Environ Monit Assess (2018) 190:613
https://doi.org/10.1007/s10661-018-6985-8

Urban ecosystem services delivered by green open spaces: an example from Nicosia City in North Cyprus

Gulay Cetinkaya Ciftcioglu · **Aslihan Aydin**

Received: 3 May 2018 / Accepted: 18 September 2018

Abstract The purpose of this study is to evaluate the major urban ecosystem services (UESs) delivered by a number of green open spaces (GOSs) and their contributions to the human wellbeing (HWB) in four selected sites located in the city of Nicosia of North Cyprus. The objectives of the study were to map the dominant GOSs in the selected sites, to identify the plant species cultivated in the GOSs, and to evaluate the major UESs delivered by the GOSs and their contributions to the components of HWB. The conceptual framework of the Millennium Ecosystem Assessment was adopted to evaluate the linkages between the different types/components of GOSs, UESs, and HWB. The relevant data were collected by combining quantitative (questionnaire) and qualitative (semi-structured interviews and field surveys) research tools. The collected data were evaluated on a 1–5 Likert scale. Overall, 31 UESs and 14 components of HWB were evaluated. The results of the evaluation revealed that 229 plant species are cultivated in the GOSs. The total average relative value of the UESs delivered by the dominant GOSs was estimated to be very low with 2.43 points. The total average relative contribution of the UESs to the HWB seems to be low with 3.56 points. Plant diversity was identified as the main criterion that influences the degree of UESs. We hope that the results of this study can help policy-makers and planners to design more effective policies in terms of building resilient cities and societies in the city of Nicosia and elsewhere.

Keywords Urban ecosystem services · Green open spaces · Social preference approach · Human wellbeing · Nicosia

Introduction

Cities are complex social-ecological landscape systems, which are facing enormous challenges (e.g., climate change, demographic aging, natural resource depletion, and intensive urbanization) (Burkhard et al. 2010; McPhearson et al. 2014; Pickett et al. 2001). The construction sector especially requires extensive resources and therefore puts a great deal of pressure on the urban landscapes. However, the continuous increase in urbanization threatens biodiversity, ecosystem functions, and human welfare in the urban landscapes (Haase et al. 2014). For that reason, the current trend in the urban landscape planning is to draw attention to the critical role of green open spaces for designing more resilient urban landscapes and improving the health of urban society.

Green open spaces (GOSs) can be defined as any vegetated areas found in the urban landscapes (e.g., parks, urban forests, lawns, home gardens, and street trees). They encompass all vegetative (e.g., parks) and blue spaces (e.g., lakes or rivers) in the urban landscapes (Cvejić et al. 2015). There is no universally accepted

G. C. Ciftcioglu (✉) · A. Aydin
Department of Landscape Architecture, Faculty of Architecture, European University of Lefke, Gemikonagi, Mersin 10, Turkey
e-mail: gcetinkaya@eul.edu.tr

Published online: 27 September 2018

definition of GOSs (WHO Regional Office for Europe 2016). A number of typologies were proposed for the classification of GOSs (Dunnett et al. 2002; Swanwick et al. 2003; Byrne and Sipe 2010). For example, Swanwick et al. (2003) proposed 25 GOSs, falling into four main categories (amenity green spaces, functional green spaces, semi-natural habitats, and linear green spaces). GOSs are essential for designing well-functioning and liveable cities (Cvejić et al. 2015). They significantly contribute to the reduction of air and noise pollution, improvement of the health of urban society, and mitigation of the "heat island effect" (Elmqvist 2011; Heinze 2011). Close and easily accessible green areas (e.g., parks and urban forests) especially provide opportunities for urban dwellers to be in contact with nature (e.g., observing nature, plants, and animals), to learn about nature, and to appreciate nature (Yli-Pelkonen and Niemelä 2005). Within this context, relevant strategies are needed for mapping and evaluating GOSs. For example, the EU Biodiversity Strategy to 2020 requires member states to map and assess GOSs (Wentworth 2017). At the Fifth Ministerial Conference on Environment and Health in Parma, Italy in 2010, the member states of the WHO European Region made a commitment "to provide each child by 2020 with access to healthy and safe environments, in which they can walk, cycle, play, and undertake physical activity" (WHO Regional Office for Europe 2016). In addition, easy access to GOSs in cities has been included in the United Nations Sustainable Development Goal 11.7, which aims to achieve "easy and safe access to green and public spaces especially for women and children, older people, and persons with disabilities by 2030" (United Nations Economic and Social Council 2017). All of these initiatives have been developed to ensure the protection and maintenance of ecosystem services delivered by the different types of UGSs.

Ecosystem services are the benefits humans obtain from ecosystems (MA 2003: p.3). They are the processes, conditions, and subsets derived from ecosystems and ecological functions (e.g., primary productivity, carbon cycling, and decomposition), which sustain and enhance human wellbeing (HWB) (Martinez-Harms et al. 2015; Costanza et al. 1997; De Groot et al. 2002; Haase et al. 2014). In cities, we call ecosystem services *as urban ecosystem services* (UESs) (Cvejić et al. 2015). The concept of ecosystem services is used to explain the dependence of humans on nature and to frame the decisions about the on-going values of nature to HWB (Bennett and Chaplin-Kramer 2016). In other words, the concept provides an important framework for linking the ecological system with the social system in cities (McPhearson et al. 2014). The Millennium Ecosystem Assessment (MA 2005) proposed a widely accepted typology of ecosystem services, under which benefits flow to human populations in four streams: provisioning (e.g., food), regulating (e.g., erosion control), cultural (e.g., recreation), and supporting (e.g., soil formation) services. Similarly, UESs are classified in four categories: provisioning services (e.g., fresh air), regulating services (e.g., erosion control and noise reduction), habitat (e.g., habitats for wildlife such as foxes, rats, and bats), and cultural services (e.g., recreation, esthetic quality, and nature experience) (Cvejić et al. 2015; Heinze 2011; Wentworth 2017; Rakhshandehroo et al. 2015; Farinha-Marques et al. 2017). UESs provide essential benefits for HWB (e.g., increasing physical activity, reducing obesity, stress-reduction, enhanced concentration capacity, recovery from illness, socializing, enjoyment, relaxation, and satisfaction with life) (Rakhshandehroo et al. 2015; Heinze 2011; Cvejić et al. 2015; McPhearson et al. 2014; Carabine et al. 2015). Thus, GOSs and relevant UESs contribute to the economic development and prosperity of cities (Elmqvist 2011). Within this context, we can argue that GOSs, UESs, and HWB are mutually interrelated.

