Barcelona

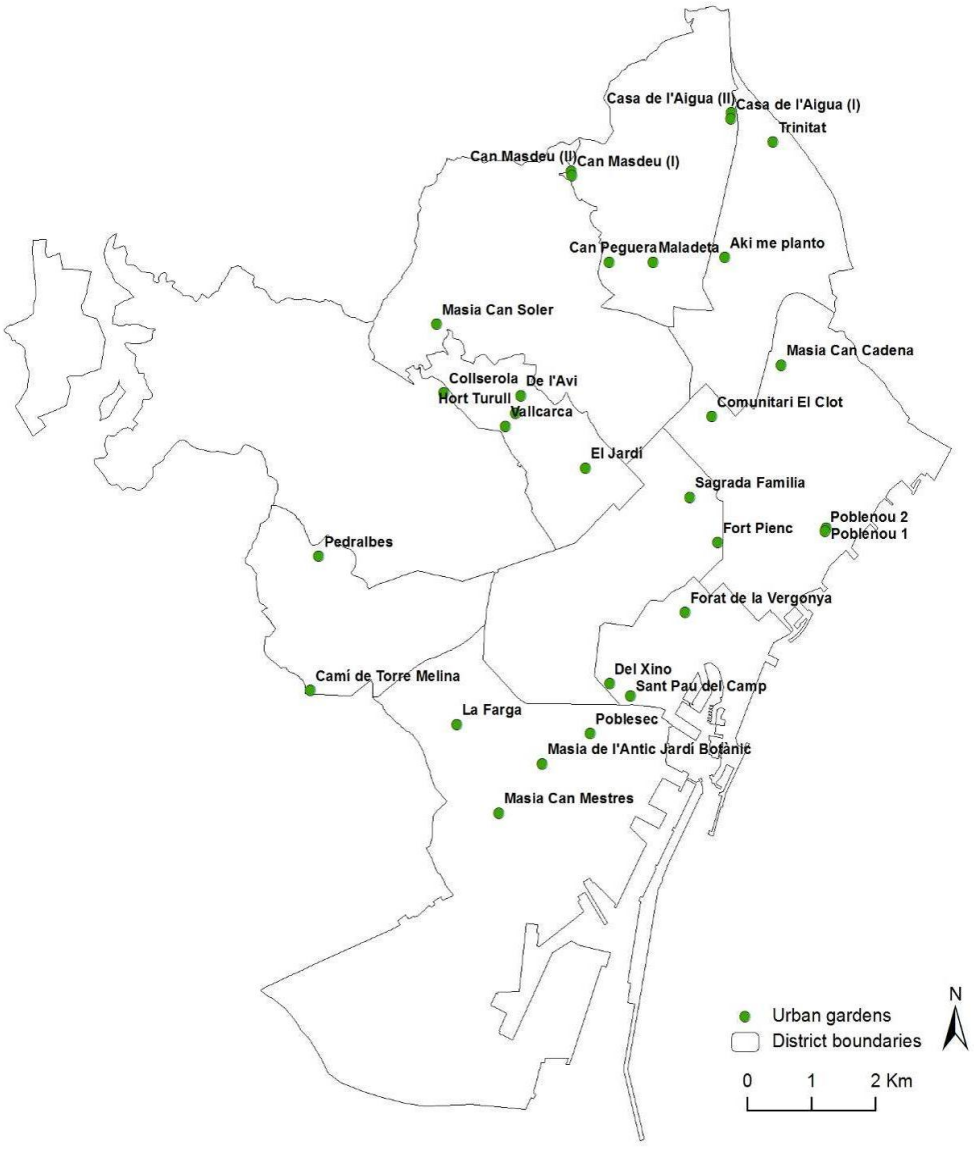

Table 2: Example of urban garden characteristics

(COST-TU1201 members are invited to contact me in order to obtain the full table)

Property regime	Linked to organization	Type of management	Approximately number of workers	Urban garden	X	Y	District	Surface (m²)	Number of cells	Foundation year
Municipal	Xarxa d'horts urbans de l'ajuntament de Barcelona	Allotment	384	Masia Can Cadena	433025,71	4585948,32	St. Martí	2722	25	2003
				Masia Can Mestres	428593,8	4579287,53	Sants-Montjuïc	9125	51	1997
				Masia Can Soler	427654,7	4586553,96	Horta-Guinardó	2288	22	2003
Squatted	Xarxa d'horts urbans comunitaris Barcelona			Comunitari El Clot	431944,03	4585186,27	St. Martí	148	1	2009
				Del Xino	430359,14	4581241,69	Ciutat Vella	600	1	2009
				El Jardí	429963,67	4584438,76	Gràcia	1056	1	2013

4.1.2 Squatted gardens

The size of squatted gardens is similar to those established by the Municipality, ranging between 274 and 6690 m² each. The number of gardeners ranges between five to ten in smaller gardens like *Forat de la Vergonya*, *Hort del Poble Sec* or *Hort del Xino* to over 50 gardeners in *Can Masdeu*, or the twin-garden *Poble Nou I* and *Poble Nou II.* An important difference between smaller squatted gardens and larger once is given by the management, namely if all plots are tendered collectively (community garden structure) or if gardeners tender individual plots (allotment garden structure).

