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Stewardship of Urban Ecosystem Services

Understanding the Value(s) of Urban Gardens in Barcelona

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Abstract The notion and assessment of ecosystem services (ES) values is becoming an established part of the discourse regarding urban green space performance. Yet, underlying factors enabling ES values are still poorly understood. We assume the production of ES value crucial for environmental stewardship in cities, and aimed in this study to uncover their key enabling factors. This study has been developed on a broad data base including a survey (n=201), interviews (n=46), field observation and remote sensing from 27 urban gardens in Barcelona, Spain, including municipal 'allotment gardens' and 'civic gardens' emerging from bottom-up

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initiatives. In a first step, we distinguished different urban gardens types regarding the ES values they provide. In a second step, we tested specific garden characteristics including (a) user profiles, (b) biophysical garden properties, and (c) institutional settings for their specific importance to trigger ES values. Results showed ES values to significantly differ with the types of gardens. For example, classical allotment gardens are more likely to provide recreational values, while emerging civic gardens are more likely to produce place-making and social cohesion. A main finding from our study is the importance of social and institutional garden characteristic as enabling factors of ES values. Results indicate, for example, a correlation between childhood experiences and a higher appreciation of ES. Our results further indicate that civic gardens with broader property rights and decision-capacities are more likely to enhance stewardship action. In providing a differentiated understanding of the ES value(s) of urban gardens, this study highlights the potential for green space planning in cities to steer the stewardship of urban gardens by providing institutional and physical space for civic gardening initiatives.

Key words Cities • Social-ecological systems • Civic ecology • Green commons • Green infrastructure
• Nature-based solutions • Urban regeneration

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Key findings

- *Social and institutional properties significantly influence the perception of ES values in urban gardens*
- *We found garden size, management, property rights, gender, education and origin to enable ES values*
- *Land use and gardeners' age have not been found to significantly influence ES values*
- *Community management and enhanced property rights stipulate place identity and social cohesion*
- *Our results indicate a correlation between childhood experiences and stewardship action*

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Introduction

1 Stewardship of ecosystem services (ES) is one of the greatest challenges for landscape and urban
2 planning in the 21st century (Rockström et al., 2015; UN, 2014:15). The global urbanization trend (Seto
3 et al., 2011) is decreasing people's awareness for human dependency on healthy ecosystems (Colding &
4 Barthel, 2013; Gómez-Bagethun & De Groot 2010; Miller et al., 2005), and impinging upon
5 environmental stewardship (Andersson & Barthel, 2016). Recent advances in assessing the value of urban
6 ES (e.g., Gómez-Bagethun et al., 2013; Haase et al., 2014) are counteracting this trend by sensitizing for
7 the importance of environmental stewardship action to maintain and restore multifunctional urban green
8 spaces for human well-being.

9

10 Among different green spaces in cities, urban gardens have shown to be hubs for civic engagement and
11 environmental stewardship in cities (Bendt et al., 2013; Colding & Barthel, 2013) that inspire civic
12 restoration and community-based green space tending (Connolly et al., 2013; Krasny & Tidball, 2009a).
13 A number of studies has helped shedding light on the specific ES values, which can be understood as an
14 expression of people's needs and preferences in relation to nature and others (Chan et al., 2016), that
15 motivate individuals or groups of people to engage in the stewardship action of community gardening
16 (Hynes & Howe, 2002; Guitart et al., 2012, Breuste & Artmann, 2014; Langemeyer et al., 2016). Chan et
17 al. (2016) distinguished ES values into intrinsic, instrumental and relational values, the latter produced
18 individually as well as collectively. Engaging in stewardship action rewards — and thus motivates —
19 gardeners with several direct benefits (Langemeyer et al., 2016; Calvet-Mir et al. 2016). Benefits include
20 emotional, practical and social values (Dunnett & Quasim, 2000) as well as enhanced food security (e.g.
21 Barthel & Isendahl, 2013), recreational benefits (e.g. Hawkins et al., 2011; van den Berg et al., 2010),
22 educational benefits (e.g. Breuste & Artmann, 2014; Doyle & Krasny, 2003), social cohesion (e.g.
23 Armstrong, 2000), and sense of place and community (e.g. Andersson et al., 2007; Andersson et al.,
24 2014). A recent study by Camps-Calvet et al. (2016) lists as many as 20 different ES that make urban

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25 gardens valuable for people. The study found relaxation, 'biophilia', the satisfaction of blooming life,
26 (Wilson, 1984) and place-making, generally considered to be process of civic or community-based urban
27 regeneration (Healey, 2007; Noori & Benson, 2016), among the most appreciated ES.

28

29 Multiple ES values urban gardens provide to city dwellers qualify them as potential nature-based
30 solutions to urban challenges (Cabral et al., 2017; Kabisch et al., 2016). Community gardening can for
31 example enhance social inclusion (Anguelovski, 2013), stimulate healthier diets (Litt et al., 2011), lower
32 the risk of obesity (Zick et al., 2013) and help urban people to reconnect to nature (Krasny & Tidball,
33 2009a). Urban gardens are also important components of larger urban green infrastructure networks that
34 provide niche habitats and ecological connectivity (Breuste, 2010; Langemeyer et al., 2016). Yet, urban
35 gardens are by no means homogenous, and rapidly changing urban conditions are leading to the
36 emergence of new varieties and approaches to urban gardens (Caputo et al., 2016). Classical 'allotment
37 gardens' (publicly owned land formally dedicated to gardening) are complemented by new forms of
38 'community gardens' or 'civic gardens' emerging from *ad-hoc* gardening initiatives which do not
39 necessarily follow top-down planning approaches (Camps-Calvet et al., 2016; Caputo et al., 2016;
40 Zammit & Erjavec, 2016). It is thus likely that these garden types provide different values and to fit
41 different needs of urban societies. Thus, drafting green infrastructure policies that enable the broad
42 potential of urban gardens in providing benefits to people requires understanding the production of ES
43 values in different types of urban gardens.

44

45 In general terms, ES values have been described as originating from the complex interactions within
46 coupled social-ecological systems (e.g. Andersson et al., 2014). Properties of urban social-ecological
47 systems that are generally assumed to enable ES values include ecological and physical elements,
48 beneficiaries' social and demographic properties as well as the institutional context (e.g. Chan et al. 2012;
49 Gómez-Bagethun & Kelemen 2008; Kremer et al., 2016; Primmer et al., 2014; Scholte et al., 2015). To

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50 our knowledge, only two studies have examined factors that enable ES values in urban gardens. Dunnett
51 & Quasim (2000) examined the relation of ES values with demographic properties of gardeners and
52 uncovered relations between the perception of values and the age and gender of gardeners as well as with
53 their employment and time they spent in the garden. Breuste & Artmann, (2014) noted ES values to vary
54 with land cover and gardeners' behaviour. Understanding institutional factors in the generation of ES
55 poses a major gap in urban ecosystem service research (Kremer et al., 2016). Institutions, which shape the
56 social-ecological relations in urban gardens, have thus far not received any attention as enabling factors
57 for ES values in urban gardens. Here, we understood institutions to be a grouping of formal and informal
58 rules, and related social practices (Ostrom, 2009:18). As mediators at the interface between the physical
59 garden space, garden users and the wider urban context (*cf.* Bendt et al., 2013; Colding et al., 2013), we
60 presume institutions to be mechanism for enabling ES values and environmental stewardship.

61
62 The goal of this study is to understand the production of ES values in urban gardens, since these values
63 may be crucial motivating factors for to engaging in environmental stewardship action in cities. Our paper
64 presents findings from a larger case study on ES from allotment and civic urban gardens in Barcelona,
65 Spain, and builds on the previous valuation of ES and characterization of garden users reported by
66 Camps-Calvet et al. (2016). To carry out our analysis, we first cluster Barcelona's gardens with regard to
67 the specific ES values. We then expand upon previous approaches in order to identify enabling factors for
68 ES values by examining the relation between ES values and (a) user properties, (b) physical garden
69 structures, as well as (c) institutional properties of urban gardens.

Case Study: Urban gardens in Barcelona

70 The city of Barcelona constitutes one of the most densely populated urban areas in Europe characterized
71 by very low levels of urban green spaces per capita. The average amount per capita is 6.64m² (IDESCAT,

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72 2013), which means Barcelonans have about 1/3 of the green space per capita compared to inhabitants of
73 other European cities (Fuller & Gaston, 2009).