The links between green spaces and human health have been recognized throughout the history. The links were one of the driving forces behind the urban parks movement of the nineteenth century in Europe and North America (WHO Regional Office for Europe 2016). When the first parks were designed in the nineteenth century, city officials hoped that parks would reduce disease, crime, social unrest, and provide "green lungs" for cities. The relevant studies show that green sites can reduce crime and stress, foster psychological wellbeing, boost immunity, enhance concentration and productivity, and promote healing (Maller et al. 2008). In other words, GOSs make a significant contribution to the improvement of human health and wellbeing (e.g., stress reduction, socialization, and crime reduction). For this reason, the existence, accessibility, and use of GOSs are important themes within the framework of urban landscape planning (WHO Regional Office for Europe 2016). The degree of contribution of UESs to the different components of HWB depends particularly on the degree of biodiversity (Haase et al. 2014; Gómez-Baggethun et al. 2013). Thus, urban biodiversity plays

an important role in the evaluation of UESs (Mace et al. 2012). However, the loss of GOSs threatens the urban biodiversity (Yli-Pelkonen and Niemelä 2005). The loss of urban biodiversity can reduce the capacity of ecosystems to supply UESs (van der Velden 2015) and worsen the health of HWB (MA 2005). Within this context, we can argue that GOSs, UESs, urban biodiversity, and HWB affect each other at a certain level (MA 2005; van der Velden 2015; Yli-Pelkonen and Niemelä 2005; McPhearson et al. 2014). Within this context, the city of Nicosia located in North Cyprus can be a case study.

The purpose of this study is to evaluate the major UESs delivered by a number of GOSs and their contributions to the HWB in four selected sites located in the city of Nicosia of North Cyprus. The objectives of the study were to map the dominant GOSs in the selected sites, to identify the plant species cultivated in the GOSs, to evaluate the major UESs delivered by the GOSs and their contributions to the components of HWB. We hope that the results of this study can help policy-makers and planners to design more effective policies in terms of building resilient cities and societies in the city of Nicosia and elsewhere.

Study area: the city of Nicosia

Cyprus is the third largest island in the Eastern Mediterranean Basin after Sicily and Sardinia (Delipetrou et al. 2008) (Fig. 1). The island has a diversity of geography, climate, flora, fauna, and also a rich history and culture (Della et al. 2006). The human presence on the island dates back to the prehistoric periods (10,000–12,000 years ago). The island was covered with the dense forests in the ancient times; therefore, it was an important center for shipbuilding and timber export. The island was dominated by a variety of civilizations (e.g., Roman, Byzantine, Lusignan, Venetian, Ottoman, and British) throughout the history. Today, the island is an important "biodiversity hotspot" due to its suitable Mediterranean climatic conditions. The existing landscapes consist of a mosaic of natural and semi-natural habitats, which can be characterized as Mediterranean rural landscapes (Delipetrou et al. 2008). The island was legally divided between the Turkish and Greek Cypriots in 1974. The city of Nicosia is the capital of both sites, which is divided by a buffer zone (al-Asad 2007).

The city of Nicosia has a rich history (Çevikel 2000). The total population of the city was 94,824 in 2011, including 49,838 males (52.6%) and 44,986 females (47.4%) (KKTC Devlet Planlama Örgütü 2013). The major population has employed in the service sector (KKTC Devlet Planlama Örgütü 2015). The following four regions located in the historical center of Nicosia were selected as study sites: Çağlayan, Köşklüçiftlik, Yenişehir, and Suriçi/GirneKap (Table 1). The selected areas have cultural heritage value due to their vernacular architecture and home garden features.

Table 1 shows that the total population of the selected sites varies between 1307 and 6798. The existing landscapes in the city can be characterized as urban landscapes with the domination of the Mediterranean maquis vegetation (e.g., oleander and olive). The dominant GOSs in the study sites are home gardens, parks, squares/plazas, and other green spaces (e.g., schoolyards, nursery, and green areas surrounding public buildings) (Fig. 2).

Method of the study

The method of the study consisted of three sections: adoption of the conceptual framework of the Millennium Ecosystem Assessment (MA 2005) for evaluating the links between UESs and HWB, integration of a social preference approach for assessing the importance of UESs and their contributions to the HWB in the city of Nicosia, and data collection and evaluation.

Adoption of the conceptual framework of the Millennium Ecosystem Assessment (2005)

The conceptual framework of the Millennium Ecosystem Assessment (MA 2005) has been integrated in this study to evaluate the major UESs provided by the dominant OGSs and their contributions to the components of HWB in the four selected sites located in the city of Nicosia. Within this context, the framework consisted of three agents: UESs, HWB, and drivers of change (Fig. 3).

Figure 3 shows the mutual relationship between the categories of UESs, HWB, and drivers of change. The three agents and their components are summarized below.

Urban ecosystem services (UESs) These are the benefits delivered by the dominant GOSs in the selected sites. There are several typologies for the classification of ecosystem services (e.g., MA 2005; TEBB 2011).

Fig. 1 Location of Cyprus Island in the Mediterranean Basin (Worldatlas 2018)

The typology suggested by the MA (2005) has been the most cited and used one (Ciftcioglu 2017); therefore, the typology of UESs in this study is based on the MA (2005) and the review of relevant literature. Supporting services represent regulating services; therefore, the category of habitat services was proposed instead of the supporting services (Martín-López et al. 2009; Ciftcioglu 2017) (Table 2).

Table 2 shows the typology of UESs for this study, which consists of four categories and 31 UESs. The UESs directly influence the different components of HWB.

Human wellbeing (HWB) means "good quality of life within the ecosystem's biophysical limits (Santos-Martín et al. 2016). The MA (2005) proposed the most comprehensive context for HWB (Ciftcioglu 2017); therefore, the typology of HWB in this study was based on the MA's (2005) classification (Table 3).

Table 3 shows the typology of HWB proposed for this study, which consists of five categories and 14 components. A number of drivers directly influence the components of UESs and HWB.

Drivers of change Drivers are the factors which cause changes in the GOSs and relevant UESs. Plieninger et al. (2014) emphasized that drivers help us to assess the links between ecosystem services and HWB. The major drivers in the case of this study were examined during the semi-structured interviews carried out in the selected sites. The major drivers identified are urbanization, land use change, and less maintenance.

