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Original Article

Determining the effect of urbanization on the vegetation of Gürün district (Sivas) based on biotope mapping and vegetation analysis

Biyotop haritalama ve vejetasyon analizine dayanarak, kentleşmenin Gürün ilçesi (Sivas) vejetasyonu üzerindeki etkisinin belirlenmesi

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ABSTRACT

Urbanization is one of the strongest negative effects on vegetational change within and around a city. In this study, it is aimed to determine the flora and vegetational changes within and around the city based on the identification and mapping of the biotopes which show differences in terms of ecologic factors met in Gurun district center and its vicinity and which are suitable for Corine biotope classification. First, 13 main biotope types are classified. In the biotopes, total 666 plant taxa were identified, 84 of which were endemic. Vegetation of the biotopes was determined, and then similarity levels of main biotopes are calculated according to the similarity coefficient method of Sorensen. Accordingly, while the similar areas are health facilities and agricultural areas the most different ones are parks and sports areas and drainage areas. The results emphasize the similarity levels of vegetation in biotopes and the negative effect of human intervention in the study area. As a result, with its rich natural structure, vegetation covers and endemism rate, the district of Gurun has significant natural biotopes and it is suggested that biotope classification should be considered in determining vegetation change and urban planning.

Keywords: Biotope mapping, categorization of biotopes, flora, gurun, land use, nature conservation, urbanization

ÖZ

Kentleşme, kent içindeki ve çevresindeki bitki örtüsü değişiminin en güçlü olumsuz etkilerinden biridir. Bu çalışmada, Gürün ilçe merkezi ve çevresinde karşılaşılan, ekolojik faktörler açısından farklılık gösteren biyotopların tanımlanması ve haritalanması, Corine biyotop sınıflandırmasına uygun olarak yapılmıştır. İlk olarak 13 ana biyotop türü sınıflandırılmıştır. Biyotoplarda, 84'ü endemik olmak üzere toplam 666 bitki taksonu tespit edilmiştir. Ana biyotopların benzerlik düzeyleri Sorensen benzerlik katsayısı yöntemine göre hesaplanmıştır. Buna göre benzer alanlar sağlık donatı alanları ile tarımsal alanlar iken en farklı olanlar parklar ve spor alanları ile boşaltım alanlarıdır. Elde edilen sonuçlar biyotoplardaki benzerlik düzeyleri ve araştırma alanında insan müdahalesinin biyotoplar üzerindeki olumsuz etkisini vurgulamaktadır. Sonuç olarak, zengin doğal yapısı, bitki örtüsü, yaban hayatı ve endemizm oranı ile Gürün ilçesi önemli doğal biyotoplara sahiptir ve kentsel planlama çalışmalarında biyotop sınıflandırmasının da dikkate alınması gerektiği önerilmektedir.

Anahtar Kelimeler: Biyotop haritalama, biyotopların sınıflandırılması, flora, gürün, alan kullanımı, doğa koruma, kentleşme

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INTRODUCTION

The word "Biotope" means the living habitat; according to Sukopp et al. (1988), it is defined as a specific living environment separate from the others while providing appropriate environmental conditions for specific organisms. Koseoğlu (1981) defines this term as a limitable area in terms of functionality where especially human beings as well as animals, plants, and all other living creatures are sheltered, fed, and protected against each other, meet their various needs, and establish mutual positive and negative relations.

Urban biotope maps are an important source of information for ecological urban planning. The biotope mapping is important to define the status and quality of the urban biotopes in landscape

and urban planning and in addition, it has an important place in the impact assessment and impact settlement (Bochow et al., 2007). One of the preconditions of successful urban planning strategies is to have knowledge especially about flora and vegetation in biotopes and their ecological characteristics.

In developing cities, determination of the flora and vegetation of a city and its environ may help us understand changes in vegetation. For this purpose, determination and classification of biotopes may be used as a base. Biotope mapping activities have been started with studies on the protection of landscapes in rural and urban areas; from the 1950s, Europe, America, and Canada give direction to the usage area classifications (Atik, 1997). In our country, the studies to mapping the urban biotopes, which are launched by Koseoglu (1981 and 1983) for the example of the Aegean region and Bornova, have been followed by the studies of Yılmaz (1986) for Buca, Atik (1997) for Adana city, Yılmaz (2001) for Bartin and its vicinity, and Mansuroglu et al. (2003) for Mansuroglu. The studies for mapping the natural biotopes have been started with the studies of Uzun et al. (1995a;b) and Artar (2002) for the example of Cukurova Delta coastal ecosystems and continued with the studies of Altan et al. (2001) for the mapping of natural biotopes in the Delta of Cukurova and of Fidan (2006) for the mapping of the Antakya Samandag coastline, Ersoy (2008) for the mapping of the Aliaga (İzmir) coastal region, and Nayim (2010) for the mapping of the important biotopes situated between Amasra and Inkum (Bartın).

Studies on vegetation changes based on the biotope mapping in Turkey are still in the initial stage. In this context, it is aimed to determine the effect of urbanization on the flora and vegetation in the biotopes of the city of Gürün and its environ. To reach this purpose, it was aimed (1) to determine and map biotopes, (2) to find flora and vegetation in the biotopes, (3) to investigate the changes in vegetation, and (4) to evaluate the results in respect of urban planning.