74
75 Urban gardens in Barcelona have long suffered from a lack of broader societal and policy appreciation
76 (Domene & Saurí, 2007). We argue that to sustain environmental stewardship in urban areas in the long-
77 run, it is critical to create a broader understanding of the values urban gardens provide. In other
78 (Northern) European cities, such as the city Leipzig in Germany, the “Schreber”-movement enhanced the
79 popularity of urban gardening for educational and leisure purposes as early as the 19th century
80 (Keshavarz, 2015). Today gardens cover about 4.1% (1240 ha) of the total urban surface (own calculation
81 based on Stadt Leipzig, 2015a,b). In Barcelona in turn — as in many parts of the Mediterranean and other
82 urbanizing parts of the world — agricultural production sites and horticulture gardens where gardens have
83 a history of being marginalized and expelled from the city through different waves of urbanization over
84 the course of the 20th century (Roca, 2000; Vendrell & Clanchet, 1992). The Barcelona City Council
85 (2013) estimates that today not more than 0.3% of the city's total surface is used for gardening.

86
87 But, on par with larger trends in Europe and around the globe (Caputo et al., 2016), in the last two
88 decades Barcelona is undergoing a dynamic restoration of urban gardens, both through top-down
89 ('allotment gardens') and bottom-up ('civic gardens') approaches (Camps-Calvet et al. 2015; 2016;
90 Domene & Saurí, 2007) (Figure 1). Top-down approaches include a municipal garden program launched
91 in 1997 for the city-wide creation and allocation of 'public gardens' to retired and socially marginalized
92 citizens (Giacchè & Tóth, 2013), as well as the municipal '*Pla Buit*' (*Empty-Spaces Plan*), which since
93 2013, grants vacant land owned by the municipality to civic initiatives for interim uses (Barcelona City
94 Council, 2015). In parallel, Barcelona is witnessing a considerable emergence of self-governed gardens
95 from the bottom-up. These 'civic gardens', or 'community gardens' as Camps-Calvet et al. (2016) call

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96 them, are often associated with squatting of vacant public and private land and have gained particular
97 momentum since the beginning of the global financial crisis in 2007-2008 (Camps-Calvet et al., 2015).

98

Post-Print

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Figure 1: Physical appearance of urban gardens in Barcelona, Spain.



a. *Can Mestre* founded in 1997 by the municipality.



b. *Turull* founded in 2004 by the municipality.



c. *Can Masdeu* founded in 2002 from a civic initiative.



d. *Poblenou 2* founded in 2012 from a civic initiative.

Source: Authors' personal photographs.

Data & Methods

99 Our research assessed 27 urban gardens within the municipal boundaries of Barcelona (Figure 1) and
100 included 'allotment gardens' created under the municipal garden program. In addition we included 'civic
101 gardens' emerging from bottom-up initiatives, identified by means of web-research and snowball
102 techniques. Due to limited accessibility other types of urban gardens, such as home gardens and school
103 gardens, were excluded from our study. In 2013, at the time we conducted the fieldwork for this study,
104 gardens created under the '*Pla Buits*' (*Empty-Spaces Plan*) were still in an embryonic stage. After initial
105 visits to *Pla Buits* it became apparent that it was too early to fully assess activities, we discarded them
106 from the assessment. We strongly encourage, however, the consideration of gardens emerging from '*Pla*

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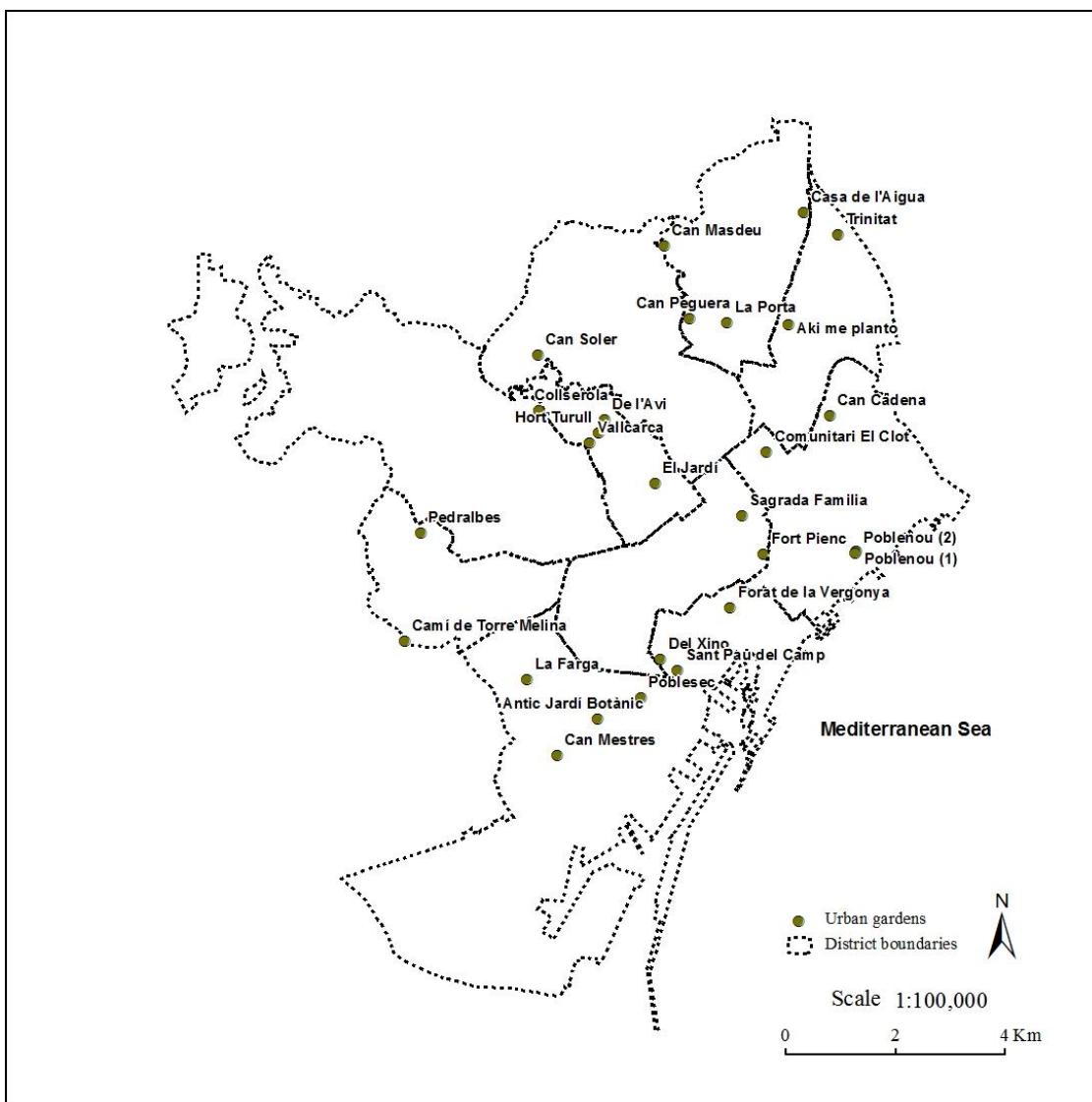
107 *Buits'* as well as newly emerging civic gardens, such as the recently restored *Hort de la Font Trobada*, in

108 follow-up research.

109

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Figure 2: Location of urban gardens in Barcelona, Spain



Own elaboration based on European Urban Atlas, 2005-2007.

Distinguishing garden types based on ES values

110 To broaden our understanding around the heterogeneity of urban gardens, as a first step we rigorously
 111 distinguished garden types by the ES values they provide. For this purpose, we used disaggregated ES
 112 valuation data from Camps-Calvet et al. (2016), derived from a survey among 201 urban gardeners across
 113 the 27 urban gardens in our case study. Of 20 valued ES (listed in Table 1), provisioning services and
 114 cultural services in particular, provide direct benefits to the gardeners and are thus assumed to be more

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115 important in motivating environmental stewardship. The survey used for the valuation of ES by means of
 116 a Likert-scale ranking approach is comprehensively described in Camps-Calvet et al. (2016). Based on
 117 the survey results, average ES values were generated for each individual garden in our sample. Urban
 118 gardens were then categorized by means of a cluster analysis with regard to the ES values they provide. In
 119 addition, we applied a non-metrical dimensional scale (NMDS) approach to visualize the 'distances' (the
 120 levels of difference) between urban gardens regarding the ES values they provide as well bundles
 121 between specific ES values that are produced together.

Table 1: Ecosystem services provided by urban gardens in Barcelona, Spain.