Table 1 The total population of the study sites located in the city of Nicosia (KKTC Devlet Planlama Örgütü 2016)

Region	Population		Total population
	Male	Female	
Çağlayan	667	640	1307
Köşklüçiftlik	1465	1474	2939
Yenişehir	1864	1851	3715
Suriçi	3809	2989	6798
Total	7805	6954	14,759

Adoption of a social preference approach

Interest in ecosystem service valuation has grown exponentially in environmental and policy science since the publication of the Millennium Ecosystem Assessment (MA 2005) and the Economics of Ecosystem Services and Biodiversity (TEEB 2011) (Santos-Martín et al. 2016). The Oxford Dictionary defines "value as the regard that something is held to deserve, the importance, worth, or usefulness of something." The key word here is 'importance'

A view from the 'Saman Bahçe Quarter'

A view from the Kumsal Park

Fig. 2 Two views from the GOSs located in the city of Nicosia

(Gómez-Baggethun and Martín-López 2015). Valuation means "the act of assessing, measuring value or importance of something" (Dendoncker et al. 2013). The question is how the importance of ecosystem services can be quantified or qualified (Gómez-Baggethun and Martín-López 2015). Values can be grouped into three broad domains: ecological, socio-cultural, and monetary (Gómez-Baggethun and Martín-López 2015; Jacobs et al. 2018; van der Velden 2015; Santos-Martín et al. 2016).

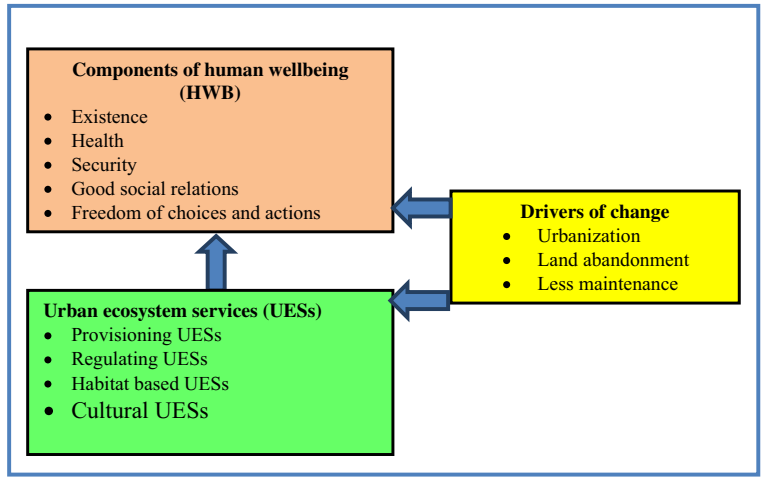

Fig. 3 The conceptual framework for assessing the categories of UESs, HWB, drivers of change, and the interrelationship between them in the study sites (adopted from the MA 2005)

Table 2 The typology of UESs proposed for this study

Category of UESs	Type of UESs	Reference
Provisioning UESs	-Food	-MA (2005)
	-Firewood	-TEEB (2011)
	-Fodder	-Hein et al. (2006)
	-Ornamental plants	-Boyd and Banzhaf (2007)
	-Medicinal and aromatic plants	-De Groot et al. (2002, 2010)
	-Edible plants	-Jim and Chen (2003)
	-Mulching and composting	-Costanza et al. (1997)
Regulating UESs	-Climate regulation	-Daily (1997)
	-Flood control	
	-Water storage	
	-Soil fertility	
	-Refuge for biodiversity	
	-Pollination	
	-Erosion prevention	
	-Biological control (e.g., seed dispersal)	
Habitat-based UESs	-Habitat for wild plants	
	-Habitat for pets	
	-Maintenance of biodiversity	
Cultural UESs	-Aesthetic quality	
	-Relaxation and stress reduction	
	-Entertainment and pleasure	
	-Recreation	
	-Information for cognitive development	
	-Sense of place	
	-Sense of belonging	
	-Inspiration for culture, art and design	
	-Historical and cultural values	
	-Spiritual and natural experience	
	-Traditional knowledge	
	-Biophilia	
	-Tranquility	

Table 3 The typology of HWB proposed for this study (adopted from the MA 2005)

Category of HWB	Component of HWB
Basic materials for good life/existence	• Adequate livelihood • Fresh air • Nutrition
Health	• Physical health • Mental health
Security	• Secure access to resources • Security of person • Security of health
Development of good social relations	• Family cohesion • Community cohesion • Ability to help other • Mutual respect
Freedom of choice and actions	• Individual development • Economic freedom (income generation and employment opportunities)

Ecological and/or biophysical value The ecological value of an ecosystem is about its capacity to provide ecosystem services. The capacity of an ecosystem can be measured by a number of ecological criteria (e.g., resistance, resilience, and integrity) (van der Velden 2015), the use of biophysical units (e.g., analysis of land cover or land use), and relevant indicators (Gómez-Baggethun et al. 2013; Martín-López et al. 2014).

Economic value Monetary valuation approaches have been developed to contribute to the environmental decision-making (Jacobs et al. 2018). The economic value of an ecosystem can be measured in four different ways: direct market value, indirect market value, contingent value, and group value (van der Velden 2015). Unfortunately, the monetary valuation fails to capture the importance of nature beyond economic values

(Jacobs et al. 2018; Santos-Martín et al. 2016; Gómez-Baggethun and Martín-López 2015).

Socio-cultural value Many people regard biodiversity and ecosystems as a crucial source of non-material wellbeing, which influences the national, historical, religious, ethical, and spiritual values of people (van der Velden 2015). The socio-cultural valuation approaches try to uncover the contribution of nature to HWB (Jacobs et al. 2018). In other words, the socio-cultural methods assess the values a society attributes to ecosystem services (Agbenyega et al. 2009). The term "socio-cultural valuation" is defined as an umbrella term for multiple methods. There are various methods (e.g., psycho-cultural valuation, social valuation, qualitative valuation, and subjective assessment) to evaluate the socio-cultural values of ecosystem services. The selection of an appropriate method depends on the available data and purpose of valuation (Santos-Martin et al. 2017). Landscape management requires the participation of social groups into decision-making processes (Agbenyega et al. 2009; Ciftcioglu 2017); therefore, we have adopted a social preference approach to elicit the values of UESs delivered by the dominant GOSs in the city of Nicosia.

The social preference assessment is a direct consultative method that assesses the individual and social importance of ecosystem services by analyzing perceptions, knowledge, and associated values of ecosystem services (Santos-Martin et al. 2017). It is a highly suitable method to value ecosystem services at local and regional spatial scales (Kelemen et al. 2014). A set of quantitative and qualitative research approaches (e.g., surveys and interviews) and participatory tools (focus groups) can be used to express preferences in quantifiable terms (Kelemen et al. 2014; Ciftcioglu 2017). Relevant data can be collected through free-listing exercise, ecosystem service ranking, rating, or other selected mechanisms (Santos-Martin et al. 2017).