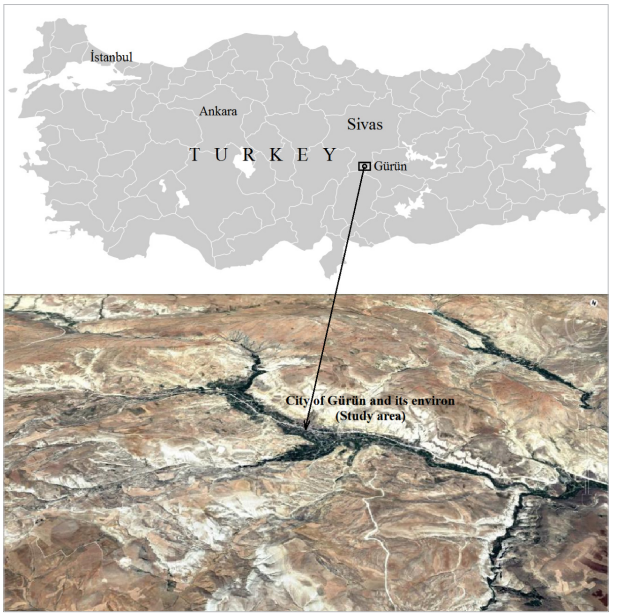

Figure 1. The location of the city of Gürün, which is the study area

MATERIALS AND METHODS

Study Area

The study area was the Gürün district center. It has a surface area of 2.797 (as of 1994) km^2 (Oz, 1999) (Figure 1). The research was conducted in the city center and within a contiguous area of 410 km^2 and the natural biotope areas in the inner city, on the urban edge, and in the immediate vicinity are defined and mapped by considering the potential and ecological characteristics of the city. Gürün and its surrounding area are situated between the mountains of Hezanli and Govdeli, which are the continuation of the Southeast Taurus Mountains and on a field where the Southeastern Taurus and the Eastern Taurus are separated from each other in the western part of the Eastern Anatolia Region.

The soil groups in the study area are classified as follows: (1) Zonal Soils (Brown Soils, Chestnut Colored Soils), (2) Azonal Soils (Alluvial Soils, Lithosols), and (3) Rocky Areas (Boyraz, 2003). The vicinity of Gürün is included in the basin of upper Euphrates. The waters of this region are drained by Tohma River and Balikli/Fishy Tohma, which are the biggest streams of the Gürün County and the most important branches of the Euphrates (Boyraz, 2003).

According to the climate data for the years of 1964-1996, the mean annual temperature of the city is 9.2°C, and the average of annual precipitation is 300 mm (Figure 2).

The study area is located in the floral zone of the Irano-Turanian region from a floristic point of view. In general, the dominant vegetation that is observed in and around the city of Gürün is steppe, hydrophilic, and rocky vegetation. In addition to these vegetation types, cultural plants are also found in the appropriate environment within the area.

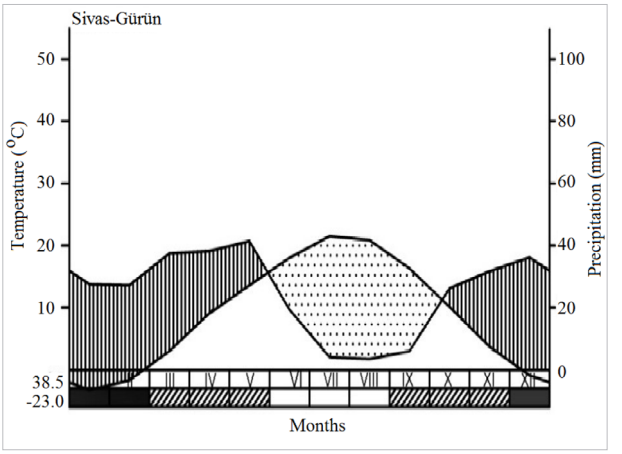

Figure 2. Walter climate diagram of the study area

Methods

Determination of the biotopes and sub-biotopes

In this study, the classification of biotopes and sub-biotope has been obtained from the CORINE Biotope Project, the Land Cover Classification Method of the CORINE project (European Communities, 1991). According to the Land Cover Classification Method of the CORINE project, the land cover classification levels predicted for our country have been evaluated for the case of Gürün county and the appropriate levels and the zoning plan of the area, the major land uses in relation with the study area as a result of the observations made on-site, and the aerial photos.

Flora and vegetation studies

In the first step, the related studies (Davis, 1965-1985; Donmez, 1998; and Karakus, 2009) were collected and the main floristic structure of the region was obtained, and a list of plants was prepared. Then, between the years of 2012 and 2015, the field studies were carried out to determine the vegetation cover on a total of 159 sample areas representing spaces that are floristically and ecologically diverse in the urban and rural landscapes. In urban landscape areas, on 78 sample areas having different land use and plant cover, some herbaceous and woody species were identified. In residential areas and transportation areas within the city, the size of the sample areas taken into account was approximately 32 m^2 (Kılınç, 2005). In other usage areas outside of the residential and transportation areas (cemeteries, health and educational facilities, parks, sport fields, etc.) by taking into account the whole covered area, the study has been conducted. In areas where there is no construction around the city and within the city, the canyons and rocky areas, the degraded open and mountainous areas, the agricultural areas, the streams and coastal zones, and the forests and wooded areas are taken into consideration with a sample area of 100 m^2 (Yılmaz, 2001). The field studies were carried out by visiting the sites during the vegetation season and the plant specimens were collected between the years of 2012 and 2015. A total of 3251 plant materials were collected. The samples collected were housed in the ISTO Herbarium of Faculty of Forestry, İstanbul University-Cerrahpaşa University.