<i>Habitat services</i>	Biodiversity
<i>Provisioning services</i>	Medicinal resources and aromatic plants Food supply (quantity) Food supply (quality)
<i>Regulating services</i>	Air purification Local climate regulation Global climate regulation Maintenance of soil fertility Pollination
<i>Cultural services</i>	Social cohesion & Integration Place-making Political fulfilment Biophilia Aesthetic information Nature & Spiritual experiences Relaxation & Stress reduction Entertainment & Leisure Exercise & Physical recreation Learning & Education Maintenance of cultural heritage

Based on Camps-Calvet et al. (2016) extending the ecosystem service classification introduced by TEEB (2010).

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Examination of enabling factors for ES values

122 In order to examine enabling factors for different ES values, in the second step, we relied on data about
 123 garden user characteristics (Camps-Calvet et al., 2016) and assessed biophysical and institutional
 124 properties of each of the 27 urban gardens. User properties as well as biophysical and institutional garden
 125 properties were examined regarding their statistical significance to sustain ES values. The different
 126 garden properties and respective data sources are summarized in Table 2.

Table 2. Properties of urban gardens and characteristics of users examined as enabling factors for ES values

<i>Properties</i>	<i>Criteria</i>	<i>Data Source</i>
Gardeners		
Gender	Masculine; female	Survey (Camps-Calvet et al., 2016)
Age	Average gardeners age	Survey (Camps-Calvet et al., 2016)
Education	Higher education courses	Survey (Camps-Calvet et al., 2016)
Income	Average household income divided people in the household	Survey (Camps-Calvet et al., 2016)
Origin	Barcelona; Other parts of Catalonia; Other parts of Spain; Other European countries; Non-European countries	Survey (Camps-Calvet et al., 2016)
Migration period	Year of migration (if applicable)	Survey (Camps-Calvet et al., 2016)
Biophysical		
Size	Total garden surface & numbers of workers	Remote sensing & Non-participant observations; Participant observation
Land cover	Sealed surfaces; horticulture land; Other green spaces (e.g. areas with ornamental plants, lawns, trees); Other unsealed surfaces; (e.g. pebble-paths)	Remote sensing; Non-participant observation
Equipment	Compost-boxes; Benches; Shelters	Non-participant observation
Surrounding land-uses	Highways; Parks; Residential areas	Non-participant observation
Institutions		
Foundation	Civic; Public	Review of grey literature; Semi-structured interviews
Property rights	Access; Withdrawal; Management; Exclusion	Review of grey literature; Semi-structured interviews
Decision-making*	Top-down; Participatory	Review of grey literature; Semi-structured interviews

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Management	Individual; Collective	Non-participant observations; Participant observation
Practices & Activities	Time spent in the garden; Composting*; Plague treatment*, Educational activities*,	Survey (Camps-Calvet et al., 2016) Participant observation; Semi-structured interviews;

*Not statistically tested as enabling factor for ES values.

127 *a. Gardeners' properties*

128 To examine which garden users' properties were enabling ES values, we used multivariate analysis (least-
129 square multiple regression). In addition to (a) age and (b) gender of gardeners which Dunnett & Quasim
130 (2000) had found to influence ES values, we included (c) education, (d) income, (e) origin and (f)
131 migration period of 201 garden users across 27 urban gardens in Barcelona in the assessment. The main
132 user properties described by Camps-Calvet et al. (2016) can be summarized as follows: About three-
133 quarters of all urban gardeners in Barcelona were found to be male, whereby female gardeners made up
134 about 40% in civic gardens and only about 14% in allotment gardens. Over 80% of the gardeners were
135 above an age of 50 and about 70% were retired. Around 40% of the gardeners had received higher
136 education (beyond secondary school), compared to 20.3% for all of Catalonia (www.idescat.cat, 2011).
137 More than one third of the urban gardeners in Barcelona reported a monthly household (average size of
138 2.5 persons) income below 1000€, another third of 1000-2000€, and about 15% above 2000€ (the
139 remainder of respondents were not willing to state their income). Gardeners originating from Barcelona
140 were 31%; those from other parts of Catalonia 8%; those from other parts of Spain (mainly from
141 Andalucía) 54%; those from other European member states 4%; and those from Non-European states 2%.
142 Over 80% of the Non-Catalan gardeners migrated to Barcelona during the large rural-urban migration
143 periods before 1980. For our analysis we dropped 30 samples from the original 201 survey samples due to
144 partially incomplete data from survey respondents. Garden user properties aggregated across the
145 remaining 171 samples were related as explanatory variables to ES values as dependent target variables,
146 while internal consistency was assured by means of Chronbach alpha (alpha=0.89). Explanatory variables
147 included age, and income (monthly income in a household divided by the number of people living in the

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148 household) as continuous variables and gender (0= female, 1= masculine), education (0= lower than
149 secondary education, 1= secondary education and higher), origin (0=childhood not spent in Barcelona; 1=
150 childhood spent in Barcelona), and migration period (0= after 1980, 1= before 1980) as binary variables.
151 The regression analysis was conducted in STATA 12.

152

153 *b. Biophysical garden properties*

154 To examine biophysical properties as enabling factors of ES values, we first applied a principal
155 component analysis (PCA) to the disaggregated data on ES values (based on Camps-Calvet et al., 2016).
156 Through a superimposition of biophysical garden properties on the PCA results, we then identified those
157 characteristics that showed a significant influence (0.005-level, tested against the unconstrained model
158 through permutation test for PCA under the reduced model) on differences in ES values. The biophysical
159 properties we considered as potentially relevant for influencing ES values included (a) size (surface &
160 number of gardeners), (b) land cover, which Breuste & Artmann (2014) assumed to influence ES values,
161 (c) human artefacts and (d) dominant land-uses in the surroundings of the garden. We assumed the size to
162 potentially influence relational values, such as social cohesion and place making (Chan et al., 2016). The
163 examination of land cover included the surface of cultivated plots, other green spaces (such as areas with
164 ornamental plants, lawns and trees), permeable surfaces (e.g. pebble-paths), and impermeable surfaces
165 (including pavement and shelters). We further examined human artefacts, such as compost-boxes,
166 benches, and shelters. Dominant land-uses in the surroundings, such as continuous urban fabric, parks or
167 transport infrastructure, were viewed as generating specific needs for ES. Biophysical properties were
168 assessed through spatial analysis conducted in *Miramont* and *ArcGIS* based on orthographic photographs
169 from the Catalan Cartographic Institute (resolution 1:5000) and complemented by field notes based on
170 participant (active engagement in gardening activities) and non-participant observations as well as
171 informal conversations with gardeners. The statistical analysis have been carried out in RStudio using the
172 'vegan'-script developed by Oksanen et al. (2013).

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173

174 *c. Institutional garden properties*

175 To examine the relation between institutional properties and ES values, we used the same procedure as
176 described above for biophysical properties, hence, a superimposition of institutional garden properties on
177 the PCA results. The institutional garden properties that have been tested include: (a) garden foundation
178 (civic gardens created by bottom-up citizen's initiatives / allotment gardens implemented by the
179 Barcelona's City Council), (b) property rights, (c) decision-making (public regulation / user assemblies),
180 (d) management (individual / collective plot tending), as well as (e) practices and activities (such as
181 composting, pest treatment, joint gardening, educational activities, group activities), and (f) the time spent
182 in the garden. The 'time spent in the garden', which Dunnett & Quasim (2000) had observed to positively
183 influence ES values, results from the survey are from 201 respondents and has been tested together
184 with the gardener properties as a binary variable (0= less than two hours; 1= more than two hours). All
185 other institutional properties have been assessed by means of semi-structured interviews (N=46),
186 conducted with 44 urban gardeners across all 27 urban gardens (these interviews were also used for the
187 identification of benefits from urban gardens presented in Camps-Calvet et al. 2016) and with two
188 municipal green space managers. Interview partners were chosen for long-term gardening experience or
189 for undertaking some kind of leadership or representation in the respective garden. The two interviews
190 with green space planners specifically addressed the property regime of public and civic gardens in
191 Barcelona. Following Colding et al. (2013), and based on Ostrom & Schlager (1996), property rights were
192 distinguished into the right of (a) access ("the right to enter a defined physical area and enjoy non-
193 subtractive benefits"), (b) withdrawal ("the right to obtain the resource units or 'products' of a resource"),
194 (c) management ("the right to transform the resource by making improvements"), (d) exclusion ("the right
195 to determine who will have an access right, and how that right may be transferred"), and (d) alienation
196 ("the right to sell or lease") (see Table 3; Colding et al., 2013; Ostrom & Schlager, 1996: 133).
197 Information obtained through the interviews was contrasted and complemented by a review of grey

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198 literature, including web-information, newspaper articles and planning documents as well as participant
199 and non-participant observations.