A similar mix of horticulture cultivation as described for municipal gardens can be observed in squatted gardens managed in an allotment structure. However, the amount and variety of herbal, medicinal and ornamental plants cultivated in squatted gardens is larger than in their municipal pendants. These plants are usually cultivated at limits between individual plots or in collectively tendered areas. In squatted gardens that are fully tendered collectively the percentages of the total area used for the cultivation of (eatable) horticulture plants are smaller than in garden with allotment structures.

Some squatted gardens use high-beds due to known or suspected soil pollution, for example *Hort del Xino*, which reduces the available space for horticultural cultivation. Gardeners also widely stick to organic horticultural practices, including the use of manure and composted organic waste for fertilization, and various specific techniques for the prevention and treatment of pests and plagues, e.g. combination of plant species. Many gardeners also experiment with gardening techniques inspirited from biodynamic agriculture. Gardening and management strategies are generally orally agreed upon in gardener's assemblies and enforced through mutual control mechanisms.

The possibility of self-organized management leads to a large variety of built facilities in the different gardens. While most gardens possess of basic facilities, including compost, a simple shelter for tools, tables and chairs, others embed rudimentary green houses (for example at *Fort Pienc*), covered relaxation areas (*Hort Poble Sec*), or even rudimentary kitchen facilities (*Hort del Xino*). Common activities, such as the annual distribution of manure (observed at *Can Masdeu*), common meals, educational events and open workshops were only observed in squatted gardens.

As stated above, gardeners in squatted gardens usually hold a wider bundle of property rights. However, due to their illegal foundation most squatted gardens are threatened to be displaced by other land-uses. Only a minority of squatted gardens aspired and reached toleration

agreements with district governments. Toleration exists, for example, for the *Forat de la Vergonya,* embedded within the community-based design of a public square (*cf*. Anguelovski 2013). Other forms of toleration include the formal guarantee of access to gardens established on public land and the provision of irrigation water, for example at *Fort Pienc*.
A special case of a squatted garden is *Hort la Maladeta.* Contrary to other squatted gardens in the city, the creation of this garden was not community-based, i.e. started by a previously organized group, but by two individual gardeners who created individual garden plot on a wasteland in front of their multi-family houses. Encouraged by their initiative other neighbors followed to create their own plots and between 2005 and 2013 about 20 garden plots were established. Welcoming the initiative, the district administration provides irrigation water for a symbolic payment and helped establishing a legal agreement for interim land-uses with the private land-owner.

Figure 2: Municipal and squatted gardens in Barcelona
(Sources: a. author's personal photographs; b. with friendly permission by Marta Camps Calvet)

a. Masia Can Mestre founded in 1997.

b. Can Masdeu founded in 2002.

4.2 Production of ecosystem services in urban gardens

Following the assessment of garden characteristics, the second objective of this study consists in an examination of ecosystem services provided by different garden types. Along the stated importance of ecosystem services in different gardens, statistical testing allowed demonstrating, which ecosystem services are generated together as bundles and which exclude each other. It further allowed distinguishing and clustering garden types with regard to the ecosystem services provided. Ecosystem service values for each garden are shown as spider diagrams in Appendix I (for municipal gardens) and Appendix II (for squatted gardens).

4.2.1 Synergies and trade-offs in the production of ecosystem services

Results, shown in Table 3, demonstrate that synergies exist in the production of ecosystem services by urban gardens, i.e. many ecosystem services are generated simultaneously. I describe this synergetic production of services in terms of ecosystem service bundles (Raudsepp-Hearne et al. 2010, Martín-López et al. 2012). Contrariwise, the production of specific ecosystem services at least partially excludes the generation of others, and it can be spoken about trade-offs between ecosystem services (Maes et al. 2012).
Bundles or synergies in the production of ecosystem services can be described between the provision of 'food supply quality', 'food supply quantity' and the 'maintenance of soil fertility' (shown by NDMS2 in Table 3). This bundle is in the following referred to as food supply bundle.