Data collection and evaluation

A number of quantitative (questionnaire) and qualitative (semi-structured interviews and field surveys) data collection tools were used to collect data on the research objectives:

- A questionnaire form was designed to obtain data on the perception of urban residents towards the importance of UESs and their contributions to the components of HWB in the study sites located in the city of Nicosia. The questionnaire form was structured in four sections. The profile of the respondents (e.g., age, gender, education, and occupation) was examined in the first section. The second section focused on the respondents' perception related to the capacity of the GOSs to deliver UESs. In the third section, the respondents' perception towards the contribution of the UESs identified in the components of HWB was assessed. The respondents were provided with a close list of UESs and components of HWB. The respondents expressed the values they attach to the UESs and HWB on a 1- to 5-point Likert scale. The questionnaire was conducted face to face with 160 participants, who were randomly selected in the selected sites (Table 4). The relevant data were periodically collected from 14 January to 26 February 2017.

Table 4 shows that a balance between male and female respondents was provided in the questionnaire. Assessment of the age profile indicates that the age profile of most respondents varies between 40 and over 60 years old. The majority of the respondents are office clerks, housewives, or retiree. The education level of the respondents is high with a university degree. The number of people at household level is limited to two to three people. One person usually works at the household level.

Assessment of the data obtained from the questionnaire revealed that 60% of the respondents very often visit the GOSs in the selected sites. The visiting frequency varies at the base of gender and age factors. Assessment of the gender factor showed that 64.5% of female and 56% of male respondents very often visit the GOSs. Analysis of the age factor indicated that the age profile of the respondents, who very often visit the GOSs, changes between 30 and 39 (59.3%) and over 60 (81%) years old.

- Several field surveys were carried out from 14 January to 26 February 2017 in the study sites to identify the major plant species cultivated in the GOSs. In addition, the distribution of the GOSs in the selected sites was mapped. The base map was obtained from the State Planning Organization in the city of Nicosia.

Table 4 Population profile of the respondents in the study sites (n = 160)

Criteria for population profile	Variable of population profile	Number of respondents	Percentage of respondents
Gender	Female	76	47.5
	Male	84	52.5
Age range	Under > 19	2	1.3
	20–29	14	8.8
	30–39	27	16.9
	40–49	43	26.9
	50–59	32	20.0
	60 and < 60	42	26.3
Occupation	Office clerk	55	34.4
	Housewife	38	23.8
	Retired	32	20.0
	Self-employed	23	14.4
	Student	10	6.3
	Farmer	2	1.3
Education level	Illiterate	2	1.3
	Primary school	41	25.6
	High school	44	27.5
	College	72	45.0
Number of persons at household level	1 person	13	8.1
	2–3 people	83	51.9
	4–5 people	51	31.9
	6–7 people	13	8.1
Number of working people at household level	None	36	22.5
	1 person	64	40.0
	2 people	40	25.0
	3 people	11	6.9
	4 people	8	5.0

- We conducted one or two semi-structured interviews in each study site to examine the major UESs, components of HWB, and drivers of change. Two or three urban people participated in each semi-structured interview, which was usually held in a square or park located in the study sites. In addition, the respondents were informed about the aim, objectives, and expected outcomes of the study.

The collected data via the questionnaire were analyzed by using a 1- to 5-point Likert scale, where:

1. no value
2. very low value
3. low value
4. medium value
5. high value

The collected data were analyzed using the Statistical Package for Social Science (SPSS Version 15.0). The reliability analysis was performed at the base of 57 questions. The results of the analysis showed that the reliability of statistics is high with $\alpha = 0.853$ (Table 5). The one-way ANOVA test was performed to determine the average relative value of the UESs and their contributions to the components of HWB. The independent samples t test was performed to analyze the influence of several factors (gender, education, age, and occupation) on the different categories of the UESs and HWB in the study sites.

Table 5 Reliability statistics

Cronbach's Alpha	N of items
.853	57

Results and discussion

The plant composition in the green open spaces of the city of Nicosia

The results of the field surveys revealed that a total number of 229 plant species (39 trees, 38 shrubs, 23 succulents, 27 vegetables, 10 fruits, 73 flowering plants, 7 ground covers, and 12 interior plants) are cultivated for a variety of purposes in the dominant GOSs located in the city of Nicosia. The plant diversity varies at the base of GOSs (Table 6).

Table 6 shows that the average relative value of the plant diversity in the dominant GOSs seems to be very low with 2.88 points. The highest average relative value of the plant diversity was identified in the parks and home gardens, respectively. The lowest average relative value of the plant diversity was found to be in the squares.

Distribution of the green open spaces in the city of Nicosia

The major types of GOSs (home garden, park, square/plaza, and other green spaces, e.g., green sites surrounding public buildings, schoolyards, mosque, church, and nursery) in the selected sites were mapped as a result of the field surveys conducted in the study sites (Fig. 4).

Assessment of Fig. 4 shows that the dominant type of GOSs in the selected sites is home garden.

The major urban ecosystem services delivered by the dominant green open spaces in the city of Nicosia

This part of the study focuses on the major UESs delivered by the dominant UGSs in the selected sites located in the city of Nicosia. Thirty-one UESs were evaluated by operating the one-way ANOVA test (Table 7).

Table 6 The average relative value of the plant diversity (in a 1–5 scale) in Nicosia

Type of GOSs	Average relative value of the plant diversity	St. deviation
Park	3545	1920
Home garden	2989	1638
Square	1250	0707
Other green sites	2529	1580
Total	2881	1691

Table 7 shows that the dominant GOSs deliver a variety of UESs to the urban society in the city of Nicosia. The total average relative value of the UESs delivered by the GOSs was estimated to be very low with 2.43 points. The average relative value of the UESs at the base of different types of GOSs varies between the home gardens by 2.48 points (very low) and the squares by 2.30 points (very low). This assessment shows that all categories of GOSs in the selected sites provide UESs at a very low degree. Considering the semi-structured interviews and field surveys, we can argue that the degree of the UESs varies depending on the plant diversity in the GOSs. This approach supports the findings of Haase et al. (2014), Gómez-Baggethun et al. (2013), and Mace et al. (2012). We can also argue that the loss of GOSs causes a decrease in the flow of UESs. This argument supports the findings of Yli-Pelkonen and Niemelä (2005) and van der Velden (2015).