Table 3. Characterization of gardeners regarding their property 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				

Source: Colding *et al.* (2013), based on Ostrom & Schlager (1996).

Results

ES values of different types of gardens

200 With regard to the different ES values, urban gardens in Barcelona can be divided into two main clusters
201 shown in Figure 3. Values that are distinctive for the first cluster ('red cluster' referring to the framings in
202 Figure 3) are 'place-making', 'social cohesion' and 'political fulfilment'. Detailed NMDS results showing
203 bundles of ES values that are produced together are shown in Annex A. The red cluster is exclusively
204 formed by civic gardens. All gardens in this cluster are further characterized by relatively small
205 geographical sizes and respectively low numbers of workers. The vast majority (eight out of nine) of
206 these gardens were founded between 2009 and 2013 (except *Aki me planto* founded in 2003), after the
207 beginning of the economic crisis in Spain, and the gardeners were described as garden proprietors. In
208 addition, all gardens in this cluster were self-governed by participatory decision-making processes,
209 mostly through assemblies; and all (except the twin gardens *Poblenou 1* and *Poblenou 2*) used
210 collectively tended plots. Gardeners in civic gardens widely relied on organic horticultural practices,
211 including the use of manure and composted organic waste for fertilization, and various specific

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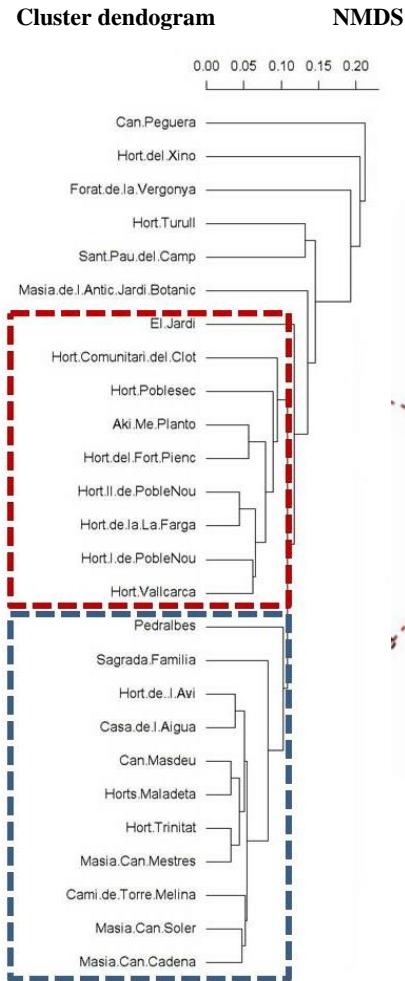
212 techniques for the prevention and treatment of pests and plagues, e.g. specific combinations of plant
213 species. Practices were generally orally agreed upon in gardeners' assemblies and enforced through
214 mutual control mechanisms. Common activities, such as the annual distribution of manure, joint meals,
215 educational events and open workshops were observed or reported in most civic gardens.

216
217 The typical ES values of gardens in the second cluster ('blue cluster' in Figure 3) include 'aesthetic
218 information', 'relaxation & stress reduction', 'entertainment & leisure' and 'biophilia'. In addition,
219 gardens in this cluster are highly valued for the provision of food (quality and quantity). This cluster
220 exclusively includes larger gardens (with twenty or more gardeners) that had been founded before 2009,
221 the beginning of the economic crisis in Spain. The cluster includes nine public gardens and two civic
222 gardens (*Can Masdeu* and *La Porta*). The two civic gardens are an exception in this cluster when it comes
223 to decision-making processes. *Can Masdeu* was the only garden in this cluster with participatory
224 decision-making; all other gardens in the cluster were characterized by top-down decision-making
225 processes. *La Porta* decisions were mainly taken individually. Public gardens provide gardeners with
226 proprietor rights (usually guaranteed for five years) over the plots and authorized user rights over the
227 remaining garden surface. Also, different than the other gardens in this cluster, gardeners in the two civic
228 gardens held proprietor rights over the entire garden surface. Due to the toleration by district authorities at
229 the time of our study, gardeners perceived their proprietor rights at *Can Masdeu* and *La Porta* as
230 relatively stable compared to most other civic gardens, though *La Porta*'s existence has been strongly
231 disputed in the time since our study. A common characteristic of all gardens in the blue cluster is the
232 principal tending of the gardens in individual plots (*Can Masdeu* embeds, in addition, a small collectively
233 managed area). The remaining six gardens (*Antic Jardí Botànic*, *Hort Turull*, *Sant Pau del Camp*, *Can*
234 *Peguera*, *Del Xino*, and *Forat de la Vergonya*) could not clearly be correlated with any larger cluster
235 regarding the ES values perceived. These gardens all show some peculiarities. For example, the particular
236 emergence of *Forat de la Vergonya* out of (violent) contestations (cf. Anguelovski, 2013), claimant rights

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237 exclusively held at *Antic Jardí Botànic*, or the particular land-cover at *Del Xino* that barely included any
238 area of food production (this garden was dismantled in 2017). Finally it should be noted that all gardens
239 in our study were almost equally perceived as valuable for the provision of regulating services, such as
240 pollination and improvements of the local climate. Values related to global climate regulations, which
241 were lower in smaller civic gardens, are an exception.

Figure 3: Common characteristics of urban gardens regarding their ecosystem service values.

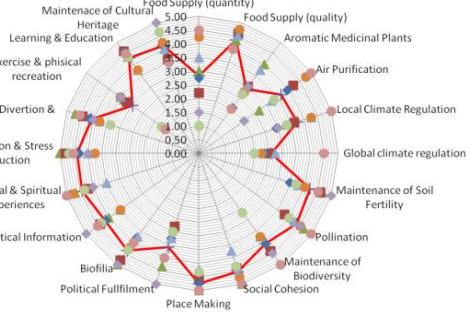


Garden characteristics

Red cluster

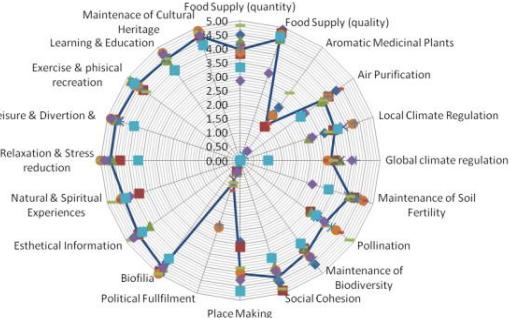
- Small geographical size / number of workers
- Emergence 2009-2013
- Participatory decision-making
- Proprietors
- Collective management
- 60% masculine gardeners
- High level of education
- Migration after 1990 (if applicable)

Ecosystem service values



Blue cluster

- Large geographical size / >20 workers per garden
- Emergence 2002-2009
- Top-down decision-making
- Auth. users of gardens / proprietors of plots
- Individual management
- >85% masculine gardeners
- Extreme low level of education
- Migration before 1970 (if applicable)



Left: Cluster dendrogram showing two main clusters (red and blue frame).

Centre left: 'Top view' of the two main clusters (based on NMDS).

Centre right: Generalization of garden characteristics in the two main clusters (exceptions are given).

Right: Ecosystem service values in the two main garden clusters.

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Factors enabling ES values

242 When observing different ES values in the distinctive gardens, as a second step, we systematically
243 examined the specific enabling factors for ES values. An overview of the main characteristics of urban
244 gardens in Barcelona underlying the examination is given in Annex A. Significant factors have been found
245 across all three domains, (a) gardeners' properties, (b) biophysical garden structures and (c) the
246 institutional garden settings. Results from the correlation analysis between gardeners' properties and ES
247 values are shown in Table 4; overall gardeners' properties only explained 24.0% of the variance,
248 indicating that there were other important factors, such as biophysical and institutional garden properties,
249 enabling ES values. An overview of biophysical and institutional characteristics that significantly
250 ($P \leq 0.005$) influenced ES values is given in Figure 4. These results derived from a PCA explained another
251 46.3% of the variance. This means that overall, more than 70 % of the variance of ES values can be
252 explained by the enabling factors systematically addressed in this study.

253
254 *a. Gardeners' properties*
255 Among the specific characteristics of garden users (assessed by Camps-Calvet et al., 2016), gender
256 ($P \leq 0.001$), education ($P \leq 0.05$) and migration period ($P \leq 0.05$), were found to determine the values of
257 urban gardens significantly. For dichotomous variables, such as gender, the negative correlation observed
258 means that women (variable: 0) value ES higher than men (variable: 1) (Figure 4). Respectively gardeners
259 with lower education levels (0) attach higher values than those with higher education levels (1), and
260 people who migrated to Barcelona before 1980 (0) perceive in average a higher importance of ES from
261 urban gardens than their peers who arrived later (1). In addition, gardeners' income ($P \leq 0.1$) and origin

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262 (P≤0.1) may have an influence on the perception of values, whereby individuals with lower income and

263 gardeners from Barcelona valued gardens to a greater extent than their peers.

