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The use of EUNIS habitat classification to assess ecosystem services capacity: the case of Mamak district (Ankara, Türkiye)

Ekosistem hizmetleri kapasitesini değerlendirmede EUNIS habitat sınıflandırmasının kullanımı: Mamak ilçesi örneği (Ankara, Türkiye)

İrem TÜFEKCİOĞLU[1]

Muhammed Hakan ÇAKMAK[2*]

Çiğdem COŞKUN HEPCAN[3]

[1] Division of Ecology, Department of Biology, Hacettepe University, Beytepe 06800, Ankara, Türkiye

[2] Republic of Türkiye Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks, 06560, Ankara, Türkiye

[3] Department of Landscape Architecture, Faculty of Agriculture, Ege University, Bornova 35100, İzmir, Türkiye

***** Corresponding author (Sorumlu yazar):

muhammedhakan.cakmak@gmail.com

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ABSTRACT

Objective: The ecosystem services (ES) term is defined as all of the products, services, and benefits provided by ecosystems on earth to human beings and other living entities. In order to determine the ES capacity and integrating such data into management plans is a key element for nature conservation and sustainable land-use planning. Hence, a study was conducted, and the objective of this study was to determine the ES capacity of Mamak district (Ankara, Turkey) with an evaluation approach based on expert opinions using EUNIS habitat data.

Material and Methods: Besides raw scores obtained from experts with the evaluation approach based on expert opinions, the areal ES capacity (AESC) indices for each EUNIS habitat type were calculated, and maps were developed accordingly.

Results: The results obtained from this study showed that; (1) with raw scores, ES capacities of habitat types are very diverse for each ES type, (2) with AESC indices, almost all ES capacity class are same for each habitat type.

Conclusion: As a conclusion, it can be stated that the use of EUNIS habitat maps is applicable to assess ES capacities in such studies if and when the presence of such habitat data.

Keywords: Biodiversity, ecosystem service mapping, GIS, habitat data

ÖZ

Amaç: Ekosistem hizmetleri (EH) terimi, yeryüzündeki ekosistemlerin insan ve diğer canlılara sağladığı ürün, hizmet ve faydaların tümü olarak tanımlanmaktadır. EH kapasitesinin belirlenmesi ve bu tür verilerin yönetim planlarına entegre edilmesi, doğanın korunması ve sürdürülebilir arazi kullanım planlaması için kilit bir unsurdur. Bu çalışmada, EUNIS habitat verileri kullanılarak uzman görüşlerine dayalı değerlendirme yaklaşımı ile Mamak ilçesinin (Ankara, Türkiye) EH kapasitesinin belirlenmesi amaçlanmaktadır.

Materyal ve Yöntem: Uzman görüşlerine dayalı değerlendirme yaklaşımı ile uzmanlardan alınan ham puanların yanı sıra her bir EUNIS habitat tipi için alansal EH kapasite (AESC) indeksleri hesaplanmış ve buna göre haritalar geliştirilmiştir.

Araştırma Bulguları: Sonuçlar göstermiştir ki; (1) ham puanlarla, habitat tiplerinin EH kapasiteleri her EH tipi için çok farklı iken, (2) AESC indeksleriyle, hemen hemen tüm EH kapasite sınıfları her habitat tipi için aynıdır.

Sonuç: Sonuç olarak bu çalışma, EUNIS habitat haritalarının kullanımının, EUNIS habitat verilerinin mevcut olması durumunda ve bu tip çalışmalarda EH kapasitelerini değerlendirmek için uygulanabilir olduğunu göstermektedir.

Anahtar sözcükler: Biyoçeşitlilik, ekosistem hizmetleri haritalaması, CBS, habitat verileri

INTRODUCTION

The concept of ecosystem services (ES) is defined as all of the products, services and benefits provided by ecosystems on earth to humans and other living entities (Costanza et al., 1997; Daily, 1997; MEA, 2005). The term was suggested mainly by naturalists in the late 1970s and early 1980s to point out how biodiversity loss directly impacts ecosystem functions based on services critical to human health and thereby trigger action on nature conservation (Anonymous, 2016). “Millennium Ecosystem Assessment” (MA) classifies ES under four main groups; supporting ES, regulating ES, provisioning ES and cultural ES. Supporting services are ecological functions such as biodiversity, habitats for animal and plant species, and genetic diversity; regulating services are goods from ecosystems such as purification of air and water, climate regulation, and control of pests and diseases, whereas provisioning services are what humans can obtain from the ecosystems such as food (animal and plant products), non-wood products, and medicine materials; and finally, cultural services are non-material benefits such as ecotourism, recreation, and religious value (MEA, 2005). Following that, “The Economics of Ecosystems and Biodiversity” (TEEB) labelled supporting services as “habitat or supporting services” and finally “The Common International Classification of Ecosystem Services” (CICES) organized sections hierarchically, however didn’t include supporting services (Kasparainskis et al., 2018).

Although the mapping of ES is one vital concept that is required to improve the recognition, integration and implementation of ES into various institutions and decision-making mechanisms, the quantification and mapping of ES have been put forward as one of the major challenges for the implementation of ES in decision-making mechanisms (Daily & Matson, 2008). Several new ES mapping approaches have recently been developed in a variety of research (Troy & Wilson, 2006; Turner et al., 2007; Egoh et al., 2008; Nelson et al., 2009; Tallis & Polasky, 2009; Vihervaara et al., 2010; Vihervaara et al., 2012; Hepcan & Coskun Hepcan, 2021). Most recent mapping strategies have relied heavily on biological data (for example, plant functional traits, ecosystem structure, and habitat data) (Vihervaara et al., 2012).