Mapping of biotopes

Biotope types were described based on present land use and floristic composition of the study area. During the mapping of the biotopes, in the residential areas of Sukopp and Weiler (1988), the method of mapping which covers the entire area has been used. In this study, we followed these studies to make biotope maps: (1) we obtained the following documentation to determine the current land use of the study area; (2) the geological map data of the year of 2015 from the General Directorate of Mineral Research and Exploration; (3) the Gürün county forest management plan of the year of 2015 from the General Directorate of Meteorology; and (4) Google Earth satellite imagery of the year of 2015, 1/5000 scaled master building plan of Gürün county settlement, 1/5000 scaled implementary development plan, 1/100 000 scale Gürün environment plan. These documents were used to create the biotope maps together with the satellite data in the QGIS environment.

The categorization of the biotopes

The identified biotopes were divided into four categories based on the categorization given by Herk-Hansen (2015) as follows: (1) critical biotopes, which have highest or high natural value by their structure, species content, history, physical environment, flora, and fauna. It harbors, or can be expected to harbor for red-listed species; (2) rare biotopes, which are substantial biotopes which differ from their surroundings through high species richness or the existence of regionally rare species or key features; (3) general biotopes, which have minor natural value. These biotopes have common habitats but these habitats are the so-called everyday landscape; and (4) technotopes (T), which are the areas lacking preconditions and lost flora and fauna (Herk-Hansen, 2015).

Similarity analysis of biotopes

The similarities and differences of biotopes have been calculated according to the similarity coefficient methods of Sorensen (Kent, 2012). In the calculation of Sorensen similarity coefficient, first a list of taxa is prepared and a matrix was made. In the taxa list matrix, the blanks corresponding to each row and column are encoded according to the presence-absence (1-0) method. According to this, if a taxon is growing on a specific area, "1" is placed in front of the taxon and "0" if it is not growing. Then, based on the taxa list matrix, the study areas are treated in doubles and for each double of area, the values of a, b, and c have been found. Here a is the taxon number which exists both in A and B, b is the taxon number which exists in A and does not exist in B, and c is the taxon number which does not exist in A but exist in B (Işık, 2005). Based on these values, the Sorensen similarity coefficient (SS) is calculated as follows (Kent, 2012):

$$SS=2a/(2a+b+c)$$

In the Sorensen similarity coefficient, the variables are calculated as:

a=Number of species which are common in both columns,
b=The first column number of unique species, and
c=Number of species specific to the second column.
SS value is $0.0 \leq SS \leq 1.0$ (Işık, 2005).

RESULTS

Biotope Types of the City of Gürün

A total of 13 biotope types were described in the study area based on the CORINE project land cover classification method, on present land use, and floristic composition. After evaluating the official documents (land use maps, forest management plans, Google earth data, etc.) together with the flora of the study area, 34 sub-biotope types were described (Figure 3) (Table 1).

Flora of the City of Gürün and its Environ

After collecting a total of 3251 plant specimens, 666 different plant taxa were identified from the urban and rural biotopes of the city of Gürün and its surrounding areas. Of these taxa, 550 are native and the rest 116 are exotic for Turkey. Of the native