Post-Print

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Table 4. Correlations between properties of urban gardeners and ES values

Explanatory Variable	Definition	Coefficient (standard error)	P> T
<i>Gender</i>	<i>Dichotomous variable:</i> Woman (0) Man (1)	-0.3376 (0.0893)	0.000***
<i>Age</i>	<i>Continuous variable:</i> Respondent's age (in years)	0.0013 (0.0032)	0.694
<i>Education</i>	<i>Dichotomous variable:</i> Lower than secondary school (0) Secondary school and higher (1)	-0.2034 (0.1063)	0.057*
<i>Income</i>	<i>Continuous variable:</i> Monthly household income divided by total persons living in the household	-0.0002 (0.0000)	0.100*
<i>Origin</i>	<i>Dichotomous variable:</i> Not born in Barcelona (0) Born in Barcelona (1)	0.2109 (0.1178)	0.075*
<i>Migration period</i>	<i>Dichotomous variable:</i> Migrated to Barcelona after 1980 (0) Migrated to Barcelona before 1980 (1)	0.2844 (0.1391)	0.042**

Significance levels (P>|T|): ***0.01, **0.05, *0.1. For dichotomous variables: A positive correlation means the variable 1 values ES higher than the variable 0, and vice-versa. For continuous variables: A positive correlation means that the higher the value of the variable the higher the value for ES, and vice-versa.

264 b. *Biophysical garden properties enabling ES values*

265 Among the biophysical garden properties, the size of gardens was the only characteristic with significant

266 ($P \leq 0.005$) influence on the perception of ES values both in terms of surface and number of gardeners

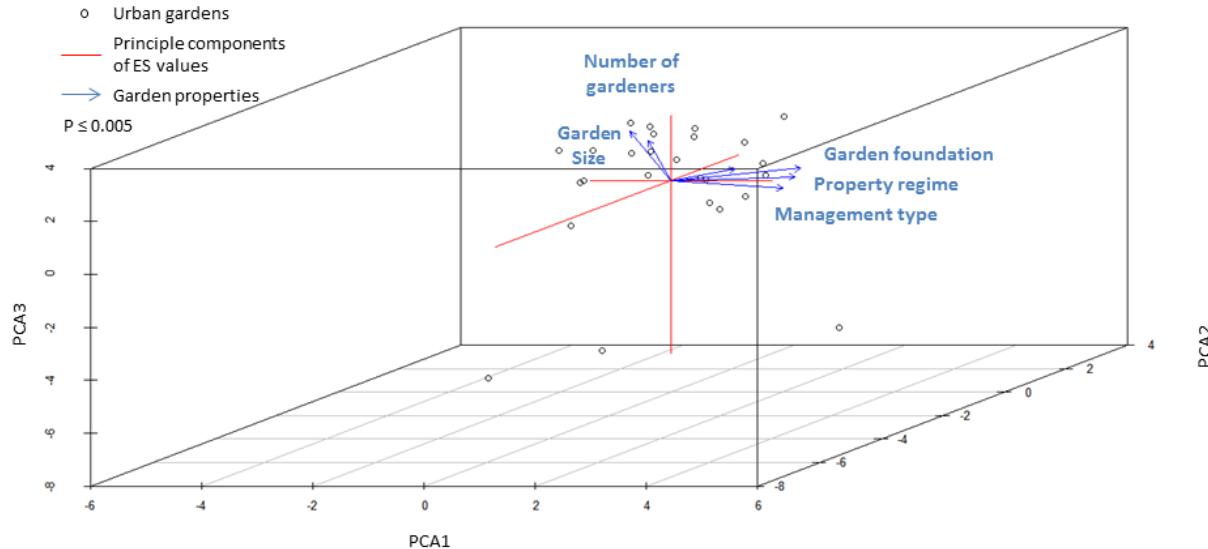
267 (Figure 4). The size of gardens in our sample ranged between 274m^2 and 9125m^2 , correspondingly, the

268 number of active gardeners ranged from 5-10 in smaller gardens, like *Forat de la Vergonya, Poble-sec* or

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269 *Del Xino*, to over 50 gardeners in *Can Masdeu* and the twin-gardens *Poblenou 1* and *Poblenou 2*. A
270 surprising finding from our study is that the land cover did not significantly explain ES values despite
271 the fact that it varied considerably between gardens. For example, at *Hort del Xino* the space for
272 horticultural cultivation was limited to about 5%, while in other gardens, 80% or more of the gardens'
273 surface was used for the cultivation of food plants. Yet, our methodology shows some limitations with
274 regard to the examination of land uses since exceptional observations such as the use of high-beds (due to
275 known or suspected soil pollution), or the specific use of land for the reproduction of seeds for the
276 maintenance of landraces, as observed at *Antic Jardí Botànic*, could not be considered in the statistical
277 testing. The same is true for the cultivation of specific landraces by migrant gardeners, i.e. local,
278 traditional, horticulture varieties, including *Solanum tuberosum*, *Vicia faba* and *Lactuca sativa*, while
279 differences in cultivated plant varieties were generally small (most commonly including *Allium cepa*,
280 varieties of *Brassica oleracea*, *Beta vulgaris*, *Capsicum annuum*, *Daucus carota*, *Fragaria × ananassa*,
281 *Lactuca sativa*, *Solanum lycopersicum*, *Solanum melongena*, *Solanum tuberosum*, *Spinacia oleracea*, and
282 *Vicia faba*). Garden equipment and surroundings also did not show significance as factors that enable ES
283 values.
284

Figure 4: Significant biophysical and institutional garden properties enabling ES values



285 *c. Institutional garden properties enabling ES values*

286 Institutional garden properties assessed in our study included common rules and practices. Of different
 287 gardening practices, only the time spent in the garden showed significant influence ($P \leq 0.04$; Coefficient
 288 0.20; Standard error 0.10) on ES values. In addition, we found the year of the gardens' foundation
 289 statistically significant in its influence on ES values ($P \leq 0.005$). Other significant enabling factors
 290 determining ES values were the management type ($P \leq 0.005$), i.e. tending of gardens either collectively or
 291 individually, and gardeners' property rights ($P \leq 0.005$). In civic gardens, gardeners effectively act as
 292 proprietors, conducting rights of access, withdrawal, management, and exclusion. However, only a
 293 minority of civic gardens aspired for and reached legal agreements with the formal land owners, and the
 294 proprietor right was often disputed. Formal toleration from the district governments exists for *Forat de la*
 295 *Vergonya* (cf. Anguelovski 2013). Gardeners in public gardens can be described as hybrids between
 296 authorized users and proprietors (see Table 1). For their individual plots they hold proprietors rights for a
 297 non-renewable five-year term, which includes rights of access, withdrawal, management, and the right of

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298 exclusion. Yet, individual plots in public gardens covered on average only 51% (range: 30-75%) of the
299 gardens' total surfaces. For the remaining garden surface gardeners only hold the rights of *access*, and
300 withdrawal, which defines the gardeners as authorized users of these areas (an exception is the garden *De*
301 *l'Avi*, where gardeners also hold the right to manage areas not included in their plots). A singular case
302 regarding the gardeners' property rights is again *Hort de la Masia de l'Antic Jardí Botànic*. This garden
303 was run by volunteers organized in a formal association under professional guidance; which defines the 20
304 gardeners as claimants, assigned with access, withdrawal, and limited management rights.

Discussion

305 Our study explores the generation of ES values in 27 urban gardens of Barcelona. While biophysical
306 properties, except garden size in terms of surface and number of gardeners, seem to have only a limited
307 influence on the different values of urban gardens, a major finding of this work is that ES values - which
308 we presume to incentivize stewardship practices - are more strongly correlated with institutions and the
309 characteristics of garden users. In terms of theoretical context, we suggest that our exploration herein
310 provides new insights on the role of 'urban green commons' (Colding et al., 2013), as a noteworthy link to
311 and foundation for future research on bottom-up nature-based solutions in the field of transitions thinking
312 towards more sustainable cities (e.g. Geels & Raven, 2006; Grin et al., 2010). Such transitions and the
313 required 'niche innovations' (Schot & Geels, 2008) have been receiving much attention of late (Kabisch et
314 al., 2016). However, technological innovations within, for instance, energy technologies and infrastructure
315 (e.g. Boyd & Juhola, 2014) seem to have gained more interest than socially innovative nature-based
316 approaches. Based on this shortcoming, Seyfang & Haxeltine (2012) suggest that social aspects, such as
317 identity building and sense of community within wider societal shifts, need more theoretical consideration
318 and development. Knowledge on the foundation of human values related to ES may thereby provide valid

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319 information for urban green space governance (Primmer & Furman, 2012) that enhances environmental
320 stewardship and thereby the adaptive capacity to maintain and increase ES values for human wellbeing in
321 cities (Dietz et al., 2003; Folke et al., 2005).