It is a fact that humanity is subjected to biodiversity and ecosystem functions, and ES are a tool to exhibit human impacts on ecosystems and biotopes such as land use (MEA, 2005; Swetnam et al., 2011; Vihervaara et al., 2012). ES in urban areas have gained significant attention due to the rapid urban development lately (Zinia & McShane, 2021). Although urban systems are perceived as separate from natural ecosystems (Costanza et al., 1997; Mcintyre et al., 2000; de Groot et al., 2002; Grimm & Redman, 2004; Niemelä et al., 2010; Li et al., 2017), every detailed study on urban ecosystems is quite significant for people living in cities (Ahern et al., 2014). According to Gutman (2007) and Sandhu & Wratten (2013), urban ecosystems and ecosystems out of the cities both provide ES for people living in cities.

EUNIS habitat classifications offer precise biodiversity data, making their usage plausible in mapping links between biodiversity and ES (Maes et al., 2016). Although these two are interrelated, there is still need for clarification on that (Haines-Young & Potschin, 2012; Vihervaara et al., 2012). Approaches such as deriving information on ES directly from land cover/habitat maps may be appropriate at national or larger scales, for areas where the dominant ecosystem service is directly related to land use, or where data availability or expertise is limited, and where the main focus is on the assumed presence of ES rather than quantification of the supply (Brander et al., 2012; Burkhard et al., 2012). However, studies on ES assessment through EUNIS habitat classification are still insufficient and new studies should be developed and supported.

Mamak is one of the utterly active districts of Ankara (Türkiye) with the wide range of different land use and habitat types within the context of constantly growing trend of urbanization and emerging slum areas (Çakmak & Aytaç, 2020). Therefore, Mamak is chosen in order to examine its wide range of different land use forms and habitat types. The main objectives of this study were;

a) to determine the ES capacity and map of the district by using EUNIS habitat data.

b) to provide a policy related data and a viewpoint to decision-makers in order to integrate ecological information (biological data and ES) into management plans.

c) to analyse the effect of different habitat types on the provision of ES in the study area.

d) to reveal a method for evaluation approach based on expert opinion and point out essential ES to be studied in detail for further studies.

MATERIALS and METHODS

Study area

The Mamak district is located in the eastern section of Ankara, Türkiye's capital city (32°55'23" E and 39°56'31" N). It covers an area of 34200 ha. Altındağ (in the north-northwest), Elmadağ (in the east) and Çankaya (in the south-southwest) are neighboring districts (Figure 1) (Çakmak & Aytaç, 2018). The district has a total population of 682420 people. Total amount of open green spaces in Mamak district is 1697.63 ha (T.C. Mamak Belediyesi, 2023). The study area is under the influence of the Mediterranean Region's continental climate. In terms of the Mediterranean bioclimatic divisions, the area is close to the slightly humid zone with semi-arid cold winter (Çakmak & Aytaç, 2018). Triassic aged Elmadağ, Emir, Keçikaya, Ortaköy formations and Late Pliocene aged Gölbaşı formations are dominant in the study area (Çelik et al., 2007).