The results of the statistical analysis revealed that the respondents mostly tended to value the category of cultural UESs at a low degree with an average relative value of 3.46 points. The respondents attached the highest degree of the average relative value to the component "tranquility" with 4.72 points (medium) in the home gardens. In the second place, the component "stress reduction" was tagged on the basis of all GOSs. Assessment of the regulating UESs showed that the home gardens and parks for "climate regulation" and "soil fertility" were mostly favored by the respondents. Based on our field surveys, we can argue that the degree of the regulating UESs can change depending on the size of GOSs and plant diversity. Thus, there is a positive correlation between the regulation of UESs and the two criteria indicated. The provisioning UESs are mostly delivered by the home gardens. The respondents mostly valued the component of "ornamental plants" within this category. Assessment of the habitat based UESs showed that the GOSs (particularly parks and home gardens) are important habitats for pets and street animals. The respondents mostly tagged the component of "habitat for pets" with 1.93 points within this category.

Evaluation of the independent samples t test at the base of socio-demographic factors revealed that the $P < 0.05$ value shows a significant difference at the base of gender factor in the category of regulating UESs. Any significant difference was not found in the other factors.

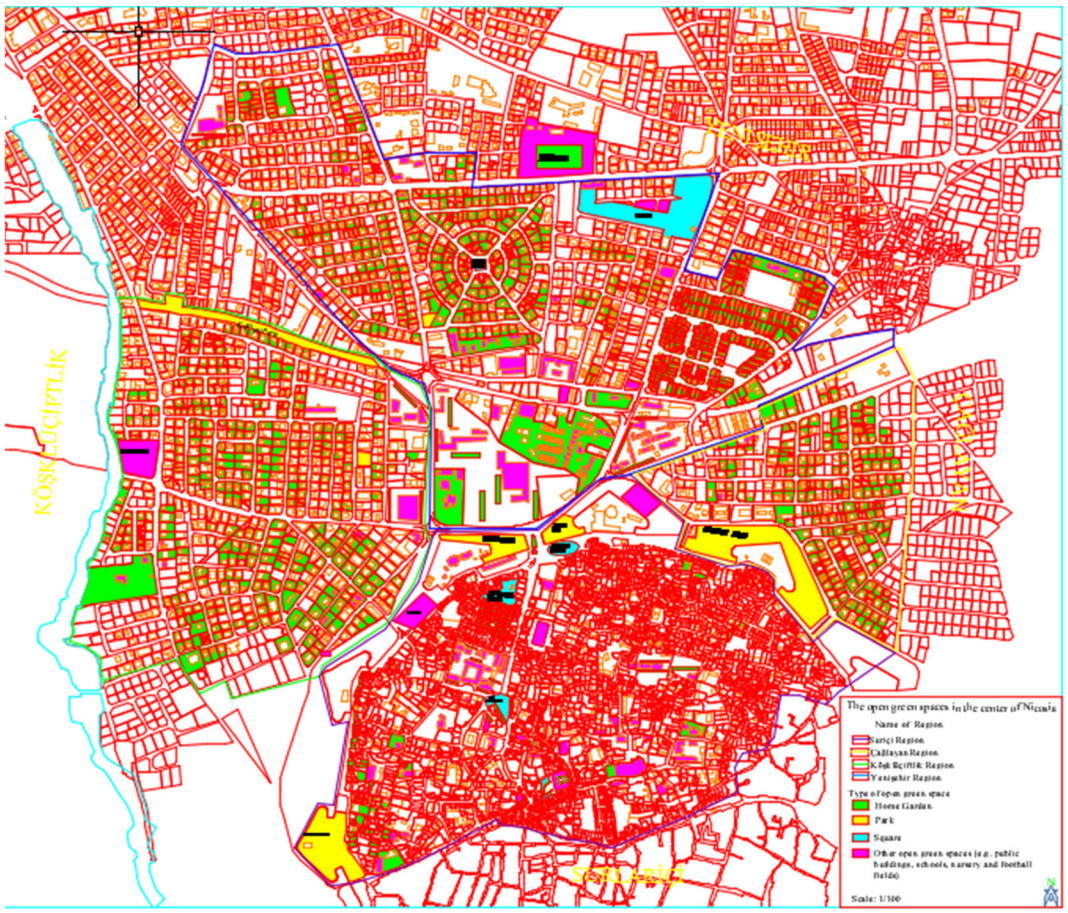

Fig. 4 Distribution of the GOSs in the selected sites located in the city of Nicosia

The contributions of the major urban ecosystem services to the human wellbeing in the city of Nicosia

This part of the study focuses on the contributions of the major UESs delivered by the dominant GOSs to the components of HWB in the selected sites located in the city of Nicosia (Table 8).

Table 8 shows that the total average relative contribution of the UESs to the HWB seems to be low with 3.56 points. The home gardens deliver the highest degree of contribution to the HWB with 3.65 points (low). The contribution of the UESs to the HWB varies between the categories of "health" with 4.65 points (medium) and "freedom of choices and actions" with 2.12 points (very low). The results of the field surveys in the selected sites showed the most important criterion affecting the degree of UESs and their contributions to the HWB is plant diversity. This argument supports the findings of WHO Regional Office for Europe (2016), Haase et al. (2014), and Gómez-Baggethun et al. (2013). "Health" was the most tagged category among all. The respondents mostly tended to value the components of "mental health" (e.g., relaxation) with 4.70 points (medium) and "physical health" (e.g., physical activity) with 4.60 points (medium). This finding supports the arguments of several scholars (e.g., Rakhshandehroo et al. 2015; Cvejić et al. 2015; Carabine et al. 2015). In the second place, the respondents mostly tagged the category of "development of good social relations." Assessment of this category showed that the GOSs provide opportunities for the urban society to "develop good social relations" with family and community members. This finding supports the argument of Ciftcioglu (2017). In the third place, the category of

Table 7 The major UESs delivered by the dominant GOSs in the selected sites located in the city of Nicosia