Strong synergies are also shown between 'political fulfillment', 'social cohesion', 'place-making', and 'natural & spiritual experiences' summarized as fulfillment bundle. Similarly, 'aesthetical information', 'relaxation & stress reduction', and 'leisure & diversion' are jointly produced as a bundle of services summarized as mental recreation.
Other bundles of services produced together can be described for the 'maintenance of biodiversity' and the provision of 'aromatic and medicinal plants', as well as for a number of regulating ecosystem services, including 'pollination', 'local and global climate regulation' and 'air purification'. Services like 'biophilia', 'exercise & physical recreation' and 'learning & education' did not show clear synergies with other services in their generation.
Trade-offs are less clearly identified, due to the statistics applied, and should rather be interpreted as tendency (thus, must not be interpreted as fully exclusive). A trade-off is, for example, observed between the food supply bundle and the fulfillment bundle. Another trade-off is given between the bundle of mental recreation and the bundle including 'maintenance of biodiversity' and 'aromatic & medicinal plants' provision.

Table 3: Examples of bundles of ecosystem services provided by urban gardens
(COST-TU1201 members are invited to contact me in order to obtain the full table)

Ecosystem Service	NMDS1	NMDS2	r2 Pr(>r)	Signif.	
Maintenance of biodiversity	0.87260	0.48844	0.0673	0.375	
Aromatic medicinal plants	0.89321	0.44964	0.3334	0.008 **	
Esthetical information	-0.90639	0.42244	0.5377	0.002 **	Mental recreation (bundle)
Relaxation & Stress reduction	-0.95392	0.30005	0.416	0.005 **	
Entertainment & Leisure	-0.97346	0.22888	0.5326	0.001 ***	

*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*
P values based on 999 permutations.

4.2.2 Cluster of urban gardens with regards to the production of ecosystem services

Clustering of urban gardens with regards to the generation of ecosystem services is finally meant to examine common social-ecological characteristics between gardens that support the production of ecosystem services. Results from the cluster analysis based on the ecosystem services produced are shown in Figure 3. The clusters obtained (confirmed by NMDS) show strong similarities to the initial division into municipal and squatted gardens, while including some important differences.
First of all, two large clusters can be identified. The first includes nine municipal gardens and the squatted gardens *Can Masdeu* and *Horts Maladeta* — as the municipal gardens, both are characterized by large areas of individually tendered plots and predominantly elderly gardeners. None of the gardens in this cluster has less than twenty gardeners and all eleven gardens have been founded before 2009 (the beginning of a severe economic crisis in Spain). The most important ecosystem services characterizing this cluster of gardens are 'exercise & physical recreation' and 'biophilia'. In addition, gardens in this cluster strongly support services summarized in the food supply bundle, as well as those in the mental recreation bundle.
A second cluster exclusively includes squatted gardens. Eight out of nine of them, *Hort Poble Nou* makes the exception, are tendered collectively, i.e. following a community garden structure. In contrast to the first cluster, the vast majority (again eight out of nine) of gardens in this cluster emerged between 2009 and 2013 (thus, during the economic crisis). The most explanatory services characterizing this group of gardens against are 'political fulfillment', together with

other services summarized in the fulfillment bundle, and the provision of 'aromatic & medicinal plants'.

The remaining six gardens cannot be clearly grouped within a cluster regarding the ecosystem services they provide. For *Masia de L'Antic Jardí Botanic* differences to other gardens were already described in the initial characterization. To which extend these different characteristics influence the provision of ecosystem services is, in the absence of comparable other gardens, speculative. The same counts for the two municipal gardens *Hort Turull* and *Sant Pau del Camp*. Although common characteristics between the two gardens are given, they cannot satisfactory explain differences in the production of ecosystem services. The remaining gardens *Can Paguera*, *Hort del Xino*, and *Forat de la Vergonya* show the strongest differences in the generation of ecosystem services to all other gardens (*COST-TU1201 members are invited to contact me in order to obtain the corresponding Figures*) Although they are all very particular in their foundation and/or structure, I assume methodological shortcomings to cause the strong deviations. Due to the small number of gardeners, only a limited number of surveys (not exceeding two per garden) was executed in each of these gardens.

5 Discussion: Social-ecological co-production of ecosystem services

Our findings allow for examining different social-ecological factors underlying the generation of ecosystem services in urban gardens (see table 4). Assuming complex social-ecological relationships (Berkes et al. 2000) behind the production of ecosystem services in urban gardens such examination is not straightforward but explorative. The discussion is structured along the TEEB-classification of ecosystem services (TEEB, 2010).

5.1 Maintenance of biodiversity

Horticulture plants cultivated in individual plots show small species variety within single gardens and across different garden types. Plant diversity is elevated in squatted gardens on (collectively managed) patches dedicated to aromatic, medicinal and ornamental plants. In municipal gardens, patches that are not used for food production are relatively poor in terms of plant diversity and mainly consist in simply manageable lawns, shrubs and trees (although an improvement can be observed with increasing age of the gardens).