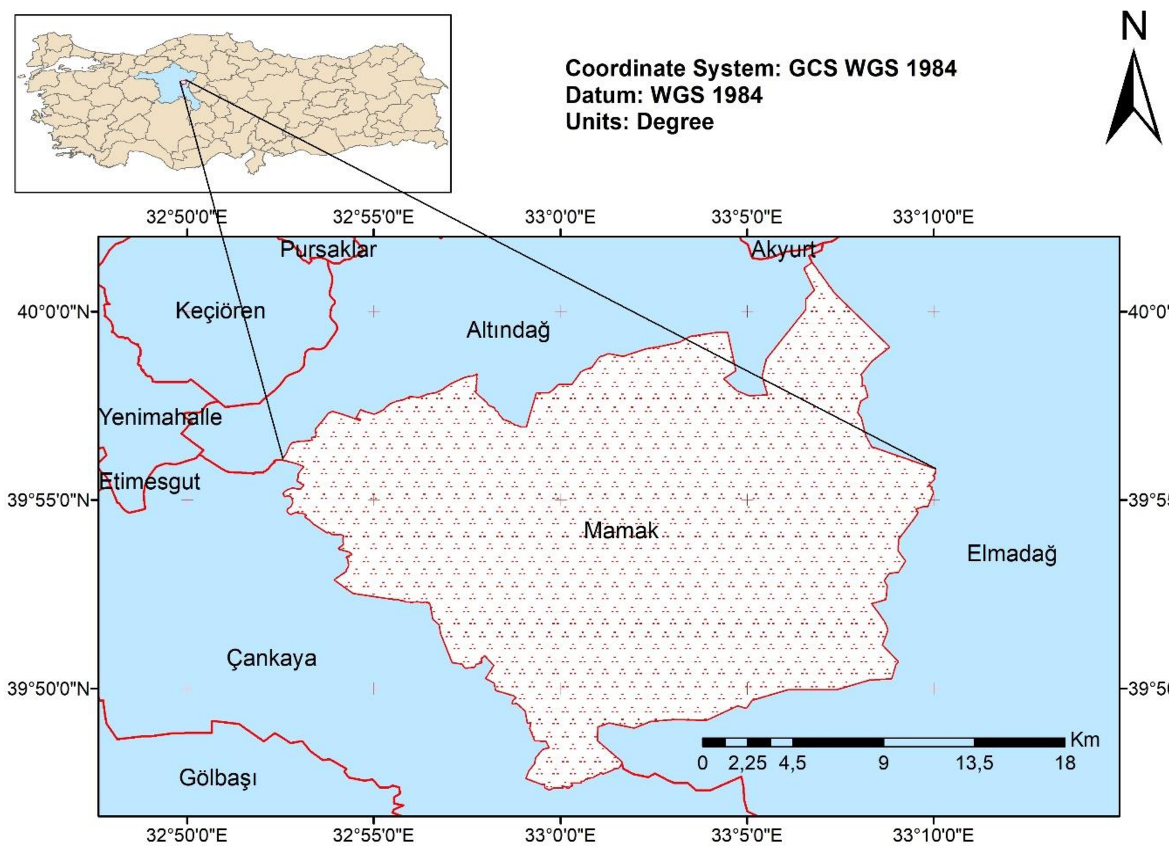

Figure 1. Location of the study area.

Şekil 1. *Çalışma alanının lokasyonu.*

Despite the district's rapid development and continuing urbanization, it nevertheless retains a diverse floristic (233 plant taxa) and habitat (29 types at level 3 and 14 types at level 4, totally 43 EUNIS habitat types) diversity (Çakmak & Aytaç, 2018, 2020). 18 habitat types at level 2 were derived from the study of Çakmak & Aytaç (2020) (Table 1, Figure 2).

Table 1. Level 2 EUNIS habitat types of Mamak district (Çakmak & Aytaç, 2020)

Çizelge 1. *Mamak ilçesinin 2. seviye EUNIS habitat tipleri (Çakmak & Aytaç, 2020)*

EUNIS Habitat Codes (Level 2)	EUNIS Habitat Names	Area (ha)	Area (%)
C1	Surface standing waters	80.77	0.24
C2	Surface running waters	165.57	0.48
C3	Littoral zone of inland surface waterbodies	109.82	0.32
E1	Dry grasslands	5468.67	15.97
E2	Mesic grasslands	52.79	0.15
E5	Woodland fringes and clearings and tall forb stands	5.17	0.02
G1	Broadleaved deciduous woodland	828.58	2.42
G5	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice	3184.81	9.30
H3	Inland cliffs, rock pavements and outcrops	172.75	0.50
H5	Miscellaneous inland habitats with very sparse or no vegetation	1717.71	5.02
I1	Arable land and market gardens	15531.50	45.35
I2	Cultivated areas of gardens and parks	81.18	0.24
J1	Buildings of cities, towns and villages	3355.90	9.80
J2	Low density buildings	1169.78	3.42
J3	Extractive industrial sites	890.85	2.60
J4	Transport networks and other constructed hard-surfaced areas	1351.73	3.95
J5	Highly artificial man-made waters and associated structures	6.55	0.02
J6	Waste deposits	71.62	0.21
	TOTAL	34245.75	100

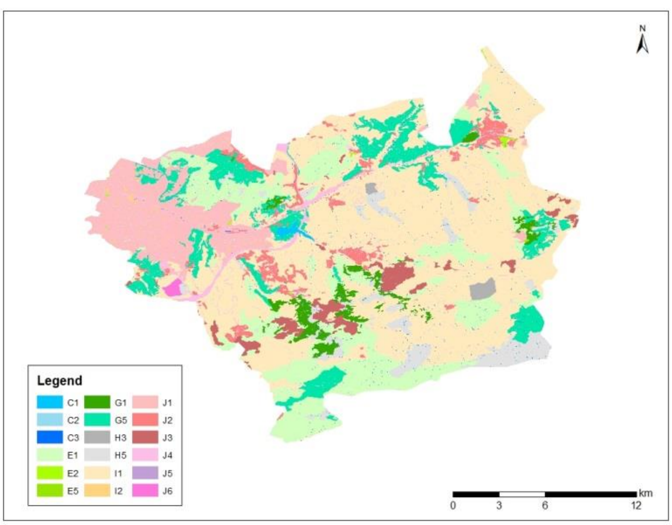

Figure 2. EUNIS habitat types (level 2) of the study area (Çakmak & Aytaç, 2020).

Şekil 2. *Çalışma alanının EUNIS habitat tipleri (2. seviye) (Çakmak & Aytaç, 2020).*

Methods

The main approach in this study was to evaluate the EUNIS habitat types for Mamak in terms of ES by using an evaluation approach based expert opinion, first step was to prepare a matrix table as a survey where experts have to grade ES capacities by considering EUNIS habitat types (Table 2). On the behalf of ES classes, four main groups (provisioning, regulating, cultural and supporting ES) according to MEA (2005) and “ES bundles” as the bundles of all four types were included. Besides that, EUNIS habitat types of the study area was obtained from a study conducted by Çakmak & Aytaç (2020) where habitat types ranked up to EUNIS level 2 (Table 1, Figure 2). In accordance with the EUNIS habitat classification system, level 1 delineates primary ecosystem types, level 2 broadly encompasses habitats similar to a land cover system, and at level 3, notably, phytosociological units such as alliances and associations play a pivotal role in habitat identification (Davies et al., 2004; Arslan & Arslantürk, 2009; Çakmak & Aytaç, 2021). In the aforementioned study, the abundance of habitat types (43 habitats) below level 2 rendered them impractical for ES assessment due to the need for more intricate knowledge and analyses. Consequently, as the utilization of habitat types below level 2 for ES assessment was considered to be unfeasible, level 2 was used in the study.