Category of UESs	Average relative value of the UESs at the base of different types of GOSs (1–5 Likert scale)				Average relative value of the categories of UESs
	Home garden ($n = 96$)	Park (n: 22)	Square ($n = 8$)	Other green spaces ($n = 34$)	
Provisioning UESs					2.14
Food (vegetables and fruits)	3.15	1.22	1.37	2.17	
Fire wood	1.17	1.13	1.00	1.14	
Fodder	1.17	1.18	1.50	1.20	
Ornamental plants	4.33	2.59	3.00	3.94	
Medicinal & aromatic plants	2.28	1.36	1.87	1.82	
Edible plants	2.78	1.13	1.37	2.11	
Mulching and composting	1.86	1.00	1.00	1.94	
The average relative value of the provisioning UESs	2.39	1.37	1.58	2.05	
Regulating UESs					2.26
Climate regulation	3.59	3.40	4.12	3.47	
Flood regulation	1.19	1.63	1.87	1.55	
Water storage	1.27	1.45	1.12	1.41	
Soil fertility	3.50	3.68	3.12	2.88	
Refuge for biodiversity	1.91	2.95	1.37	2.44	
Pollination	1.56	2.72	1.50	1.88	
Erosion prevention	1.29	1.54	1.50	1.50	
Biological control	3.38	2.68	2.75	2.91	
The average relative value of the regulating UESs	2.21	2.51	2.17	2.25	
Habitat based UESs					1.87
Habitat for wild plants	1.88	2.04	2.37	1.85	
Habitat for pets	1.93	2.86	2.12	1.32	
Maintenance of biodiversity	1.72	2.04	1.25	1.79	
The average relative value of the habitat based UESs	1.85	2.31	1.91	1.65	
Cultural UESs					3.46
Aesthetic and visual quality	4.16	3.81	4.25	4.35	
Relaxation and stress reduction	4.47	4.27	4.62	4.35	
Entertainment and pleasure	3.31	3.63	4.00	2.73	
Recreation	2.50	3.63	3.25	1.88	
Information for cognitive development	2.19	2.27	3.00	2.61	
Sense of place	4.37	3.77	4.12	4.44	
Sense of belonging	4.47	3.50	4.00	4.47	
Inspiration for culture, art and design	2.05	2.59	2.50	2.82	
Historical and cultural value	2.82	3.72	4.75	4.02	
Spiritual and natural experience	2.21	2.50	1.87	2.70	
Traditional knowledge	3.57	2.27	2.87	3.23	
Biophilia	4.22	3.22	3.37	4.14	
Tranquility	4.72	3.95	3.37	4.23	
The average relative value of the cultural UESs	3.47	3.32	3.53	3.54	
The total average relative value of the UESs at the base of each GOSs	2.48	2.38	2.30	2.37	
The total average relative value of the UESs					2.43

Table 8 The average relative contribution of the major UESs to the components of HWB in the selected sites located in the city of Nicosia

Category and component of HWB	Average relative contribution of the UESs to the HWB at the base of different types of GOSs (1–5 Likert scale)				
	Park ($n = 22$)	Home garden ($n = 96$)	Square ($n = 8$)	Others ($n = 34$)	Total ($n = 160$)
Existence					
Adequate livelihood	1.22	2.02	1.00	1.55	1.76
Fresh air	4.59	4.58	4.00	4.38	4.51
Nutrition	1.22	2.53	1.00	1.73	2.10
The average relative contribution to the category of "existence"	2.34	3.04	2.00	2.55	2.79
Health					
Physical health	4.68	4.62	4.25	4.58	4.60
Mental health	4.81	4.77	4.25	4.55	4.70
The average relative contribution to the category of "health"	4.75	4.69	4.25	4.57	4.65
Security					
Secure access to resource	3.22	3.16	2.50	3.05	3.11
Security of person	3.81	4.75	3.62	4.67	4.55
Security of health	4.50	4.64	4.25	4.47	4.56
The average relative contribution to the category of "security"	3.84	4.18	3.45	4.06	4.07
Development of good social relations					
Family cohesion	4.13	4.39	3.62	3.47	4.12
Community cohesion	4.00	4.58	3.75	4.47	4.43
Ability to help other	3.95	4.27	4.12	3.85	4.13
Mutual respect	3.59	4.03	4.25	3.97	3.96
The average relative contribution to the category of "development of good social relations"	3.92	4.32	3.93	3.94	4.16
Freedom of choices and actions					
Individual development	2.86	2.47	2.12	3.55	2.74
Economic freedom	1.04	1.59	1.00	1.64	1.50
The average relative contribution to the category of "freedom of choices and actions"	1.95	2.03	1.56	2.60	2.12
The total average relative contribution to the HWB	3.36	3.65	3.04	3.54	3.56

"security" was selected. The GOSs (especially home gardens) are important sites for the security of people by providing a safe environment. Assessment of the category of "existence" showed that all types of GOSs provide "fresh air" for the urban residents. In the last place, the component "economic freedom" was tagged within the category of "freedom of choices and actions." This situation shows that the GOSs are not designed to generate income for the urban society in the selected sites.

Assessment of the Independent Samples *t* Test at the base of the socio-demographic factors revealed that the $P < 0.05$ value shows a significant difference at the base of gender factor in the category of "freedom of choices and actions" and at base of "occupation" factor in the category of "development of good social relations." Any significant difference was not found in the other factors.

Conclusions

This study has tried to explore the major UESs delivered by the dominant GOSs and their contributions to the components of HWB in four selected sites located in the city of Nicosia. The results of the evaluation revealed that the GOSs in the city of Nicosia deliver a variety of UESs with a very low degree. The GOSs and relevant UESs contribute to the HWB with a medium degree.

The evaluation also revealed that the degree of the UESs and their contributions to the HWB changes depending on the plant diversity in the GOSs. Based on this, we can argue that plant diversity is the key criterion to evaluate UESs and their contributions to HWB within GOSs. Within this context, we suggest that plant diversity should be enhanced to ensure the sustainable flow of the UESs and their contributions to the HWB in the GOSs located in the city of Nicosia. This approach supports the findings of Haase et al. (2014), Gómez-Baggethun et al. (2013), and Mace et al. (2012). In addition, enhancement of the GOSs can contribute to increasing the resilience of urban landscapes and relevant urban policies. Unfortunately, the loss of GOSs threatens the overall biodiversity and the capacity of ecosystems to deliver UESs not only in the City of Nicosia and elsewhere. The other major contributions of the study are summarized below:

- Identification and sustainable management of UESs are crucial issues within the framework of sustainable urban landscape planning and human development not only in the city of Nicosia and elsewhere.
- The mapping of UESs and integration of their values into urban and landscape planning strategies can help policy-makers, landscape architects, planners, and designers to protect urban ecosystems in a sustainable manner in the city of Nicosia and elsewhere.
- There is no national landscape planning strategy in North Cyprus. For that reason, the GOSs in the city of Nicosia were not strategically planned. Within this context, a national landscape planning strategy is urgently needed for the sustainable conservation and management of urban landscapes, associated ecosystems, and services in North Cyprus.