Notwithstanding positive effects for biodiversity, the collective management of non-food areas embeds the introduction of exotic species (including abandoned indoor and balcony plants), which may have unwanted effects on urban biodiversity. This phenomenon is especially observed in gardens with few gardeners, while in larger gardens local varieties dominate also in the non-food areas. The existence of stronger traditional ecological knowledge (Berkes, 1999) given within larger groups of gardeners may be an explanatory factor for the better control in larger gardens.

Traditional ecological knowledge may increase species diversity in a second way. Gardeners with persisting (family) ties into the country-side tend to prefer local varieties and introduce seeds and seedlings of horticultural plants from their rural origins. The maintenance of local varieties, also increasing the resilience in local food supply (Barthel et al. 2014), is also favored in all gardens possessing of facilities for plant reproduction (e.g., green houses); remarkably this always involves individual gardeners with professional (*Antic Jardí Botanic*), or local ecological knowledge (*Can Masdeu, Fort Pienc*).

5.2 Provisioning services

Results have shown that the maintenance of biodiversity widely correspondence with the provision of 'aromatic & medicinal plants'. Field observation showed that the cultivation of aromatic and medicinal plants often takes place on collectively managed areas rather than within the individual plots. This also explains why the provision of 'aromatic & medicinal plants' is not found in the service bundle summarized as food supply.

Contrariwise, this bundle includes the 'maintenance of soil fertility' alongside 'food supply' (quality and quantity). The Millennium Ecosystem Assessment (MEA, 2005) describes 'maintenance of soil fertility' as *supporting service*, underlying the generation of other ecosystem services, e.g. the production of food. Our results clearly demonstrate this relationship. Furthermore, it could be observed that gardeners actively engage in the maintenance of soil fertility by adding manure and compost with the goal to enhance the 'food supply'. A wide consensus exists among gardeners that such organic practices result in the supply of food that is healthier and more tasteful.

Apart from gardening techniques I found that (opposite to the provision of 'aromatic & medicinal plants') gardens with an allotment structure of individual plots are better adapted to the production of food. Or said in other words, services embedded in the food supply bundle are generally not prioritized in community gardens. The emergence of community gardens during the economic crisis is, thus, not explained with the need for an enhanced 'food supply'.

5.3 Regulating services

With the exception of 'maintenance of soil fertility', our study provides relative little explanation about the production of regulating services. This is related to the relative small importance gardeners gave these services. For example, 65.9 % of 44 interviewed gardeners listed the maintenance of soil fertility as an important ecosystem service. At the same time only 13.6 % identified 'local climate regulation', understood as urban cooling (Gómez-Baggethun & Barton, 2013), as an important benefit from urban gardens, while 'pollination' was only mentioned by 11.4 % of the interview partners.

The 'maintenance of soil fertility' was strongly related to practices of composting and the introduction of compost and manure into the soil. Less recognition was given to ecological soil processes. Only the enrichment of soil fertility through legumes (nitrogen fixation) and the formation of soil organic matter by flora and fauna (especially *Lumbricidae*) were recognized.

'Pollination' was mainly related to flowering ornamental plants. Again the existence of such plants in urban gardens widely depends on the availability of areas different from individual plots and gardener's management rights to these areas. However, the scientifically undisputed importance of 'pollination' as supporting service for 'food supply' and 'biodiversity' (e.g., Andersson et al., 2007) stayed widely unrecognized by the gardeners.

The remaining regulating services ('local climate regulation', 'air purification', and 'global climate regulation') were usually mentioned as a bundle and roughly related to the existence of plants lacking more specific description of ecological processes. Instead, 'local climate regulation' and 'air purification' were often described as feelings and related to an increased well-being through nature exposure in gardens. Based on previous studies on regulating ecosystem services in urban contexts (Baró et al. 2013), I assume urban gardens in Barcelona to accomplish a very small contribution to the production of these services. Still, the larger a garden is and the more trees it hosts, the larger is its contribution to 'local climate regulation', 'air purification', and 'global climate regulation'.

5.4 Cultural ecosystem services

Urban gardens have been defined as places where food is produced (Domene & Saurí, 2007). Though true, the production of food in urban gardens is supporting manifold other ecosystem services — most of them cultural ecosystems services (see appendices I and II), which have previously been described as the most important services provided by urban gardens (Armstrong, 2000). Still, cultural ecosystem services produced strongly differ with specific social-ecological characteristics of urban gardens.

5.4.1 Fulfillment

Results have shown that ecosystem services summarized in the fulfillment bundle ('social cohesion & integration', 'place-making', 'political fulfillment', 'nature & spiritual experiences') are predominantly provided by squatted gardens that emerged with the beginning of the economic crisis. Tidball (2012) described similar processes as *community-based ecological restoration*, emerging from "… the affinity we humans have for the rest of nature, the process of remembering that attraction, and the urge to express it through creation of restorative environments …" in moments of crisis. Following Tidball's argumentation, the production of services in the fulfillment bundle depends on the provision of institutional and physical space in the moment of crisis, allowing for a reconnection to the "… ecological self and sense of ecological place …" (Tidball & Stedman, 2013). For example, gardeners described to obtain 'political fulfillment' through the ability to work the soil and grow their own food. Similarly, 'place-making' and 'nature & spiritual experiences' are obtained through the active engagement with and formation of the ecological environment gardening permits.