As the second step, thirty experts from different backgrounds such as water management, non-wood production, animal and plant products, green spaces in cities, micro climate conditions in cities, carbon sequestration, bio-assessment in accordance with the topics that form the basis of 4 different ES (provisioning, regulating, cultural and supporting) were determined and matrix table were shared with these experts as the survey where they can grade. The assessment grades ranged from 1 to 5 as the Likert scale, where 1 grade presented “no relevant capacity to provide a certain ES”, and 5 grade presented a “very high relevant capacity to provide a certain ES” (Vihervaara et al., 2012). Thus, experts scored the relationship of each ES with each EUNIS habitat types. Although most experts were familiar with the environmental, social and economic conditions of the study area, some documents such as maps and reports about the district were also provided them. Twenty-seven experts filled up the survey matrix table. After gathering survey results, the standard deviation was calculated by taking sum of scores into consideration, and two extreme lowest values were removed. Therefore, analyses were focused on other 25 surveys.

In this study, mainly two methods were employed: using (1) sum of scores of experts, (2) AESC (Areal ES Capacity) indices. The results of both methods were mapped for four main ES (provisioning, regulating, cultural and supporting) and ES Bundles. EUNIS habitat types obtained from Çakmak & Aytaç (2020) were used as the base in the maps by using ArcGIS 10.8. In addition, the most prioritized EUNIS habitat types for conservation (C1, E1, G1, H3, I1 and J1) according to the study of Çakmak & Aytaç (2020) were also evaluated.

For the areal ES capacity (AESC) indices for each EUNIS habitat type were calculated by using the following equation (Vihervaara et al., 2010), and 4 main ES and ES bundles maps were prepared:

$$I_{AESC} = \sum \frac{X_{HABITAT} A_{HABITAT}}{A_{TOTAL}} \quad (1)$$

where $X_{HABITAT}$ is the habitat value (average of ES production capacity per habitat), $A_{HABITAT}$ is the area of the EUNIS habitat type in the study area, and A_{TOTAL} is the area of the study area.

Table 2. A sample scoring matrix table (survey) for the interview with experts

Çizelge 2. *Uzman görüşmelerinde kullanılan matris (araştırma) tablosu örneği*

EUNIS Habitat Types / Ecosystem Services		Provisioning ES are defined as products obtained from ecosystems; examples of services such as the provision of food (plant and animal products), access to clean water resources, obtaining wood products (firewood and round timber), contribution to the seed bank, natural medicine making can be given. In this context, please evaluate this service type and score between 1-5 for each EUNIS habitat type given in the columns.	Regulating ES are defined as benefits derived from ecosystem processes; examples of services such as climate regulation (carbon storage), purification of air and water, contribute to pollination (seed transport), erosion control, reducing noise pollution, control of pests and diseases can be given. In this context, please evaluate this service type and score between 1-5 for each EUNIS habitat type given in the columns.	Cultural ES are defined as intangible benefits derived from ecosystems; examples of services such as ecotourism, recreation, hunting, aesthetic benefits of urban green areas, inspiring values, moral and spiritual values can be given. In this context, please evaluate this service type and score between 1-5 for each EUNIS habitat type given in the columns.	Supporting ES are defined as the ecological functions underlying the production of ecosystem services; examples of services such as biodiversity, providing a habitat for plant and animal species, ensuring genetic diversity can be given. In this context, please evaluate this service type and score between 1-5 for each EUNIS habitat type given in the columns.
C1	Surface standing waters	5	5	4	5
C2	Surface running waters	5	5	3	5
C3	Littoral zone of inland surface waterbodies	4	5	4	5
E1	Dry grasslands	5	5	3	5
E2	Mesic grasslands	2	3	4	2
E5	Woodland fringes and clearings and tall forb stands	3	3	2	3
G1	Broadleaved deciduous woodland	5	5	4	5
G5	Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice	3	3	3	3
H3	Inland cliffs, rock pavements and outcrops	3	3	2	4
H5	Miscellaneous inland habitats with very sparse or no vegetation	3	3	2	4
I1	Arable land and market gardens	3	2	1	2
I2	Cultivated areas of gardens and parks	3	3	4	3
J1	Buildings of cities, towns and villages	1	1	1	1
J2	Low density buildings	1	1	1	1
J3	Extractive industrial sites	1	1	1	1
J4	Transport networks and other constructed hard-surfaced areas	1	1	1	1
J5	Highly artificial man-made waters and associated structures	3	2	2	2
J6	Waste deposits	1	1	1	1
Sum of scores		**52**	**52**	**43**	**53**

RESULTS and DISCUSSION

Based on the expert evaluations

Based on the expert evaluations, four main ES and ES bundles were mapped and depicted in Figure 3.