References

Agbenyega, O., Burgess, P. J., Cook, M., & Morris, J. (2009). Application of an ecosystem function framework to perceptions of community woodlands. *Land Use Policy, 26*, 551–557.

al-Asad, M. (2007). Rehabilitation of the walled City Nicosia, Cyprus. On site review report, 2098. CYP. https://archnet.org/system/publications/contents/1564/original/FLS1807.pdf?1384750430. Accessed 27 July 2018.

Bennett, E. M., & Chaplin-Kramer, R. (2016). Science for the sustainable use of ecosystem services. *F1000Research, 5*, 2622. https://doi.org/10.12688/f1000research.9470.1.

Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics, 63*(2–3), 616–626.

Burkhard, B., Petrosillo, I., & Constanza, R. (2010). Ecosystem services: bridging ecology, economy and social sciences. *Ecological Complexity, 7*, 257–259.

Byrne, J., & Sipe, N. (2010). Green and open space planning for urban consolidation – a review of the literature and best practice. Urban Research Program, Issues paper 11. https://research-repository.griffith.edu.au/bitstream/handle/10072/34502/62968_1.pdf. Accessed 29 July 2018.

Carabine, E., Venton, C. C., Tanner, T., & Bahadur, A. (2015). The contribution of ecosystem services to human resilience. Shaping policy for development. February 2015. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9394.pdf. Accessed 26 September 2017

Çevikel, N. (2000). Kıbrıs – Akdeniz'de bir Osmanlı Adası (1570–1878), 47 Numaralı Yayıncılık/Tarih – İnceleme Dizisi, İstanbul.

Ciftcioglu, G. C. (2017). Social preference-based valuation of the links between home gardens, ecosystem services, and human well-being in Lefke Region of North Cyprus. *Ecosystem Services, 25*, 227–236.

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*, 253–260.

Cvejić, R., Eler, K., Pintar, M., Železnikar, Š., Haase, D., Kabisch, N., & Strohbach, M. (2015). A typology of urban green spaces, eco-system services provisioning services and demands. The EU FP7 (ENV.2013.6.2-5- 603567) GREEN SURGE project (2013–2017). https://greensurge.eu/working-packages/wp3/files/D3.1_Typology_of_urban_green_spaces_1_.pdf/D3.1_Typology_of_urban_green_spaces_v2_.pdf. Accessed 29 July 2018.

Daily, G. C. (1997). *Nature's services: societal dependence on natural ecosystems*. Washington, DC: Island Press.

De Groot, R. S., Wilson, M. A., & Boumans, R. M. J. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics, 41*, 393–408.

De Groot, R. S., Alkemade, R., Braat, L., Hein, L., & Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity, 7*(3), 260–272.

Delipetrou, P., Makhzoumi, J., Dimopoulos, P., & Georghiou, K. (2008). Cyprus. In I. Vogiatzakis, G. Pungetti, & A. M. Mannion (Eds.), *Mediterranean island landscapes, natural and cultural approaches* (pp. 170–219). Berlin: Springer.

Della, A., Paraskeva-Hadjichambi, D., & Hadjichambis, A. C. (2006). An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus. *Journal of Ethnobiology and Ethnomedicine, 2*, 34.

Dendoncker, N., Keune, H., Jacobs, S., & Gomez-Baggethun, E. (2013). Inclusive ecosystem services valuation. In S. Jacobs, N. Dendoncker, & H. Keune (Eds.), *Ecosystem services: global issues, local practices* (pp. 3–12). San Diego: Elsevier.

Dunnett, N., Swanwick, C., & Woolley, H. (2002). Improving urban parks, play areas and green spaces. May 2002. Department for Transport, Local Government and the Regions. UK.

http://publiekeruimte.info/Data/Documents/e842aqrm/53/Improving-Urban-Parks.pdf. Accessed 29 July 2018.

Elmqvist, T. (2011). Ecosystem services and social systems in urban landscapes. In J. Niemela, J. H. Breuste, G. Guntenspergen, N. E. Mclntyre, T. Elmqvist, & P. James (Eds.), *Urban ecology: patterns, processes, and applications* (pp. 182–189). Oxford: Oxford University Press.

Farinha-Marques, P., Fernandes, C., Guilherme, F., Lameiras, J. M., Alves, P., & Bunce, R. G. H. (2017). Urban habitats biodiversity assessment (UrHBA): a standardized procedure for recording biodiversity and its spatial distribution in urban environments. *Landscape Ecology, 32*(9), 1753–1770.

Gómez-Baggethun, E., & Martín-López, B. (2015). Ecological perspectives on ecosystem services valuation (Chapter 11). In J. Martinez-Alier & R. Muradian (Eds.), *Handbook of ecological economics* (pp. 260–282). UK: Edward Elgar Publishing, Inc..

Gómez-Baggethun, E., Gren, A., Barton, D. N., Langemeyer, J., McPhearson, T., O'Farrell, P., Andersson, E., Hamstead, Z., & Kremer, P. (2013). Urban ecosystem services (chapter 11). In T. Elmqvist, M. Fragkias, J. Goodness, B. Güneralp, P. J. Marcotullio, R. I. McDonald, S. Parnell, M. Schewenius, M. Sendstad, K. C. Seto, & C. Wilkinson (Eds.), *Urbanization, biodiversity and ecosystem services: challenges and opportunities, a global assessment* (pp. 175–252). Springer.

Haase, D., Larondelle, N., Andersson, E., Artmann, M., Borgström, S., Breuste, J., Baggethun, E. G., Gren, A., Hamstead, Z., Hansen, R., Kabisch, N., Kremer, P., Langemeyer, J., Rall, E. L., McPhearson, T., Pauleit, S., Qureshi, S., Schwarz, N., Voigt, A., Wurster, D., & Elmqvist, T. (2014). A quantitative review of urban ecosystem service assessments: concepts, models, and implementation. *Ambio, 43*(4), 413–433.

Hein, L., van Koppen, K., de Groot, R. S., & van Ierland, E. C. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological Economics, 57*, 209–228.

Heinze J. (2011). Benefits of green space – recent research, April 25, 2011. Environmental Health Research Foundation. Chantilly, VA 20153. http://www.ehrf.info/wp-content/uploads/2011/09/BenefitsofGreenSpace.pdf . Accessed 29 July 2018.

Jacobs, S., Martin-Lopez, B., Barton, D. N., Dunford, R., Harrison, P., Kelemen, E., Saarikoski, H., Termansen, M., Garcia-Llorente, M., Gomez-Baggethun, E., Kopperoinen, L., Luque, S., Palomo, I., Priess, J. A., Rusch, G. M., Tenerelli, P., Turkelboom, F., Demeyer, R., & Smith, R. (2018). The means determine the end – pursuing integrated valuation in practice. *Ecosystem Services, 29*(PC), 515–528.