5.4.2 Biophilia

The concept of biophilia, introduced by Wilson (1985), is understood as human's "… natural affinity for life …" simplified, resulting from the co-evolution of humans with other species that binds us to them. The generation of biophilia in urban gardens epitomizes the social-ecological co-production of ecosystem services, and has been described as the reciprocal act of growing plants and "seeing plants grow" (oral gardener's statement). Its valuation was stronger in the garden cluster with allotment garden structures.

Table 4: Examples for social-ecological factors favoring the production of ecosystem services *(COST-TU1201 members are invited to contact me in order to obtain the full table)*

	Ecosystem services	***Social factors***	***Ecological factors***
Habitat services	*Maintenance of Biodiversity*	- Ties to country-side	- Reproduction of seeds & seedlings
Provisioning services	*Medicinal resources and aromatic plants*	- Management rights to common areas	- Provision of non-food production areas
Regulating services	*Maintenance of soil fertility*	- Composting - Introduction of compost and manure	- Natural soil formation
Cultural services	*Learning & Education*	- Experimentation with gardening practices	- Natural response (e.g. plant growth)

5.4.3 Mental recreation

A strong importance for mental recreation, including 'aesthetical information', 'relaxation & stress reduction', and 'entertainment & leisure', was stated across all garden types. Effects of mental recreation through the exposure to nature and active engagement in gardening activities have been experimentally shown and are comprehensively described and recognized in the clinic and therapeutic gardening literature (e.g., Ousset et al., 1998; Söderback et al., 2004). Even gardener's descriptions of regulating services, such as local climate regulation, are often contextualized among benefits for mental recreation.

5.4.4 Exercise & physical recreation

The importance of the production of benefits in form of 'exercise & physical recreation' is unique for the cluster of gardens with allotment garden structures. Interpreting statements from the interviews, this service seems to be mainly determined by the fact that gardeners affiliated to allotment gardens are very often elderly people. The gardening activity is described as a physical exercise (sometimes even a burden) that leads to an increased fitness. In community gardens frequently tendered by younger gardeners no such service has been described.

5.4.5 Learning & Education

'Learning & education' refers to the recovery and conveyance of knowledge on nature in general and horticultural practices in particular, as well as social learning embedded in community-based actions. Urban gardens provide opportunities for experimentation and knowledge exchange to citizens detached from horticultural practices. As such, 'learning & education' is important for the restoration of ecological knowledge as an underlying factor to the 'maintenance of biodiversity', as well as to 'food supply' and increases urban resilience (Krasny & Tidball, 2009). Learning processes were given importance across all gardens in our assessment.

5.4.6 Maintenance of cultural heritage

The 'maintenance of cultural heritage' is especially important in the cluster of gardens with allotment structures due to the over proportional rural origins of gardeners. Gardening provides opportunity to recover individual memory, sometimes even manifested in the introduction of plant varieties obtained from the gardener's place of origin. Traditional (organic) horticultural practices allow gardeners to actively show parts of their past origins to their offspring. Yet, 'maintenance of cultural heritage' is not only manifested in individual memory. For example, the restoration of terraced, horticultural areas with the original irrigation system was an important driver for the squatting of *Can Masdeu* and the foundation of *Masia Can Mestre*, although the initiators had not personally experienced the former state of the site.

6 Conclusion

This study examined social-ecological factors favoring the production of ecosystem services in urban gardens. Understanding urban gardens as coupled social-ecological systems helps disentangling the complexity of factors underlying the production of ecosystem services. Thereby, the study provides guidance to urban policy-making and practitioners for considering urban gardens as integrated part of the multi-functional urban green infrastructure (Pauleit et al., 2011).

Especially social factors — within them institutional settings — favoring the production of ecosystem services can be influenced or modified by judiciously designed policies. For example, Andersson et al. (2007) propose the introduction of co-management for urban green

infrastructure, where professionals guide laypeople in undertaking management tasks. Our study demonstrates that wider management rights may increase the provision of ecosystem services.

In municipal gardens in Barcelona, a concrete potential to introduce co-management is given by green areas not forming part of individual garden plots, which are currently managed by the municipal green space department. Based on our results, such measure could increase ecosystem services, such as the 'maintenance of biodiversity', the provision with 'medicinal & aromatic plants' and 'pollination', while simultaneously lowering public management costs. Professional guidance helps avoiding social conflict and undesired ecological impacts, such as the introduction of exotic species.