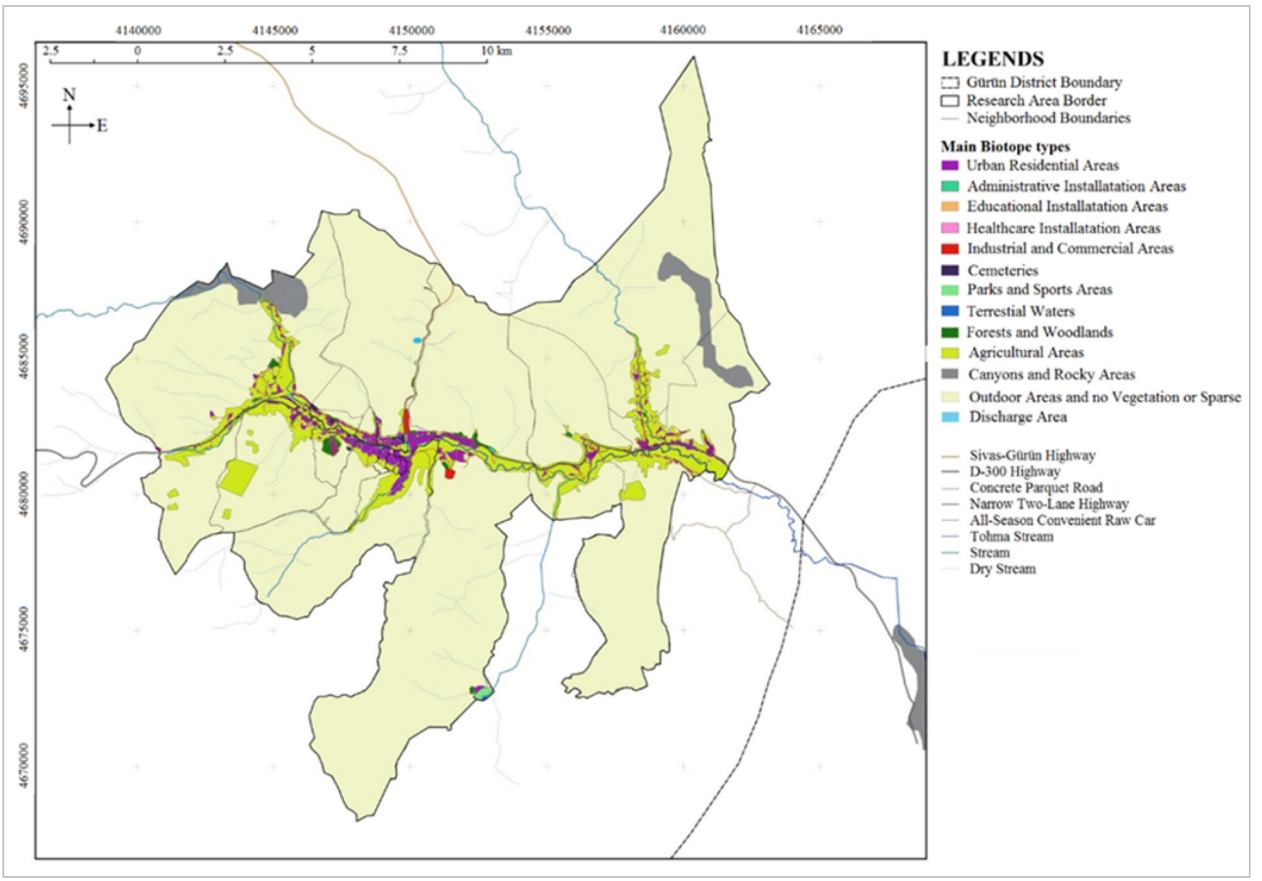

Figure 3. The main biotope types in the study area

taxa, 506 are herbal plants and the rest 44 are woody plants. Regarding exotic taxa, 57 of them are woody and the rest 59 are herbal plants.

Although 225 of the native plants are belonging to one of the phytogeographic regions, (Irano-Turanian, Europe-Siberian, and Mediterranean), phytogeographic regions of the rest 325 plants taxa are not known. Phytogeographical distribution of plants revealed that the study area falls into the Irano-Turainan phytogeographic region. Of the taxa, 167 are the elements of the Irano-Turanian region, 35 are Europe-Siberian elements, 21 are the elements of Mediterranean region, and 2 are cosmopolitan (Figure 4).

The number and groups (trees, shrubs, herbs, and climbers) of the plant species in each biotope type were determined and are given in Figure 5. The plant species were separated as natural and exotics in each biotope type. The highest number of exotic trees was determined in city parks and sport areas. They are lacking in canyons, riparian areas, and waste areas in the rural parts. The highest number of natural trees is also in the gardens of the houses and the lowest number is in the waste area. Totally, the lowest number of trees is in the waste area and the highest number is in parks and sport areas. While the highest number of exotic shrubs was in the parks, the highest number of natural ones was in the forest and woodland areas. The lowest number was determined in the health area. Herb coverage is composed of natural plants in general. The highest number of herb species is in the open mountainous areas. The lowest number of natural herbs is obtained from the waste area in the rural land. The number of climbers is highest in the urban areas in general and their number sharply decreases in the rural lands. Because the area is under continental climate condition and located on the Irano-Turanian phytogeographic zone, the number of trees is low, the land is generally open, and the tree coverage is very low. Because of this, and also locating on the Anatolian diagonal (Davis, 1965), the area has a wide diversity of herbal plants (Figure 5).

Both continental and phytogeographical conditions promote the number of endemic plants. The area has a total of 84 endemic plants. The highest number of endemic plants is found in the open mountainous areas, while the lowest ones are in the urban areas. Because the endemic plants are very vulnerable, in urban biotopes ecological conditions are not appropriate for these plants.

Therefore, their number in urban ecosystems is too low or completely lacking in some biotopes such as administrative and health biotopes in the city (Figure 5).

Table 1. Classifications of the biotopes and sub-biotopes of the study area

	Level 1 Classification	Main Biotope Types	Sub-Biotope Types
Classification of Biotopes	Artificial Surfaces	1.Urban Residential Areas	1.1. Close Built City Center
			2.2. High Density Residential Areas
			2.3. Medium Density Residential Areas
			2.4. Low Density (Rural) Residential Areas
		2.Administrative installation areas	2.1. Government House and National Education Directorate Garden
			2.2. Private Administration Directorate Garden
			2.3. P.T.T (National post) Directorate Garden
		3.Educational installation areas	3.1. Vocational School Garden
			3.2. Anatolian High School Garden
			3.3. Turkish telecom High School Garden
			3.4. Industrial vocational High School Garden
			3.5. Cumhuriyet Primary School Garden
			3.6. Kurultay Primary School Garden
			3.7. Kemal Ozalper Primary School Garden
		4.Healthcare installation areas	4.1. State Hospital Garden
			4.2. Community clinic garden
		5.Industrial and Commercial Areas	5.1 Gurunsoy Packing facility Garden
			5.2 Kucuk/ Small Industrial Site Garden
			5.3. Access areas
		6.Parks and Sport Areas	6.1. Gokpinar Lake Natural Life Park
			6.2. Seyfi Saltoglu Park
			6.3. Erol Gurun Park
			6.4. Nuri Acıkalin Park
			6.5. Sefik Ozturk Park
			6.6. Demirciler Park
			6.7. Sport areas
		7.Cemeteries	7.1 Yassicaatepe Cemetery
			7.2 Pınaronu Cemetery
		8.Discharge Areas	8.1 Discharge areas
	Agricultural areas	9.Agricultural areas	1.1. Dryland agriculture areas
			1.2 Garden farming Areas
			1.3. Irrıgated farming areas (Poplar Plantations and Damp meadowlands)
	Forestland and natural areas	10. Outdoor Areas with no vegetation or sparse vegetation	10.1. Sparse vegetation areas Steppe Areas
		11. Forests and Woodlands	11.1. Needle-Leafed Afforestation Areas
			11.2. Shrub Communities and Fences
	Water Mass	12. Canyons and Rocky Areas	12. Canyons and Rocky Areas
		13. Terrestrial waters	13. River and Coastal Zones