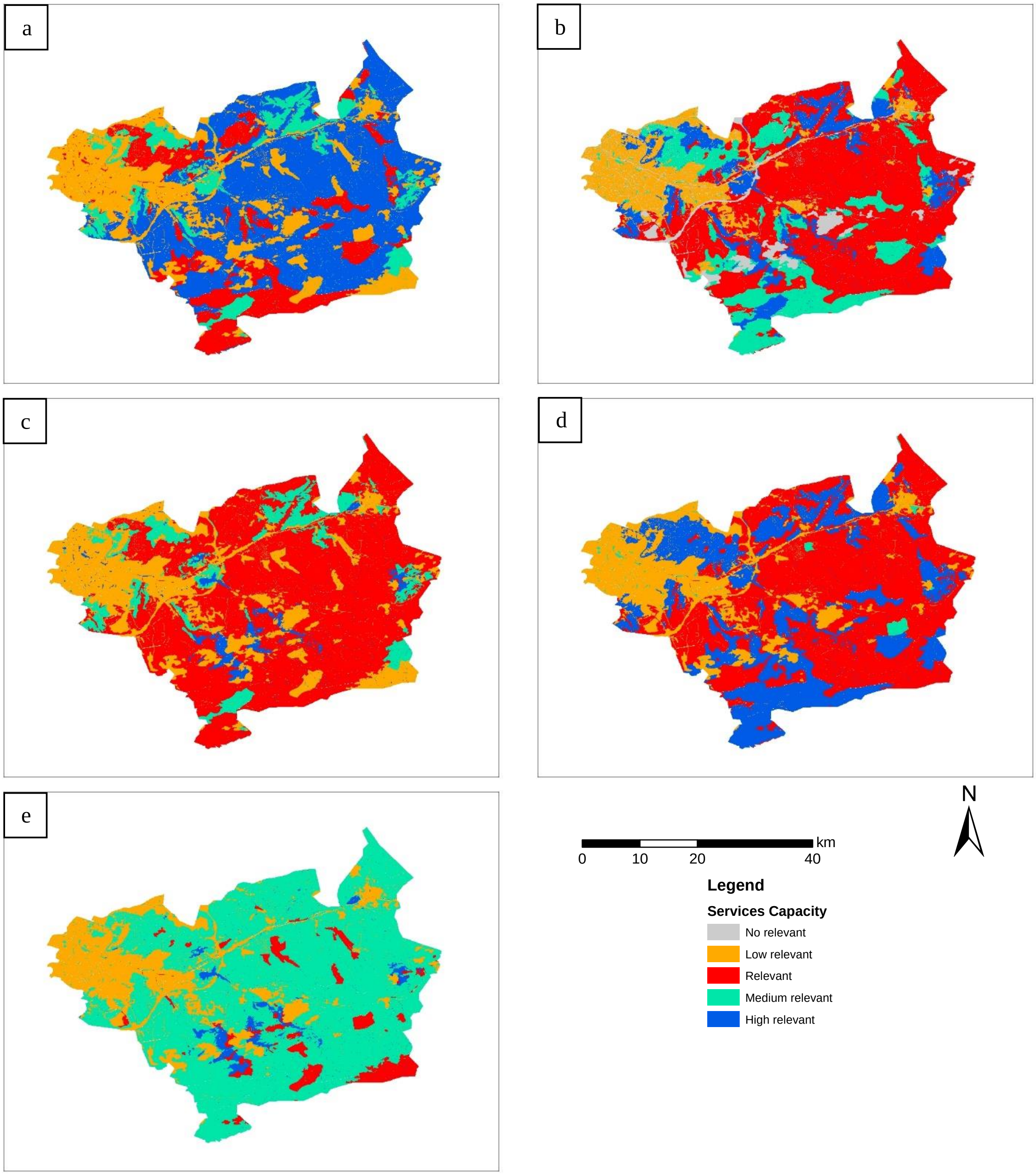

Figure 3. ES mapping based on the mean scores (3a: Provisioning, 3b: Regulating, 3c: Cultural, 3d: Supporting, 3e: Bundles).

Şekil 3. *Ortalama puanlara dayalı EH haritalaması (3a: Tedarik, 3b: Düzenleyici, 3c: Kültürel, 3d: Destekleyici, 3e:Tüm).*

As I1 habitat covers about %45 of the study area and is “high relevant” in terms of provisioning ES, checking over Figure 3a may cause a misunderstanding of results, since except G1 habitat (also high relevant), the half of the other habitats have low relevance to provisioning services. The same trend was valid for other ES maps: the results for the other 3 ES types (regulating, cultural and supporting) are mostly “relevant”, therefore these maps are seen as most of the EUNIS types are also “relevant”. However, habitats such as C1, C2 and G1 are high relevant for them. Regulating ES reached the result of no relevant for J3, J4 and J6 habitat types.