Urban policy-makers are also recommended to acknowledge the importance of spontaneously emerging community-based gardens, such as the squatted gardens in Barcelona that emerged with the economic crisis. Although not so apt for the provision of food, such gardens provide a range of cultural ecosystem services, (e.g. social cohesion, place-making) that top-down implemented gardens are less capable to provide. Supporting or even encouraging such bottom-up initiatives requires the availability of land and sufficient institutional flexibility.

Finally, I want to acknowledge that all gardens assessed in our study provide manifold ecosystem services simultaneously, which may be understood as encouragement for the maintenance of existing and creation of new horticulture gardens in cities.

Acknowledgements

This study is funded through a Short-Term-Scientific-Mission from the EU COST Action TU1201 Urban Allotment. I would like to thank all COST-members who supported and approved the proposal, and guided the elaboration of this report with their kind advice; among others my home supervisor Dr Erik Gómez-Baggethun, Dr Annette Vogt, and Dr Runrid Fox-Kämper. Furthermore, I would like to thank Prof Dr Thomas Elmqvist, my host at the Stockholm Resilience Centre, in representation of all other SRC-members and visiting scholars mentioned throughout this report and who supported this STSM in manifold different ways.

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Appendices

***Appendix I**:*

Stated importance of ecosystem services in municipal urban gardens in Barcelona (COST-TU1201 members are invited to contact me in order to obtain the graphic)

Appendix II

Stated importance of ecosystem services in squatted urban gardens in Barcelona
(COST-TU1201 members are invited to contact me in order to obtain the graphic)

Appendix III

Letter of confirmation, Prof Thomas Elmqvist, Stockholm University

Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship

Stockholm University

30 June 2014

To whom it may concern

It is my pleasure to confirm that Mr. Johannes Langemeyer has successfully completed a Short Term Scientific Mission (STSM) at the Stockholm Resilience Centre (SRC, Stockholm University) from 1st April until 30th June 2014.

Johannes has shown great initiative and enriched our work at SRC with his presence. He held two short presentations, organized a research seminar and shared his research with Master-students at SRC during a class presentation.

During his STSM, he participated in PhD courses at the Stockholm Resilience Centre and took part in the SRC urban theme meetings. He used this opportunity to enhance his theoretical and practical knowledge on urban resilience, social-ecological systems, and ecosystem services, as well as to apply this knowledge to his ongoing research on the provision of ecosystem services by urban gardens in Barcelona.

Johannes gathered a series of individual and group meeting with scholars, who have long experience in investigating urban gardens in Stockholm, South Africa and the US; among them SRC-researchers Dr Stephan Barthel and Dr Erik Andersson, as well as guest researchers at SRC Prof Dr Sarel Cilliers. (North-West University, South Africa) and Prof Dr Parwinder Grewal (University of Tennessee, US). While creating ideas for potential future research-collaborations, these meetings allowed Johannes' to discuss and adjust the framework and methods of his investigation on urban gardens.

Sincerely yours,

Professor Thomas Elmqvist
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Appendix IV

Timetable of daily activities during STSM (March 1 – June 30, 2014)

WEEK 1

01/04/2014	• **SRC-meeting** • **Meeting Prof Thomas Elmqvist (Introduction to SRC)**
02/04/2014	• **Organization of workspace** • **Meeting Prof Thomas Elmqvist** - presentation of study proposal - joint elaboration of reading list
03/04/2014	• **Organization of workspace (continued)** • **Adaptation of study proposal**
04/04/2014	• **Organization of workspace (continued)** • **Adaptation of study proposal** • **Literature review on social ecological systems & urban ecology**

WEEK 2

07/04/2014	• **SRC-meeting** • **Prepare MSc-Course**
08/04/2014	• **Study presentation in MSc-Course** • **Elaboration of book chapter outline (COST-TU1201: Chapter 5)**
09/04/2014	• **Adaption of STSM-proposal** • **Reading: Niemelä (ed.): Urban Ecology** • **Elaboration of study background**
10/04/2014	• **Readings: PhD-Course (Dr Green)** • **Meeting Prof Thomas Elmqvist**
11/04/2014	• **Readings: PhD-Course (Dr Green)** • **Meeting of Stockholm region projects and people Library** • **Elaboration of book chapter outline (continued)**

WEEK 3

07/04/2014	• **SRC-meeting** • **Prepare MSc-Course (test of group valuation)** • **Print out**
08/04/2014	• **Study presentation in MSc-Course** • **Elaboration of book chapter outline (COST-TU1201: Chapter 5)**
09/04/2014	• **Adaption of STSM-proposal** • **Reading: Niemelä (ed.): Urban Ecology** • **Elaboration of study background**
10/04/2014	• **Readings: PhD-Course (Dr Green)** • **Meeting Prof Thomas Elmqvist** • **Preparation of presentation for SRC-meeting (14/04/2014)**
11/04/2014	• **Readings: PhD-Course (Dr Green)** • **Meeting of Stockholm region projects and people Library** • **Elaboration of book chapter outline (continued)**