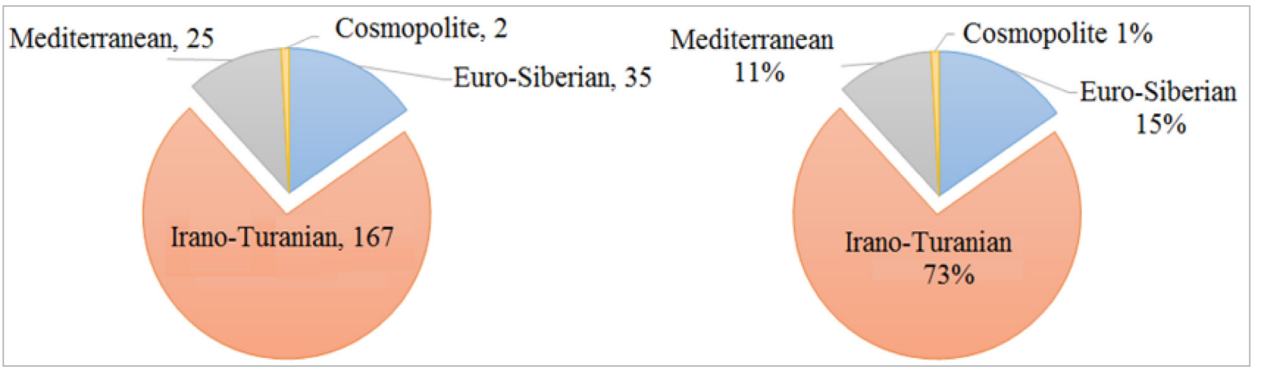

Figure 4. The phytogeographical distribution of the species identified. In the left pie graph, the number of the species and in the right one, their percentages are given. The area falls into the Irano-Turanian phytogeographical zone having 73% of the plant species

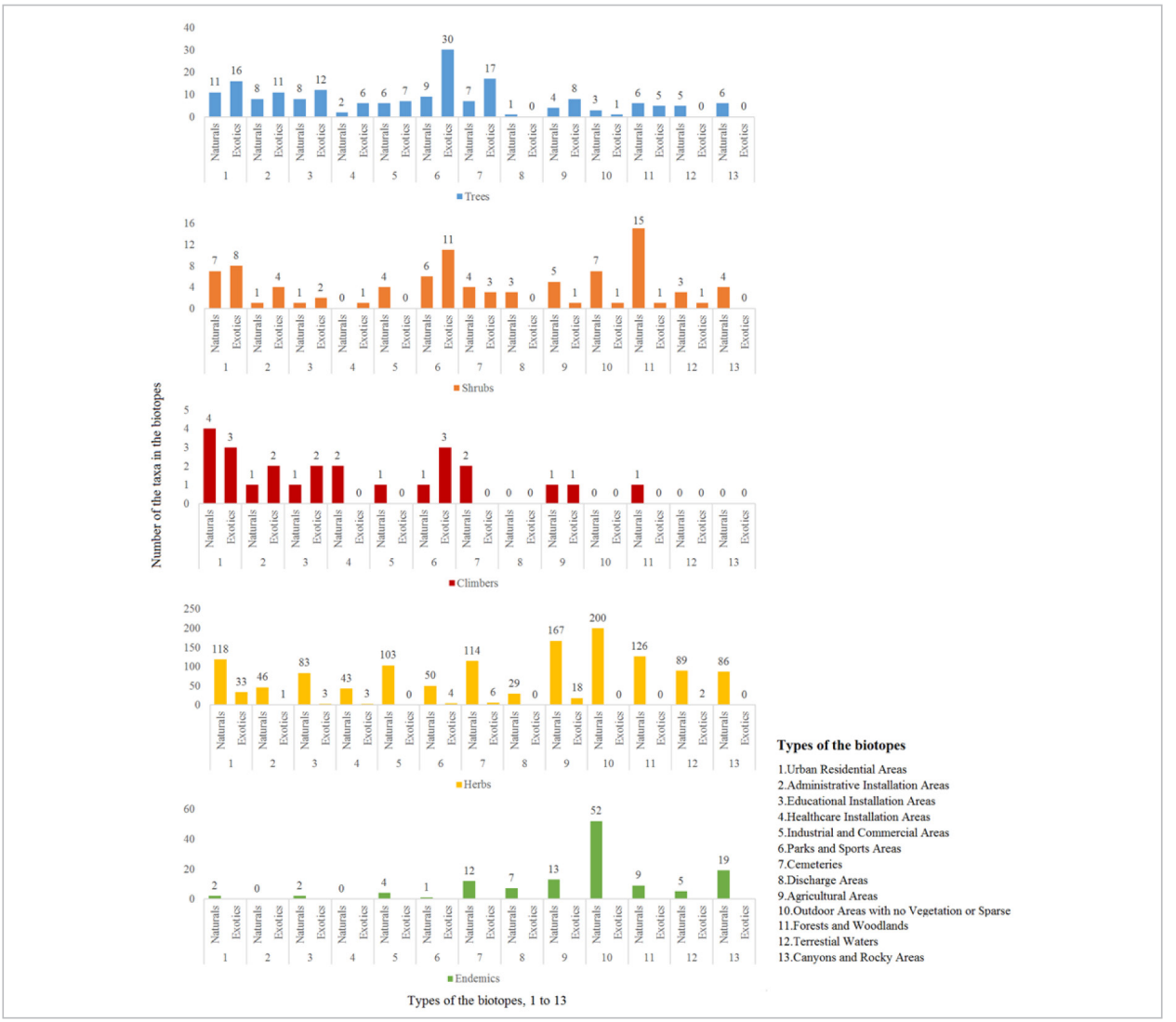

Figure 5. The numbers of the plant groups (trees, shrubs, herbs, climbers, and endemics) in the biotopes. The number of endemic plants is higher in the natural rural areas and low or lacking in the urban ecosystems. The biotopes: 1. Urban Residential Areas, 2. Administrative installation areas, 3. Educational installation areas, 4. Healthcare installation areas, 5. Industrial and Commercial Areas, 6. Parks and Sport Areas, 7. Cemeteries, 8. Discharge Areas, 9. Agricultural areas, 10. Open Areas Around the City, 11. Forests and Woodlands, 12. Canyons and Rocky Areas, and 13. Terrestrial waters

The Biotope Categories

Based on human impact, vulnerability, rareness, natural floristic richness, and vegetation structure, the 13 biotopes determined with this study were grouped as (1) critical biotopes, (2) rare biotopes, (3) general biotopes, and (4) technotopes (Table 2).