As mentioned as the most prioritized EUNIS habitat types for conservation; C1, E1, G1, H3, I1 and J1 are also examined in detail. The scores of G1 and J1 habitats are self-balanced. While G1 is high relevant to all ES types while J1 is low relevant. On the other hand, H3 habitat ranges from low relevant to medium relevant. High relevant habitat types for provisioning ES are G1 and I1, for regulating and cultural ES are C1 and G1, for supporting are C1, E1 and G1. According to which ES capacity class each EUNIS habitat is in, the calculated areal percentages in percent (%) that these capacity classes cover in the whole study area were determined. The ES capacity of the study area is shown in Figure 3 and Table 3. The provisioning services capacity of the study area has high relevant capacity with %48 percentage. These figures show that almost half of the area of the district has high production capacity. For regulating ES; nearly half of the area of district has relevant capacity (%51), while %7 of the study area has no relevant capacity. This shows that regulating ES do not have much big impact for the study area. According to relevant capacity (%62), cultural ES do not have a huge impact in the study area, just like regulating ES. The supporting services capacity is similar to the situation of the regulating and the cultural services capacities, whereas the supporting services capacity do not have a very large impact for the district. Finally, when all ES capacity of the study area is evaluated, it can be seen that medium relevant capacity has the highest percentage (%71).

Table 3. The areal distribution percentages of ES capacities for each ES types

Çizelge 3. *Her bir EH tipi için EH kapasitelerinin alansal dağılım yüzdeleri*

ES Capacities	Provisioning ES (%)	Regulating ES (%)	Cultural ES (%)	Supporting ES (%)	ES Bundles (%)
No relevant	0	6.76	0	0	0
Low relevant	25.49	13.23	24.99	19.97	19.97
Relevant	16.39	50.87	61.86	50.39	5.55
Medium relevant	10.34	16.38	9.77	0.91	71.33
High relevant	47.77	12.76	3.38	28.73	3.14

Based on the AESC indices

The results of the AESC indices are given as maps in Figure 4. For all ES types, as I1 habitat covers nearly half of the district, the study area mostly has the capacity class “high relevant”.

By examining the AESC indices scores for each EUNIS habitat type, the ES type with the highest value (most dominant) for that habitat type was determined. Then, by using the coverage percentages of these EUNIS habitat types, the coverage percentages of the most dominant ES types were calculated and mapped (Figure 5 and Table 4). The areal distribution percentages of dominant ES types respectively are as follows; provisioning ES (48%), supporting ES (25%), cultural ES (14%), regulating ES (9%), and finally, in 4% of the district, supporting and cultural ES are dominant together (Table 3 and Figure 5). ES types that are dominant for C2, C3, E1, E2, H3, H5, I1, I2 and J2 habitats are dominant with high differences from other ES types score-wise when each habitat is evaluated within itself. On the other hand, for J1, J3, J4, J5, J6 habitats, the difference in score between the other 3 ES types and the dominant ES type is low. Besides for C1 habitat, regulating and cultural ES are close to supporting ES score-wise, while for E5, G1 and G5 habitats' regulating and supporting ES are close to each other.