Value(s) of gardens for inclusive urban regeneration

322 It has been argued that the specific situation of economic crisis, present in Barcelona since 2009, enhanced
323 a politically motivated civic gardening and environmental stewardship movement as a resistance to
324 predominant models of urban development (Camps-Calvet et al, 2015). In this context, it is worth
325 highlighting that in post-crisis gardens (red cluster) the political ideal of food sovereignty and the
326 knowledge of food production were far more important than the actual quantity of produced food. The
327 emergence of urban gardens in Barcelona during the economic crisis can thus not (mainly) be explained
328 with the need for enhanced food supply — the small surface of gardens in the red cluster and a lower
329 proportion of land used for the cultivation of food plants reflect this — but rather as the cultivation of
330 mind and utopias, i.e. 'food for thought', and experimental engagement with the urban environment.

331
332 The smaller surface and a limited number of gardeners seem to enhance the perception of *collective values*
333 in urban gardens. That means relational values associated with cultural ES experienced in groups (cf. Chan
334 et al. 2016), such as 'political fulfilment', 'social cohesion' and 'place-making', i.e. the community-based
335 creation of meaning in relation to the garden's physical and social design (Noori, & Benson, 2016).

336 Results indicate a considerable shift towards these *collective values*, expressing both contestations to the
337 predominant institutional model as well as a request for stronger community resilience in cities (Camps-
338 Calvet et al., 2015), since the beginning of the economic crisis in 2009.

339

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340 Tidball (2012) explains the “community-based ecological restoration” in moments of crisis are
341 manifestations of an urge to express human’s affinity with nature through the creation of restorative
342 environments; this may allow citizens to reconnect to their “ecological self and sense of ecological place”
343 (Tidball & Stedman, 2013). Civic gardens in Barcelona may thus be interpreted as places where adaptive
344 capacity in the face of the economic crisis is built. In this line of thinking, gardens can be seen as seeds for
345 adaptation and transition, and claims for a just and sustainable city (Dempsey et al., 2011; Fainstein,
346 2010). Put in other words, urban gardens serve as protective membranes for niche innovations (Schot &
347 Geels, 2008) and places for experiments with new and diverse forms of value articulation, decision-
348 making, social practices in a potential transition towards an socially inclusive and ecosystem based urban
349 regeneration (*cf.* Bendt et al., 2013).

Value(s) of urban gardens for environmental stewardship

350 Results show values of urban gardens to be at least partly related to the socio-demographic characteristics
351 of garden users’. Thereby, confirming previous findings by Dunnett & Quasim (2000). It has been argued
352 that citizens lacking economic purchasing power, (especially retired and unemployed people) have
353 stronger incentives for engaging in urban gardening (Camps-Calvet et al., 2016). We believe in addition,
354 that childhood socialization might be a strong incentive for environmental stewardship through urban
355 gardening. This belief is fortified by the fact that a large majority of citizens who engage in urban
356 gardening migrated to Barcelona from rural areas where increased exposure to agriculture is likely.
357 Despite there being fewer female urban gardeners in Barcelona, there seemed to be a stronger appreciation
358 of ES by female garden users. Martín-López et al. (2012) related stronger female environmental
359 stewardship to the specific role of women in agro-ecological labour, expertise and knowledge. The low
360 number of female gardeners in Barcelona, which stands in sharp contrast to figures with regard to the

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361 gender of gardeners from Northern Europe (Barthel et al., 2010), might indicate institutional or cultural
362 barriers impeding females from engaging in urban gardening. Yet, civic gardens have shown to be more
363 inclusive with regard to gender. Results also indicate that lower educational levels stipulate the
364 appreciation of urban gardens for the provision of ES, indicating that formal education does not
365 necessarily increase awareness for the importance of multi-functional green spaces in cities. If these
366 observations hold true, the inherent social-ecological understanding gained during childhood might be a
367 stronger incentive for civic engagement in local stewardship action than formal cognitive appreciation of
368 ES values (cf. Giusti et al., 2014). Future research on environmental stewardship is encouraged to address
369 the role of migrant gardeners, female gardeners and childhood experiences more thoroughly.

370

371 Opposite from our expectations, differences in the land-uses of urban gardens did not appear to play a
372 critical role for different ES values of urban gardens. On the one hand, this may be due to the fact that
373 gardens are quite homogenously perceived as valuable for the provision of regulating services and habitat
374 services, which we expected to be the closest ES values related to land-use for their stronger biophysical
375 character. On the other hand, various specificities of land uses could not be tested for their statistical
376 significance and thus escaped our systematic analysis. We assume these factors to be embedded in the
377 30% of variance in ES values that our methodological approach was not able to explain.

378

379 Results showed a stronger perception of *individual values* such as 'aesthetic information', 'relaxation &
380 stress reduction', and 'biophilia', related to gardens founded before 2009. *Individual values* are often
381 rooted in long-term care and stewardship relations (cf. Chan et al. 2016). Gardeners in older gardens were
382 also more inclined to develop place specific knowledge and values with a bearing on food production,
383 both in terms of quality and quantity, and the exchange of such knowledge through learning and

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384 education. Results akin to this observation have been found for urban gardens in Berlin. Bendt et al.
385 (2013) highlighted that social practices and social learning as well as political engagement had stronger
386 importance in younger gardens and described a focus on individual values in older gardens. This finding
387 might point towards a more general pattern between the values of younger and older gardens. It may also
388 potentially imply a trade-off for urban planning that aims to boost the stewardship of ES between
389 collective values, such as place-making and social cohesion, and individual values, such as recreation (cf.
390 Bendt et al., 2013).
391
392 Our results further demonstrate links between property rights and ES values generated by urban gardens.
393 The strong value for place-making, often the base for sense of place and community (cf. Raymond et al.,
394 2010; Noori, & Benson, 2016) in civic gardens indicates a beneficial relationship between extended
395 property rights to inclusive urban green spaces and the creation of *collective values*. Since cities are
396 usually loci of social diversity (Zanoni & Janssens, 2009), we argue here that green spaces with property
397 rights that are inclusive to a rich variety of lifestyles, gender, ethnicities and different age-groups, are
398 rendered especially relevant for environmental stewardship among heterogeneous urban populations
399 (Colding & Barthel, 2013). Gardeners who hold proprietor rights have the possibility to learn how to adapt
400 the garden's physical and institutional design with regard to the ES they appreciate most, which makes
401 their engagement more beneficial. From the perspective of adaptive ecosystem governance (Boyd &
402 Folke, 2011), creating a feedback-loop that allows for an alteration of the social-ecological properties of
403 urban gardens to changing human demands, depends on the capacity of institutional actors to consider
404 citizens' values (Dietz et al., 2003). In gardens, where gardeners have reduced ability to decide on and
405 design the social-ecological garden structure, this feedback is not given. In this context, the recent shift in
406 urban garden policies by Barcelona's municipal green space planners towards the '*Pla Buits*' (*Empty-*

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407 *Spaces Plan*) seems worth mentioning, amplifying both property rights and physical space for the civic
408 management of urban green spaces might foster adaptive management given '*Pla Buits*' gardens will
409 remain over time. Our study further indicates that public gardens embedded in the municipal garden
410 program constitute a concrete potential to introduce experimental co-creation structures by extending
411 gardeners' management rights beyond the individual garden plots and involving them in decision-making.

Conclusion

412 From the perspective of civic ecology (Krasny & Tidball, 2009^b) "the sustainable city does not only weave
413 nature into its physical landscape, but also into the everyday practices and experiences of its citizens"
414 (Bendt et al., 2013:29). Thinking of cities as coupled social-ecological systems is still not yet widely
415 adapted in urban planning. However we found here that *values* related to garden ES in urban Barcelona
416 tend to emerge from complex social-ecological relations, including institutions mediating interrelations
417 between the social and biophysical space in cities. Properties of relevance are the size of gardens
418 (including surface and number of gardeners), the management regimes, the property rights and the gender,
419 education and migratory background of the gardeners. Our study thereby shows that a more holistic
420 understanding and consideration of the underlying properties that give value(s) to urban gardens is
421 required to improve urban planning and to design nature-based solutions as integrated parts of urban green
422 infrastructure strategies.