Critical Biotopes: These biotopes are the areas having the highest or high natural values with very rich flora and natural areas and endemic plants. The canyons and stony areas (Biotope type 12) are considered as critical biotopes due to both their physical values and floristic structures and also their ability to host endemic and rare species (Figure 6) (e.g., *Juniperus oxycedrus* L. ssp. *oxycedrus* L., *Saponaria prostrata* Willd. ssp. *anatolica* Hedge, *Scutellaria orientalis* L. ssp. *bicolor* (Hochst.) Edmonson, *Isatis glauca* Aucher ex Boiss ssp. *sivasica* (Davis) Yıldırım, *Astragalus campylosema* Boiss ssp. *campylosema* Boiss, *Dianthus zederbaueri* Vierh., *Anthemis armeniaca* Freyn et Sint., *Minuartia juniperina* (L.) Marie et Petitm., *Verbascum natolicum* (Fisch. et Mey.) Hub.-Mor., *Iris schachtii* Markgraf, *Iris sari* Scott ex Baker, *Scorzonera suberosa* C. Koch., *Hypericum thymopsis* Boiss, *Silene caryophylloides* (Poiret) Otth ssp. *stentoria (Fenzl)* Coode et Cullen, *Stachys lavandulifolia* Vahl. var. *lavandulifolia* Vahl., *Thymus pectinatus* Fisch. et Mey. var. *pectinatus* Fisch. et Mey., *Nonea stenosolen* Boiss. et Bal., *Anthemis armeniaca* Freyn et Sint., *Veronica cinerea* Boiss. et Bal., *Aubrieta canescens* (Boiss.) Bornm., and *Salvia cryptantha* Montbret et Aucher ex Bentham and *Fumana trisperma* Huber-Morath).

Figure 6. A view from the critical biotope (Sugul Canyon)

Figure 7. A view from the rare biotopes (an open area around the Gürün district)

Rare Biotopes: Within the scope of these biotopes, open lands (Biotope type 10) and needle-leaved afforestation areas (Biotope type 11) having a very rich flora around the city are considered as rare biotopes (Figure 7) (e.g., *Juniperus excelsa* M. Bieb., *Quercus brantii* Lindley, *Ephedra major* Host., *Pyrus elaeagnifolia* Pallas ssp. *elaeagnifolia* Pallas, *Cotoneaster integerrimus* Medik., *Cerasus incana* (Pallas) Spach var. *incana* (Pallas) Spach, *Atraphaxis billardieri* Jaub. Et Spach var. *billardieri* Jaub. Et Spach, *Frangula alnus* Miller ssp. *alnus* Miller, *Cornus sanguinea* L., *Cousinia sivasica* Hub.-Mor., *Matthiola anchoniifolia* Hub.-Mor., *Salvia eriophora* Boiss. et Kotscshy, *Tchihatchewia isatidea* Boiss., *Campanula pinnatifida* Hub.-Mor. var. *robusta* Hub.-Mor., *Gladiolus kotschyanus* Boiss., *Boreava orientalis* Jaub. et Spach, *Hypericum thymopsis* Boiss., *Haplophyllum myrtifolium* Boiss., *Astragalus lamarckii* Boiss., *Astragalus hirsutus* Vahl., *Asyneuma limonifolium* (L.) Janchen ssp. *limonifolium* (L.) Janchen, *Thymus pectinatus* Fisch. et Mey. var. *pectinatus* Fisch. et Mey., *Scutellaria orientalis* ssp. *bicolor, Festuca anatolica* Markgr.-Dannenb. ssp. *anatolica* Markgr.-Dannenb., *Asperula stricta* Boiss. ssp. *latibracteata* (Boiss.) Ehrend., *Marrubium cephalanthum* Boiss. et Noe, and *Astragalus brachypterus* Fischer).

General Biotopes: These biotopes are cemeteries (Biotope type 7) (Figure 8), discharge areas (Biotope type 8), the agricultural areas (Biotope type 9), and terrestrial rivers near the city (Biotope type 13). These areas are under human impact and have minor natural value. In these areas, it is observed that the hydrophilic species, especially the fauna types, are also damaged and these species are replaced by anthropogenic steppe species (river and coastal zones) and some native plants (e.g., *Hyacinthus orientalis* L., *Fumana trisperma, Astragalus nitens* Boiss. Et Heldr., *Astragalus lamarckii, Astragalus brachypterus* Fischer, *Haplophyllum telephioides* Boiss., *Heracleum platytaenium* Boiss., *Cruciata taurica* (Pallas ex Willd.) Ehrend., *Salvia euphratica* Montbret ete Aucher ex Bentham var. *euphratica* Montbret ete Aucher ex Bentham, *Ranunculus repens* L., *Hyoscyamus niger* (Linn.), *Hyoscyamus reticulatus* L., *Bellis perennis* L., *Mentha longifolia* (L.) Hudson ssp. *typhoides* (Briq.) Harley, *Lysimachia vulgaris* L., *Prunella vulgaris* L.,

Tussilago farfara L., *Lithospermum officinale* L., *Thalictrum minus* L. var. *majus* (Crantz) Crepin, *Hieracium bornmuelleri* Feryn., *Iris sari, Iris schachtii, Pennisetum orientale* L. C. M. Richard, *Scirpoides holoschoenus* (L.) Sojak, and *Asparagus officinalis* L.).