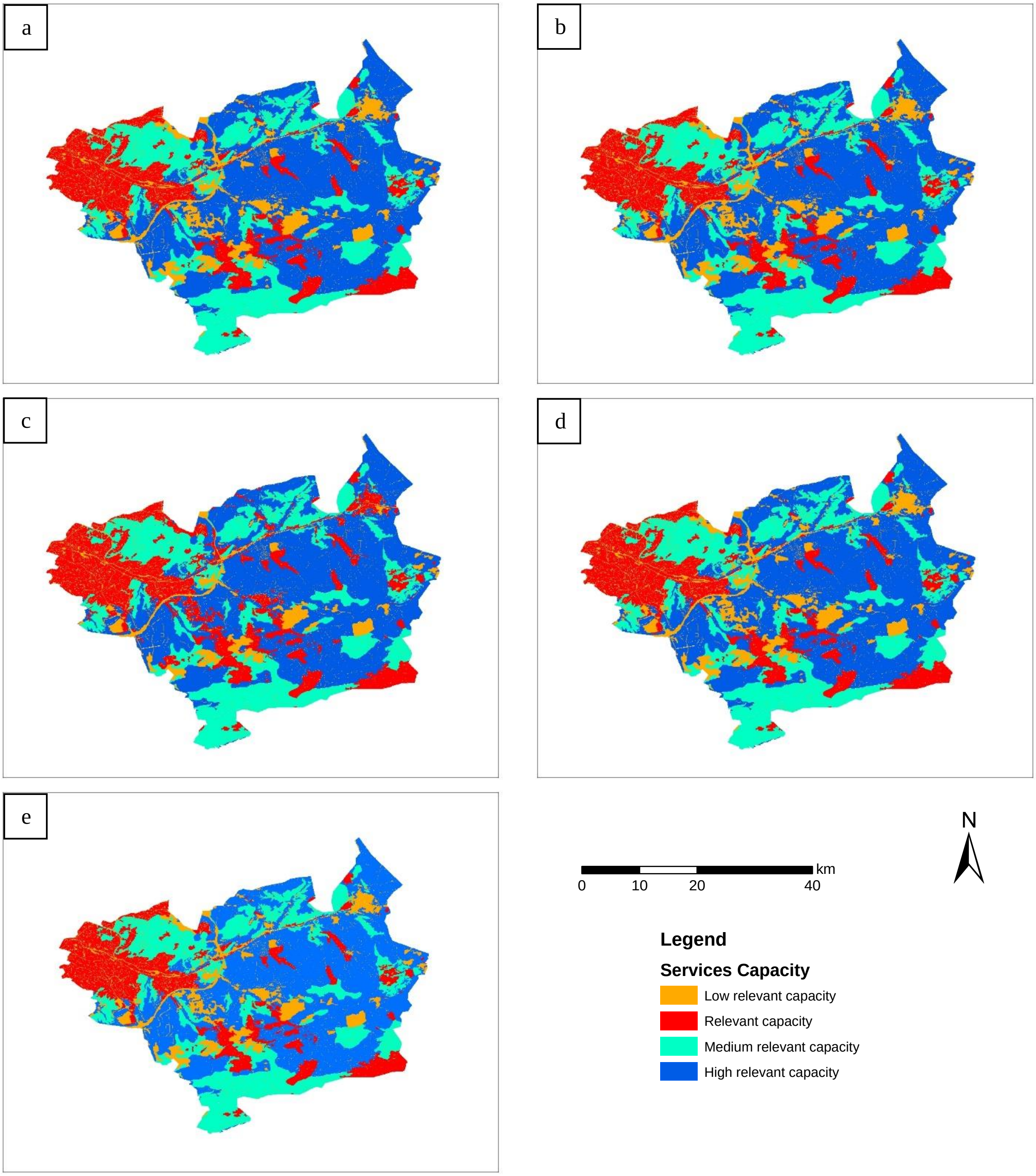

Figure 4. ES mapping based on the AESC indices scores (6a: Provisioning ES, 6b: Regulating ES, 6c: Cultural ES, 6d: Supporting ES, 6e: ES Bundles).

Şekil 4. *AEHK indis puanlarına dayalı EH haritalaması (4a: Tedarik EH, 4b: Düzenleyici EH, 4c: Kültürel EH, 4d: Destekleyici EH, 4e:Tüm EH)*

Table 4. The areal distribution percentages of dominant ES types

Çizelge 4. *Baskın EH tiplerinin alansal dağılım yüzdeleri*

ES Types	Percentage (%)
Provisioning ES	47.95
Supporting ES	25.35
Cultural ES	13.45
Regulating ES	9.30
Supporting - Cultural ES	3.95

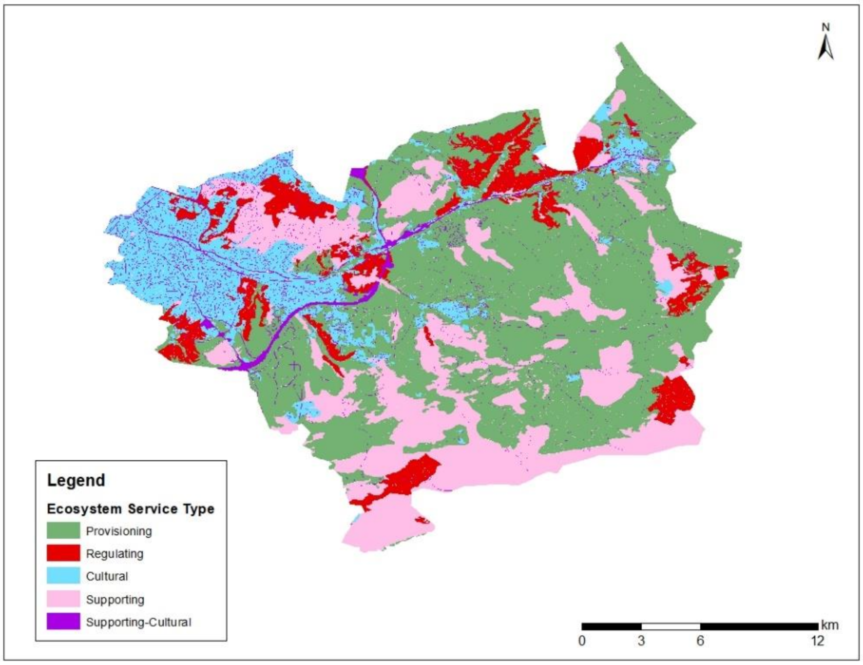

Figure 5. Dominant ES mosaic map.

Şekil 5. *Baskın EH mozaik haritası.*

This study was conducted with an objective to determine the ES capacity of the study area with evaluation approach based on expert opinion by using EUNIS habitat data to provide a viewpoint to decision-makers to integrate ecological information (biological data and ES) into management plans. As EUNIS habitat classification is more detailed, comprehensive and updated system compared to other habitat classification/land cover systems in Europe (e,g, CORINE Land Cover, EU Habitats Directive, Palaearctic Habitat Classification, Nordic Habitat Classification), it provides a significantly accurate basis for the ES assessment than the others (Evans, 2012; Çakmak & Aytaç, 2020). However, as mentioned in the “Methods” section, in this study EUNIS habitats were used in level 2, since the ES assessment of habitat types below level 2 requires more complex and specific analyses and there are too many habitat types (43 habitats) Çakmak & Aytaç (2020). Hence, it is not feasible to analyze each single habitat for the ES assessment.

According to the evaluation of expert scores, the capacities of ES were quite different from each other except for the J habitat type (constructed, industrial and other artificial habitats). J1 and J2 have the same ES capacity class for all ES types, both separately and together. On the other hand, J3, J4, J5 and J6 have the same ES capacity class for all ES types but regulating services. Experts stated that J3, J4, and J6 habitats have nothing to do with regulating services. However, in accordance with the AESC indices; all the ES capacities are relevant for J1 and low relevant for J3, J4, J5, and J6. Finally, J2 habitat type is low relevant to ES capacities except cultural ES. That means, there are differences between J habitat type according to two different methods.