423
424 Cities are rapidly developing from socio-demographic and biophysical perspectives, and the stewardship
425 of ES for urban inhabitants is among the great challenges in an urbanizing world. Involving civic
426 stewardship groups have been highlighted as a promising way to build creative capacity and resilience in
427 cities (Colding & Barthel, 2013; Andersson et al., 2014). Our study creates new understanding about

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428 motivations for people to engage in civic stewardship, by highlighting underlying properties that give

429 value(s) to ES generated by gardens in Barcelona.

430

431 However, incentivizing civic engagement in local stewardship activities does not seem as linear as
432 creating awareness for the values related to ES from urban green spaces. For instance, our study suggests
433 that civic institutions and childhood socialization, including gender roles and the understanding of social-
434 ecological relations (usually gained in rural environments), may be an important explanation for valuing
435 urban gardens and engaging in stewardship action. The confirmation of these findings in future research
436 will increase the challenge to create environmental stewardship in a world of an increasingly
437 individualized life-style, where more and more people living in cities do not experience direct
438 dependencies on healthy ecosystems in their day-to-day life. Even small patches of green spaces, such as
439 urban gardens in Barcelona, may thus become important pieces for an inclusive urban regeneration that
440 allows civic engagement in stewardship relationships with nature.

441

442 From our study we assume that judiciously designed green infrastructure strategies might enhance or

443 modify people's stewardship motivations. Hence, green infrastructure strategies must take into account

444 and draw on the fact that cities are often hotspots of tensions between cosmopolitan mindscapes and local

445 pockets of resistance, rich in terms of diversity related to world-views and life-styles. Therefore

446 opportunity structures for stewardship should be tailored to fit micro-scale specific urban circumstances.

447 Future studies may engage in a comparative agenda with focus on motivations related to urban civic

448 stewardship across cities of varying histories and geographies. Also, action-based research approaches

449 might create further understanding on barriers to the stronger inclusion of specific social groups, including

450 female and migrants, in urban gardening.

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451

452 This paper ends with a policy suggestion to green planning authorities in Barcelona and elsewhere;

453 flexibility and tolerance to pluralistic ways in how urban gardens may be managed, gained through civic

454 engagement and participatory decision-making, may broaden the relevance of urban gardens as innovative

455 stewardship arenas for ES generation. Such a strategy promises to attract broader citizen groups that seek

456 to intertwine gardening practices with wider sets of issues: cultural, political, community, and spiritual.

457 This may further increase the importance of urban gardens as restorative urban pockets and places for

458 social-ecological experiments, as well as to motivate people to engage in transiting towards a more

459 socially inclusive, sustainable, and resilient cities.

References

Andersson E., Barthel, S. (2016). Memory Carriers And Stewardship of Metropolitan Landscapes. *Ecological Indicators*, 70, 606–614.

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

Andersson, E., Barthel, S., Borgström, S., Colding, J., Elmquist, T., Folke, C., Gren, Å. (2014). Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. *Ambio*, 43(4), 445-453.

Anguelovski, I. (2013). Beyond a livable and green neighborhood: Asserting control, sovereignty and transgression in the Casc Antic of Barcelona. *International Journal of Urban and Regional Research*, 37(3), 1012-1034.

Armstrong, D. (2000). A survey of community gardens in upstate New York: Implications for health promotion and community development. *Health & Place*, 6(4), 319-327.

Barcelona City Council (2015). Pla Buits (Empty-Spaces Plan). In Catalan. Available online: <http://www.bcn.cat/habitatge/plabuits>. Latest access: 27/05/2015.

Barcelona City Council (2013). Barcelona green infrastructure and biodiversity plan 2020. (Original title: Plan del verd i de la biodiversidad de Barcelona 2020). Barcelona. In Catalan with English summary.

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Barthel, S., Folke, C., & Colding, J. (2010). Social–ecological memory in urban gardens—Retaining the capacity for management of ecosystem services. *Global Environmental Change*, 20(2), 255–265.

Barthel, S., & Isendahl, C. (2013). Urban gardens, agriculture, and water management: Sources of resilience for long-term food security in cities. *Ecological Economics*, 86, 224–234.

Bendt, P. Barthel, S. and Colding, J. (2013). Civic greening and environmental learning in public-access community gardens in Berlin. *Landscape and Urban planning*, 109, 18–30.

Boyd, E., & Folke, C. (Eds.). (2011). *Adapting institutions: Governance, complexity and social-ecological resilience*. Cambridge University Press.

Boyd, E., & Juhola, S. (2014). Adaptive climate change governance for urban resilience. *Urban Studies*, 0042098014527483.

Breuste, JH. (2010): Allotment Gardens as Part of Urban Green Infrastructure: Actual Trends and Perspectives in Central Europe. In: Müller, N., Werner, P. and Kelcey, JG. (eds) *Urban Biodiversity and Design*. Blackwell Publishing Ltd, 463-476.

Breuste, J. H., & Artmann, M. (2014). Allotment Gardens Contribute to Urban Ecosystem Service: Case Study Salzburg, Austria. *Journal of Urban Planning and Development*.

Calvet-Mir, L., March, H., Nordh, H., Pourias, J., & Čakovská, B. (2016). Motivations behind urban gardening. In Bell, S., Fox-Kämper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., & Voigt, A. (Eds.). *Urban Allotment Gardens in Europe*. Routledge. 320-341.

Camps-Calvet, M., Langemeyer, J., Calvet-Mir, L., Gómez-Bagethun, E., March, H. (2015). Sowing Resilience and Contestation in Times of Crises: The Case of Urban Gardening Movements in Barcelona. *Partecipazione e Conflitto*, 8(2), 417-442.

Camps-Calvet, M., Langemeyer, J., Calvet-Mir, L., Gómez-Bagethun, E. (2016). Assessment and valuation of ecosystem services provided by urban gardens in Barcelona, Spain: Insights for policy and planning. *Environmental Science and Policy*, 62, 14-23.

Caputo, S., Schwab, E., & Tsiambaos, K. (2016). Emergent approaches to urban gardening. In Bell, S., Fox-Kämper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., & Voigt, A. (Eds.). *Urban Allotment Gardens in Europe*. Routledge. 229-253.

Chan, K. M., Guerry, A. D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., ... & Woodside, U. (2012). Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), 744-756.

Chan, K. M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Bagethun, E., ... & Luck, G. W. (2016). Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, 113(6), 1462-1465.

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Colding, J., Barthel, S. (2013). The potential of 'Urban Green Commons' in the resilience building of cities. *Ecological Economics* 86: 156-166.

Colding, J., Barthel, S., Bendt, P., Snep, R., van der Knaap, W., & Ernstson, H. (2013). Urban green commons: Insights on urban common property systems. *Global Environmental Change*, 23(5), 1039-1051.

Connolly, J. J., Svendsen, E. S., Fisher, D. R., & Campbell, L. K. (2013). Organizing urban ecosystem services through environmental stewardship governance in New York City. *Landscape and Urban Planning*, 109(1), 76-84.

Dempsey, N., G. Bramley, S. Power., & C. Brown (2011). The social dimension of sustainable development: defining urban social sustainability. *Sustainable Development* 19:289-300.

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science*, 302(5652), 1907-1912.

Domene, E., & Saurí, D. (2007). Urbanization and class-produced natures: Vegetable gardens in the Barcelona Metropolitan Region. *Geoforum*, 38(2), 287-298.

Doyle, R., & Krasny, M. (2003). Participatory rural appraisal as an approach to environmental education in urban community gardens. *Environmental Education Research*, 9(1), 91-115.

Dunnett, N., & Qasim, M. (2000). Perceived benefits to human well-being of urban gardens. *HortTechnology*, 10(1), 40-45.

Fainstein, S. S. 2010. *The Just City*. Cornell University Press, USA.

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

Fuller, R. A., & Gaston, K. J. (2009). The scaling of green space coverage in European cities. *Biology letters*, 5(3), 352-355.

Geels, F., & Raven, R. (2006). Non-linearity and expectations in niche-development trajectories: ups and downs in Dutch biogas development (1973–2003). *Technology Analysis & Strategic Management*, 18(3-4), 375-392.

Giacchè, G. & Tóth, A. (2013). COST Action Urban Agriculture Europe: UA in Barcelona Metropolitan Region. Short Term Scientific Mission Report.

Giusti, M., Barthel, S., & Marcus, L. (2014). Nature Routines and Affinity with the Biosphere: A Case Study of Preschool Children in Stockholm. *Children Youth and Environments*, 24(3), 16-42.