WEEK 4

14/04/2014	• **SRC-meeting: Presentation of Garden Study Outline**
15/04/2014	• **Integration of presentation comments to Garden Study Outline** • **Group meeting with Prof Dr Sarel Cilliers (North-West University, SA), Prof Parwinder Grewal (University of Tennessee, US)** - urban gardens in Cleveland (Ohio, US): social cohesion & food supply - urban and rural gardens in South Africa: health benefits - urban gardens (Barcelona, Spain): recreation
16/04/2014	• **Meeting Prof Thomas Elmqvist** - Up-date on Monday Seminar - Garden paper progress

	• **Manuscript-writing: Case study description**
17/04/2014	• **Readings: PhD-Course (Dr Green)** • **Beginning of data analysis**
18/04/2014	• **Manuscript-writing: Methodology**

WEEK 5

21/04/2014	*EASTER HOLIDAY*
22/04/2014	• **Elaboration of agenda for STSM-supervision-meeting** • **Readings: PhD-Course (Dr Green)**
23/04/2014	• **PhD-Course (Dr Green): Ecosystem Service course (9-17h)** • **PhD Supervision-meeting with Dr Gómez-Baggethun**
24/04/2014	• **STSM-supervision-meeting: Dr Gómez-Baggethun & Prof Elmqvist** • **Brown-Bag-Seminar Dr Gómez-Baggethun** • **PhD-Course (Dr Green): Ecosystem Service course (9-17h)**
25/04/2014	• **PhD-Course (Dr Green): FIELD TRIP**

WEEK 6

28/04/2014	• **PhD-Course (Dr Green): Ecosystem Service course (9-17h)**
29/04/2014	• **PhD-Course (Dr Green): Ecosystem Service course (9-17h)** • **Individual meeting: Dr Jakub Kronenberg, (University of Lodz, Poland)** - Critical feedback on study outline (ecosystem service issues) - Introduction urban gardens in Poland (discussion of paper Kronenberg et al. 2013)
30/04/2014	• **Individual meeting: Dr Stefan Barthel, SRC** • **Preparation of meeting with Barcelona City Council (31/04/2014, carried out by ICTA-UAB colleagues)** • **Meeting Prof Thomas Elmqvist**
31/04/2014	• **Updating of study design based on comments obtained in individual meetings**
01/05/2014	*NATIONAL HOLIDAY IN SWEDEN*

WEEK 7

05/05/2014	• **Printing, Signing and Sending of STMS grant letter** • **Elaboration of CV for COST-book**
06/05/2014	• **Review on ecosystem service valuation** • **Elaboration of results**
07/05/2014	• **Review on ecosystem service valuation (continued)** • **Meeting Prof Thomas Elmqvist**
08/05/2014	• **Review on ecosystem service valuation (continued)** • **Manuscript-writing: Methodology (continued)**
09/05/2014	• **Manuscript-writing: Methodology (continued)** • **Writing of final assignment PhD-Course (Dr Green):** *Valuation methods*

WEEK 8

12/05/2014	• **Due for final assignment: PhD-Course (Dr Green):** Valuation methods • **SRC-meeting** • **Attendance to half-time seminar presentation:** Social-ecological system s and ecosystem services in rural landscape, South Africa
13/05/2014	• **COST-book chapter 5 coordination & improvement of outline** • **Elaboration of results (continued)**
14/05/2014	• **Elaboration of results (continued)** • **Elaboration of presentation of results**
15/05/2014	• **Meeting Prof Thomas Elmqvist (half-time STSM-meeting)** - Up-date on methods & preliminary results - Time-planning for 2nd half of STSM

	• **Meeting Prof Thomas Elmqvist & Dr Lisa Deutsch** - Supervision evaluation (questionnaire) - Discussion on project proposal to BiodivERsA call on agro-ecosystems • **Manuscript-writing: results** • **Draft of discussion points** • **Review of study structure**
16/05/2014	• **Attendance in meeting on Resilience Conference (Montpellier) outcomes** • **Discussion with SRC PhD-students on study outline** • **Elaboration of results (continued)**

WEEK 9

19/05/2014	• **SRC-meeting** • **Meeting Prof Thomas Elmqvist** - presentation / discussion on new reading list • **Manuscript-writing: Introduction (continued)** • **Elaboration of results (continued)**
20/05/2014	• **Outline COST-book chapter 5**
21/05/2014	• **Outline COST-book chapter 5 (continued)**
22/05/2014	• **Manuscript-writing: Introduction (continued)** • **Elaboration of results (continued)** • **Meeting with Prof Dr Carl Folke & four PHD-students** - reflections on ecological economics foundation & social ecological systems science
23/05/2014	• **Elaboration of results (continued)** • **Graphical presentation of results** • **Manuscript-writing: Results (continued)**