The habitat destruction constitutes a significant threat to biodiversity and of course ES (Tilman et al., 1994). Habitat conservation is one of the most efficient and rational ways to prevent and/or slow biodiversity loss and provide continuity of ES (Lin et al., 2017; Çakmak & Aytaç, 2021). When compared the AESC indices and the expert mean scores for C1, E1, G1, H3, I1, and J1 habitats, which were stated as significant in terms of conservation by Çakmak & Aytaç (2020), only H3 and I1 habitats in provisioning ES, E1 habitat in regulating and ES bundles were found to have the same ES capacity class. Apart from this, no other capacity classes were found to be the same. This indicated that these two methods reveal quite different results from each other. The areal size of the habitats is thought to be the main reason for this because the non-constant variable in the AESC indices formula is the areal size. In addition to that, interestingly, the variability of the areal size of the habitats and the variability of the scores of the habitats are quite positively correlated with each other.

The following are the highlights of interpreting the distribution maps of the main ES types: the highest cultural ES values were observed in natural terrestrial and aquatic habitats (C1 and G1). In this case, they are water bodies and deciduous forest. It shows that experts believed that natural habitats have high cultural and recreational value than managed habitats. This result is consistent with the findings by Vihervaara et al. (2010). On the other hand, regulating ES were high in both natural and managed habitats. In this case G1 had the highest value, followed by G5, C1 and C2. This is related to disaster risk reduction functions of ecosystems (EEA, 2015; Cohen-Shacham et al., 2016). The level of provisioning ES was high in arable lands (I1) and low in urban habitats (J1-J2).

The Convention on Biological Diversity prioritizes the value of urban biodiversity and its contribution to ES (CBD, 2016). This study showed that the dominant ES of Mamak is provisioning (almost %50), that means, experts believe that access to plant and animal products, clean water, wood products etc. are still possible in urban ecosystems. On the other hand, supporting ES, which represents biodiversity and forming a suitable habitat for plant and animal species, have only %25 areal distribution percentage. Results also indicated that urban areas have the negative impacts on the supply of all ES. However, the interactions between urbanization and ES were consistent with previous studies (Tratalos et al., 2007; Vihervaara et al., 2010; Wang et al., 2020).

As conclusion, quantifying and mapping ES has become a rapidly expanding research field and several approaches have been used so far (Bolliger and Kienast, 2010; Vihervaara et al., 2012; Maes et al., 2016). ES assessments considering habitat types have become an important issue for ecological studies in Türkiye, as well as all over the world and several approaches have been used so far (Bolliger and Kienast, 2010; Vihervaara et al., 2012; Maes et al., 2016). Like for many other countries, the lack of urban biodiversity data (Kremen & Ostfeld, 2005) and more important a national assessment of ES is also the main challenge (Başak et al. 2022) for Türkiye. Therefore, EUNIS habitat classification data could be used for rapid ES assessment in urban areas. The results of assessments depend on methodology and quality data were used. The use of the ES concept has shown considerable promise in terms of presenting and developing new tools for researchers, stakeholders, and decision-makers. The outputs of ES assessment of urban habitats of Mamak district provides valuable quantitative ecological data for urban development and management plans. High-quality living environment is positively related to ES provided by urban nature (MEA, 2005; Tzoulas et al., 2007). It can be concluded that approach to ES assessments for EUNIS habitats can contribute to urban plans as expert-based decision-making and guide to development process.

In this paper, EUNIS habitat classification was used for evaluation approach based on expert opinion using EUNIS habitat data. Although a similar approach was tested in some EU countries

(Tuominen et al., 2001; Vihervaara et al., 2010), it was tested in Türkiye for the first time. While different classifications are used in these studies such as CORINE, EUNIS habitat classification are used in this study. The results obtained showed that this approach is applicable in all areas of Türkiye if and when the presence of EUNIS habitat maps. This article presented the necessity and importance of having such studies should become widespread across the country. Although different methods are used, there are ecosystem services studies conducted in Türkiye; e.g: assessing regulating ecosystem services for improving the air quality by using tree canopy (Coşkun Hepcan & Hepcan, 2017; Çakmak & Can, 2020), determining the effects of land cover changes on forest carbon storage through remote sensing (Karahalil et al, 2018), determining the importance of the historical values examining by the framework of some parameters (Tırnakçı, 2021a; 2021b, 2022), biological valuation (Bilgin & Doğan, 2012), making temporal and spatial analysis of ES potential by using social media photos (Örücü & Arslan, 2021), etc. Scientific studies on ES in Türkiye are mostly related to land use/land cover, but are not directly related to habitat classes. There are no studies on ES and habitat classification, but rather studies on ecosystems. This study was approached from such a different perspective and was conducted to fill this gap.

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Data Availability

Data will be made available upon reasonable request.

Author Contributions

Conception and design of the study: İT, MHÇ; sample collection: İT, MHÇ, ÇCH; analysis and interpretation of data: İT, MHÇ, ÇCH; statistical analysis: İT, MHÇ; visualization: İT, MHÇ; writing manuscript: İT, MHÇ, ÇCH.

Conflict of Interest

There is no conflict of interest between the authors in this study.

Ethical Statement

We declare that there is no need for an ethics committee for this research.

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