Gómez-Baggethun, E. R. de Groot (2010). Natural capital and ecosystem services: the ecological foundation of human society. In R.E. Hester and R.M. Harrison (Eds). *Ecosystem Services: Issues in Environmental Science and Technology*. Cambridge: Royal Society of Chemistry, 105–21.

Gómez-Baggethun, E., Kelemens, E. (2008). Linking institutional change and the flows of ecosystem services. Case studies from Spain and Hungary. In: Kluvánková-Oravská, T., Chobotova, V., Jílková, J., (Ed.), *Institutional Analysis of Sustainability Problems*, Slovak Academy of Sciences, 118-145.

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Gómez-Bagethun E, Gren Å, Barton DN, Langemeyer J, McPhearson T, O'Farrell P, Andersson E, Hamstead Z, Kremer P (2013). Urban Ecosystem Services. In Elmquist T. (Ed.): *Urbanization, biodiversity and ecosystem services*. Springer (open): 175-251. Available online: http://link.springer.com/content/pdf/10.1007%2F978-94-007-7088-1_11.pdf

Grin, J. (2010). Understanding transitions from a governance perspective. *Transitions to sustainable development: New directions in the study of long term transformative change*, 221-319.

Guitart, D., Pickering, C. & J. Byrne (2012). Past results and future directions in urban community gardens research. *Urban Forestry & Urban Greening* 11:364– 373

Haase D, Larondelle N, McPhearson T, Schwarz N, Hamstead Z, Kremer P, Langemeyer J, ... & Elmquist T (2014): Quantitative review of urban ecosystem services assessment: Concepts, models and implementation. *AMBIO*, 43:413–433.

Hawkins, J. L., Thirlaway, K. J., Backx, K., & Clayton, D. A. (2011). Allotment gardening and other leisure activities for stress reduction and healthy aging. *HortTechnology*, 21(5), 577-585.

Healey, P., (2007). *Urban Complexity and Spatial Strategies: Towards a Relational Planning for Our Times*. Routledge, London.

Hynes, H. P., & Howe, G. (2002). Urban horticulture in the contemporary United States: personal and community benefits. In *International Conference on Urban Horticulture* 643: 171-181.

IDESCAT – Institut d'Estadística de Cataluña (2013). Available online: <http://www.idescat.cat/pub/?id=aec&n=415>; latest access 18/01/2015.

Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., ... & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and Society*, 21.

Keshavarz, N., Bell S. (2016) History of urban gardens in Europe. In Bell, S., Fox-Kämper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., & Voigt, A. (Eds.). *Urban Allotment Gardens in Europe*. Routledge. 8-32.

Krasny, M.E., Tidball, K.G., (2009a). Community gardens as contexts for science, stewardship, and civic action learning. *Cities and the Environment* 2, 1–18.

Krasny, M. E., Tidball, K. G. (2009b). Applying a resilience systems framework to urban environmental education. *Environmental Education Research*, 15(4), 465-482.

Kremer, P., Hamstead, Z., Haase, D., McPhearson, T., Frantzeskaki, N., Andersson, E., ... & Elmquist, E. (2016). Key insights for the future of urban ecosystem services research. *Ecology & Society*, 21(2).

Langemeyer, J., Latkowska, M.J., Nicolas Gomez-Bagethun, E. (2016). Ecosystem services from urban gardens. In Bell, S., Fox-Kämper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., & Voigt, A. (Eds.). *Urban Allotment Gardens in Europe*. Routledge. 115-141.

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Litt, J. S., Soobader, M. J., Turbin, M. S., Hale, J. W., Buchenau, M., & Marshall, J. A. (2011). The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption. *American journal of public health*, 101(8), 1466-1473.

Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., Del Amo, D. G., ... & González, J. A. (2012). Uncovering ecosystem service bundles through social preferences. *PloS one*, 7(6), e38970.

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in ecology & evolution*, 20(8), 430-434.

Noori, S., & Benson, M. (2016) Urban allotment garden: A case for place-making. In Bell, S. et al. (ed.) *Urban Allotment Gardens in Europe*. Routledge, London, 291-319.

Oksanen, J., G. Blanchet, R. Kindt, P. Legendre, P.R. Minchin, R. B. O'Hara, G. L. ... & H. Wagner (2013). RPackage: vegan. Community Ecology Package (Version: 2.0-10) Available online: <http://cran.r-project.org>, <http://vegan.r-forge.r-project.org/>

Ostrom, E. (2009). *Understanding Institutional Diversity*. Princeton University Press.

Ostrom, E., Schlager, E. (1996). The formation of property rights. In: Hanna, S., Folke, C., Mäler, K.-G. (Eds.), *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. Island Press, Washington D.C, USA.

Primmer, E., & Furman, E. (2012). Operationalising ecosystem service approaches for governance: do measuring, mapping and valuing integrate sector-specific knowledge systems? *Ecosystem Services*, 1(1), 85-92.

Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: personal, community and environmental connections. *Journal of Environmental Psychology*, 30, 422e434.

Roca, E. (2000). Montjuïc, la muntanya de la ciutat. Barcelona: Institut d'Estudis Catalans, Secció de Ciències i Tecnologia. (In Catalan)

Rockström J. (2015). Bounding the Planetary Future: Why We Need a Great Transition. Great Transition Initiative. Available online: <http://www.greattransition.org/publication/bounding-the-planetary-future-whywe-need-a-great-transition>.

Scholte, S. S., van Teeffelen, A. J., & Verburg, P. H. (2015). Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. *Ecological Economics*, 114, 67-78.

Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), 537-554.

Seto, K.C., Fragkias, M., Güneralp, B. Reilly, M.K. (2011). A meta-analysis of global urban land expansion. PLoS ONE, 6(8), e23777

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Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy*, 30(3), 381-400.

Stadt Leipzig (2015^a). Kleingartenanlagen (Allotments). In German. Available online: <http://www.leipzig.de/freizeit-kultur-und-tourismus/parks-waelder-und-friedhoefe/kleingartenanlagen/>. Latest access: 27/05/2015.

Stadt Leipzig (2015^b). Available online: <http://statistik.leipzig.de>. Latest access: 10/08/2015.

TEEB (2010). *The Economics of Ecosystems and Biodiversity: Ecological and economic foundations*. UNEP/Earthprint. Available online: www.teebweb.org.

Teig, E., Amulya, J., Bardwell, L., Buchenau, M., Marshall, J. A., & Litt, J. S. (2009). Collective efficacy in Denver, Colorado: Strengthening neighborhoods and health through community gardens. *Health & Place*, 15(4), 1115-1122.

Tidball, K. G. (2012). Urgent biophilia: human-nature interactions and biological attractions in disaster resilience. *Ecology and Society*, 17(2), 5.

Tidball, K., & Stedman, R. (2013). Positive dependency and virtuous cycles: From resource dependence to resilience in urban social-ecological systems. *Ecological Economics*, 86, 292-299.

United Nations (2014). Open working group proposal. Sustainable Development Goals. A/68/970. Available online: <http://undocs.org/A/68/970>

Van den Berg, A. E., Maas, J., Verheij, R. A., & Groenewegen, P. P. (2010). Green space as a buffer between stressful life events and health. *Social science & medicine*, 70(8), 1203-1210.

Vendrell, E. & Clanchet J. (1992). Barcelona: 1986-1992. Transformation of an olympic city (Original title in catalan: Barcelona: 1986-1992. Transformació d'una ciutat olímpica). Barcelona Holding Olimpic SA. Video. 04/01/2015: https://www.youtube.com/watch?v=Hz2WSAXja6M&feature=player_detailpage (last access).

Wilson, E. O. (1984). *Biophilia*. Harvard University Press.

Zammit, A., & Erjavec, I. Š. (2016). Allotment gardens as a challenge for an urban designer. In *Urban Allotment Gardens in Europe*. Bell, S., Fox-Kämper, R., Keshavarz, N., Benson, M., Caputo, S., Noori, S., & Voigt, A. (Eds.). *Urban Allotment Gardens in Europe*. Routledge. 254-287.

Zanoni, P., Janssens, M., 2009. Sustainable DiverCities. In: Janssens, M., Pinelli, D., Reyman, D.C., Wallman, S. (Eds.), *Sustainable Cities. Diversity, Economic Growth and Social Cohesion*. Edward Elgar, Cheltenham, UK, pp. 3–25.

Zick, C. D., Smith, K. R., Kowaleski-Jones, L., Uno, C., & Merrill, B. J. (2013). Harvesting more than vegetables: the potential weight control benefits of community gardening. *American Journal of Public Health*, 103(6), 1110-1115.