Jim, C. Y., & Chen, S. S. (2003). Comprehensive green space planning based on landscape ecology principles in compact Nanjing City, China. *Landscape and Urban Planning, 998*, 1–22.

Kelemen, E., Garcia-Llorente, M., Pataki, G., Martin-Lopez, B., & Gomez-Baggethun, E. (2014). Non-monetary techniques for the valuation of ecosystem services. Open-NESS Synthesis Papers No. 6. http://www.openness-project.eu/sites/default/files/SP-Non-monetary-valuation.pdf. Accessed 29 July 2018.

KKTC Devlet Planlama Örgütü. (2013). KKTC Nüfus Sayımı, 2011. https://www.devplan.org/Nufus-2011/nufus%20ikinci_pdf. Accessed 24 September 2018.

KKTC Devlet Planlama Örgütü. (2015). 2010–2013 makro ekonomik ve sektörel gelişmeler. Eylül 2015. https://www.devplan.org/Macro-eco/MACRO20102013.pdf. Accessed 24 September 2018.

KKTC Devlet Planlama Örgütü. (2016). İstatistik yıllığı 2013. http://www.devplan.org/ISTYILLIK/IST-YILLIK-2013.pdf. Accessed 23 December 2017.

Mace, G. M., Norris, K., & Fitter, A. H. (2012). Biodiversity and ecosystem services: a multi-layered relationship. *Trends in Ecology & Evolution, 27*(1), 19–26.

Maller, C., Townsend, M., St. Leger, L., Henderson-Wilson, C., Pryor, A., & Prosser, L. (2008). Healthy parks, healthy people, the health benefits of contact with nature in a park context. A review of relevant literature. 2nd edition, March 2008. Deakin University, Melbourne. https://www.deakin.edu.au/__data/assets/pdf_file/0016/310750/HPHP-2nd-Edition.pdf. Accessed 11 January 2018.

Martinez-Harms, M. J., Bryan, B. A., Balvanera, P., Law, E. A., Rhodes, J. R., Possingham, H. P., & Wilson, K. A. (2015). Making decisions for managing ecosystem services. *Biological Conservation, 184*, 229–238.

Martín-López, B., Gómez-Baggethun, E., González, J. A., Lomas, P. L., & Montes, C. (2009). The assessment of ecosystem services: re-thinking concepts and research needs (Chapter 9). In J. B. Aronoff (Ed.), *Handbook of nature conservation*. Nova Science Publishers Inc. http://www.ecomilenio.es/ecodocs/documentos/20090626-111959_Articulo_Funciones_Servicios_Conceptos.pdf . Accessed 01 February 2017.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., & Montes, C. (2014). Trade-offs across value-domains in ecosystem service assessment. *Ecological Indicators, 37*, 220–228.

McPhearson, T., Hamstead, Z. A., & Kremer, P. (2014). Urban ecosystem services for resilience planning and management in New York City. *Ambio, 43*, 502–515.

Millennium Ecosystem Assessment (MA). (2003). *Ecosystems and human well-being: a framework for assessment*. Washington, DC: Island Press.

Millennium Ecosystem Assessment (MA). (2005). *Ecosystems and human well-being: Synthesis*. Washington, DC, Island Press.

Pickett, S. T. A., Cadenasso, M. L., Grove, J. M., Nilon, C. H., Pouyat, R. V., Zipperer, W. C., & Costanza, R. (2001). Urban ecological systems: linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. *Annual Review of Ecology and Systematics, 32*, 127–137.

Plieninger, T., van der Horst, D., Schleyer, C., & Bieling, C. (2014). Sustaining ecosystem services in cultural landscapes. *Ecology and Society, 19*(2), 59.

Rakhshandehroo, M., Mohdyusof, M. J., Tahirholder, O. M., & Yunos, M. Y. M. (2015). The social benefits of urban open green spaces: a literature review. *Management Research and Practice, 7*(4), 60–71.

Santos-Martín, F., GarcíaLlorente, M., Quintas-Soriano, C., Zorrilla-Miras, P., Martín-López, B., Loureiro, M., Benayas, J., & Montes, M. (2016). *Spanish National Ecosystem Assessment: Socio-economic valuation of ecosystem services in Spain. Synthesis of the key findings*. Madrid: Biodiversity Foundation of the Spanish Ministry of Agriculture, Food and Environment ISBN: 978-84-608-8776-8.

Santos-Martin, F., Kelemen, E., Garcia Llorente, M., & Martín-López, B. (2017). Socio-cultural valuation approaches (Chapter 4.2). In B. Burkhard & J. Maes (Eds.), *Mapping ecosystem services* (pp. 104–114). Pensoft https://www.researchgate.net/publication/315716370_Socio-cultural_valuation_approaches. Accessed 29 July 2018.

Swanwick, C., Dunnett, N., & Woolley, H. (2003). Nature, role and value of green space in towns and cities: an overview. *Built Environment, 29*(2), 94–106.

TEEB (The Economics of Ecosystems and Biodiversity). (2011). TEEB Manuel for cities: ecosystem services in urban management. In: UNEP and the European Union (Ed.), *The economics of ecosystems and biodiversity. Manuel for cities: Ecosystem services in urban management*.

United Nations Economic and Social Council. (2017). Progress towards the sustainable development goals. Report of the Secretary-General. http://www.un.org/ga/search/view_doc.asp?symbol=E/2017/66&Lang=E. Accessed on 30 December 2017.

van der Velden, M. (2015). The link between biodiversity and ecosystem services: how to incorporate scientific knowledge into a conservation strategy. Master Thesis. The University of Utrecht. The Netherlands.

Wentworth, J. (2017). Urban green infrastructure and ecosystem services. Houses of Parliament, Parliamentary Office of Science & Technology. POST Brief Number 26, July 2017. http://researchbriefings.files.parliament.uk/documents/POST-PB-0026/POST-PB-0026.pdf. Accessed 29 July 2018.

WHO Regional Office for Europe. (2016). *Urban green spaces and health*. Copenhagen: WHO http://www.euro.who.int/__data/assets/pdf_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf?ua=1. Accessed 31 July 2018.

Worldatlas. (2018). Map of the Mediterranean Sea. https://www.worldatlas.com/aatlas/infopage/medsea.htm. Accessed 31 July 2018.

Yli-Pelkonen, V., & Niemelä, J. (2005). Linking ecological and social systems in cities: urban planning in Finland as a case. *Biodiversity and Conservation, 14*, 1947–1967.