Technotopes: The residential (Biotope type 1), administrative (Biotope type 2), educational (Biotope type 3), healthcare installation (Biotope type 4), industrial and commercial areas (Biotope type 5), and parks and sport areas (Biotope type 6) are considered technotopes because they lack the natural flora elements (Figure 9). These areas are completely under heavy human impact and native floral elements are very low. In this biotope type, the ratios of the exotic plants and invasive plants are very high (e.g., *Cerinthe minor* L. subsp. *auriculate* (Ten.) Domac, *Solanum dulcamara* L., *Polygonum cognatum* Meisn., *Echium italicum* L., *Parietaria judaica* L., *Capsella bursa-pastoris* (L.) Medik, *Cardaria draba* (L.) Desv. ssp. *draba* (L.) Desv., *Euphorbia virgata* Waldst. et Kit., *Cichorium intybus* L., *Rubia tinctorum* L., *Tragopogon aureus* Boiss., *Trifolium pratense* L. var. *pratense* Boiss. Et Bal., *Trifolium repens* L. var. *repens L., Isatis glauca* Aucher Ex Boiss.

Figure 8. A view from the general biotopes (a cemetery in the Gürün district)

Figure 9. A view from the technotope (a residential area in the Gürün district)

ssp. *glauca* Aucher Ex Boiss., *Centaurea iberica Trev. Ex Sprengel, Onopordium turcicum* Danin., *Cirsium vulgare* (Savi) Ten., *Cirsium arvense* (L.) Scop. ssp. *vestitum* (Wimmer et Grab.) Petrak, *Rumex crispus* L., *Daucus carota* L., *Plantago lanceolata* L., *Plantago majör* L. ssp. *major* L., *Arctium minus* (Hill) Bernh. ssp. *pubens* (Babington) Arenes, *Alkanna orientalis* (L.) Boiss. var. *orientalis* (L.) Boiss., *Chenopodium album* L. subsp. *album*, *Lactuca serriola* L., and *Aegilops biuncialis* Vis.).

3.4. Results of similarity analysis of the biotopes

As a result of the flora and vegetation studies performed on the area, the diversity values and similarity levels in specimen areas are calculated based on the Sorensen similarity coefficient method.

According to the Sorensen similarity coefficient method, 0.0≤SS≤1.0. Within the biotopes, the residential, administrative, educational, healthcare installation, industrial and commercial areas, and parks and sport areas have a high similarity (Table 3). Similarity values are 0.31≤SS≤0.53. These biotopes have a high amount of exotic plants. Cemeteries under human impact are also similar to these biotopes. The discharge areas are rather different from all other biotopes, because of having a very low number of plants. Canyons and rocky places are rather different from all other biotopes. Similarity values are 0.10≤SS≤0.20. This biotope type is rather different from all other biotopes because of having a high number of endemic plants and low number of exotics. Agricultural areas, parks, and riparian areas have different similarity values (Table 3).

The similarity values between the biotope categories also support these results (Table 4). The similarity value is 0.57 between general biotopes and technotopes, because of being under heavy human impact. The lowest value was obtained in critical biotope, because of having only native and endemic species. The critical biotopes are the most important areas and should be protected primarily. Rare biotopes are between the critical and general biotopes and should also be protected (Table 4). The lowest similarity indexes were obtained between the critical biotope and the others, and these similarity levels slightly increase from technotopes to rare biotopes (Table 4).

DISCUSSION

The urban development in the Gürün County is irregular along the Tohma Valley and its surroundings. The urban biotopes, such as residential settlements, official institutions and foundations areas, industrial and commercial areas, and public and private green areas spreading in the city, exhibit a random texture without being included within a system and plan. Especially, in the eastward enlarging part of Tohma Valley, because of the decrease of the inclination, the urban development is shifting toward this direction.

According to today's development situation and development plan of the city and when the future potential usage status is examined, it is foreseen that the city will develop toward the east in the near future and especially the valuable agricultural

Table 3. Similarity coefficients between main biotopes calculated using the Sorensen's

		1	2	3	4	5	6	7	8	9	13	10	11	12
Technotopes	1	1												
	2	0,39	1											
	3	0,53	0,53	1										
	4	0,35	0,51	0,53	1									
	5	0,41	0,34	0,49	0,34	1								
	6	0,34	0,46	0,42	0,34	0,31	1							
General Biotopes	7	0,44	0,35	0,49	0,36	0,43	0,3	1						
	8	0,07	0,07	0,14	0,13	0,13	0,05	0,10	1					
	9	0,52	0,29	0,40	0,29	0,41	0,26	0,30	0,10	1				
	13	0,34	0,25	0,38	0,28	0,32	0,27	0,30	0.00	0,40	1			
Rare Biotopes	10	0,13	0,06	0,15	0,08	0,21	0,06	0,3	0,10	0,20	0,10	1		
	11	0,4	0,25	0,39	0,25	0,32	0,20	0,38	0,20	0,40	0,30	0,30	1	
Critical Biotopes	12	0,12	0,12	0,19	0,11	0,18	0,11	0,2	0,1	0,2	0,2	0,2	0,2	1

The biotopes: 1. Urban Residential Areas, 2. Administrative installation areas, 3. Educational installation areas, 4. Healthcare installation areas, 5. Industrial and Commercial Areas, 6. Parks and Sport Areas, 7. Cemeteries, 8. Discharge Areas, 9. Agricultural areas, 10. Open Areas Around the City, 11. Forests and Woodlands, 12. Canyons and Rocky Areas, 13. Terrestrial waters.