WEEK 10

26/05/2014	• **SRC-meeting** • **Elaboration of results (continued)** • **Graphical presentation of results (continued)**
27/05/2014	• **Preparation of speed-talk for SRC-meeting (02/06/2014)** • **Update CV COST-book** • **Outline COST-book chapter 5 (continued)**
28/05/2014	• **Elaboration of results (continued)** • **Graphical presentation of results (continued)** • **Individual meeting Prof Grewal, (University of Tennessee, US)** - soil ecosystem services by urban gardens - study presentation green/vertical roof potential
29/05/2014	• **Elaboration of results (continued)** • **Graphical presentation of results (continued)**
30/05/2014	• **Elaboration of results (continued)** • **Graphical presentation of results (continued)** • **Meeting Prof Thomas Elmqvist** - discussion on upcoming presentations next week - presentation of graphical results

WEEK 11

02/06/2014	• **SRC-meeting** - Speed-talk to announce seminar (04/06/2014) • **Elaboration of SRC-Seminar Presentation (04/06/2014)**
03/06/2014	• **Elaboration of SRC-Seminar Presentation (04/06/2014)**
04/06/2014	• **Presentation on valuation of ecosystem services** • **Feedback round with SRC-scholars and visiting scholars** (including Prof Elmqvist, Dr Tom Green, Maria Schultz (all SRC), Dr Peleg Kremer, Dr Timon McPherson (NewSchool, NYC)

	• **Review of study structure** • **Draft of discussion points (continued)** • **Outline COST-book chapter 5 (continued)**
05/06/2014	• **Elaboration of results (continued)** • **Graphical presentation of results (continued)** • **Individual meeting Dr Marco Campenni, SRC:** - Discussion on statistical methods
06/06/2014	*NATIONAL HOLIDAY IN SWEDEN*

WEEK 12

09/06/2014	• **SRC-meeting** • **SRC PhD-meeting: discussion on individual PhD-projects** • **Elaboration of results (continued)** • **Manuscript-writing: Discussion** • **Study outline send to Barcelona colleagues for feedback**
10/06/2014	• **Group meeting: Discussion & critical feedback on study outline** (including Prof Elmqvist, Prof Grewal, Prof Cilliers, Dr Andersson) • **Reading and commenting proposal COST-book chapter 4 & 6**
11/06/2014	• **Individual meeting with Dr Andersson** - comparison findings UG Stockholm & Barcelona - discussion on resilience related ecosystem services in UG • **SRC PhD-meeting: discussion on individual PhD-projects**
12/06/2014	• **Attendance MSC-Thesis defense:** - Social ecological systems & ecosystem services, agro-ecosystem Doñana, Spain • **Urban theme meeting** - study presentation • **Statistics Course (Dr Ingo Fetzer, SRC):** Multivariate stats • **Polishing of COST-book outline Chapter 5**
13/06/2014	• **Registration COST-meeting Riga** • **Coordination COST-book:** request for comments on draft • **Preparation urban garden meeting** - update presentation - draft program - send invitations

WEEK 13

16/06/2014	• **SRC-meeting** • **Urban garden meeting** (attendances: Prof Grewal, Prof Cilliers, Dr Barthel): - study presentation -1st paper proposal: global classification of urban garden ecosystem services - 2nd paper proposal: global comparison of potential for agricultural production in cities
17/06/2014	• **Elaboration of results (continued):** Multivariate stats • **Meeting Prof Thomas Elmqvist** - reporting on multiple STSM activities - strategy to finalize STSM
18/06/2014	• **Individual meeting Dr Maria Tengö** - study presentation - social-ecological systems in the urban South • **SRC PhD-meeting: discussion on individual PhD-projects** • **Draft matrix for global garden data**
19/06/2014	• **Manuscript-writing: Discussion (continued)** • **Statistics Course (Dr Fetzer): General model finding, room 248**
21/06/2014	• **Elaboration of results (continued)**

	• **Manuscript-writing: Discussion (continued)**
WEEK 14	
23/06/2014	• **SRC-meeting** • **Coordination COST-book:** - Update outline - Request for contribution
24/06/2014	• **Meeting Prof Thomas Elmqvist** - Admin issues - Outline for book-chapter-collaboration
25/06/2014	• **Elaboration of results (continued)** • **Graphical presentation of results (continued)** • **Manuscript-writing: Discussion (continued)**
26/06/2014	• **Meeting Prof Thomas Elmqvist** - Discussion on STSM report outline - Discussion on follow-up of STSM
27/06/2014	• **Start to draft STSM report**
WEEK 15	
30/06/2014	• **SRC-SU admin issues** • **Closing of STSM**