Table 4. Similarity coefficients between biotope categories using the Sorensen's formula

	Technotopes	General Biotopes	Rare Biotopes	Critical Biotopes
Technotopes	1			
General Biotopes	0.57	1		
Rare Biotopes	0.34	0.47	1	
Critical Biotopes	0.15	0.20	0.22	1

areas and natural steppe areas in this area may disappear. In the development plans prepared for the Gürün County until now, it is seen that the structural uses are taken as the basis and the small-scale areas remaining from these uses are evaluated as green areas. During the town development process, the current insufficient green areas are also decreasing day by day as a consequence of the interventions.

Because of the fact that the city of Gürün has received the "county/district" status in 1867 and that the D-300 highway is situated on the transition route, the urban population has been increased and in parallel with this increase in the population, the construction activities have been progressed rapidly toward the areas close to the city and showing natural environment characteristics. As a result of increasing depletion of building reserve areas in the city, the construction activities spreading on the agricultural areas and natural steppe areas around the city have begun to pose a serious threat to biotope areas and plant species in these areas.

The proportion of green areas in the study area depends on the Tohma watercourse areas and on the areas where its tributaries pass as well as on the concentration of the construction. It is seen that in agricultural areas where the water is abundant and the construction is less in the city, the green area ratio is very high and that the proportion of green areas is gradually decreasing in areas where the construction is intensive. For this reason, in the study area, the city center and its surrounding areas are deemed as the most lacking biotopes in terms of vegetation (green area ratio 10%).

The proportion of green areas reaching 50% from high density to medium density residential areas reaches up to 80% in low-density residential areas. The species diversity in these biotopes is also increasing at the same rate. However, in almost natural biotopes around the city, it is seen that the ratio of the green areas is decreasing again by 10%. This is due to the fact that the calcareous slopes, which are quite sloping and not holding water, create unfavorable living conditions for biotopes. However, because these biotopes are far from human intervention, they are the richest biotopes in terms of species diversity despite the low rate of the green areas. The plant species diversity and endemic plants, which have a relatively high value for the study area, are often found around urban areas where there is a lot of inclination and in areas distant from human intervention. As biotope types, these areas are in the mountainous and rocky

parts and canyons. These types of the areas were considered as critical biotopes because of having the highest ratio of rare and endemic plants. Afforested and open natural areas having very rich flora are considered rare biotopes. Cemeteries and agricultural areas have a rich flora but lower than that of rare biotopes. For that reason, these areas were considered general biotopes. On the contrary, the areas under heavy human impact, which are residential areas, administrative, educational, healthcare installation areas, parks and sport areas, rivers, and coastal zones, were considered technotopes.

In the Gürün district, the most invasive species are *Chenopodium album* ssp. *album, Cichorium intybus, Convolvulus arvensis, Isatis glauca* ssp. *glauca, Medicago sativa* ssp. *sativa,* and *Plantago major* ssp. *major* ve *Reseda lutea*. The most common endemic plants are *Scutellaria orientalis* ssp. *bicolor, Tchihatchewia isatidea*, and *Saponaria prostrata* ssp. *Anatolica,* and the rarest endemic plant is *Arenaria sivasica*.

This study revealed the effect of the urbanization on the change in the flora of the Gürün district. Because the city is getting grower, a new planning model should be made to project critical and rare biotopes and endemics. In this context and based on the results obtained, the following suggestions were developed:

In the landscaping that includes the urban settlements of the Gürün County, a "Landscape Conservation Area" should be established which aims at the protection, maintenance, and improvement of the biotopes in the study area and of all terrestrial and freshwater ecosystems that could affect them.

For the protection of the biotopes in the study area, major protected areas in Europe and the recreation- and tourism-related applications should be taken as an example. Especially in the planning and management phase, it is necessary to pay attention to how the balance between the protectoral needs and recreational needs necessary for biotope and species has been met.

First-degree protection priority for the planning and management of the place in the Gürün district should be belonging to the critical (e.g.,., canyons) and rare biotopes (e.g.,., Tohma watercourse and open areas having rich natural vegetation) because of their unique floristic, ecological, and esthetic qualities and the second-degree protection priority should belong to the widespread biotopes in the area.

CONCLUSION

The Gürün district biotope mapping in relation with the plant cover is performed and the floristic structure of the biotope types was determined. In addition, the current use status of the biotopes, the pressures on flora and vegetation, and their precautions have been defined. Thus, an important plant cover related part of the biotope mapping to be done in the future by the zoologists by including the mapping of animal species and groups in the region is completed. By this study, the urban biotopes, critical, rare, and widespread types of biotopes and their differences have been determined with the relevant suggestions being presented in terms of landscape planning. Plain areas within the locality of Suçatı situated in the east of the city are the most favorable areas for agricultural applications. In addition, the mountainous slopes of these areas have also rich species diversity in terms of natural plant species. Again, because of the spread of the species endemic to our country in biotopes situated in these areas, these areas do not exhibit a proper structure in terms of urban development. On the other hand, within the scope of the planning and management, the agricultural areas deemed as widespread biotopes having a second-degree protection priority should not be predicted as urban and industrial development areas. The ecological and general functions of these biotopes must be maintained and their pastoral aspect as well as their aesthetic contribution to rural landscape should be considered in the planning. Thus, it can be concluded that the development of the city should be predicted in areas other than the above-mentioned critical, rare, and agricultural biotope areas.

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