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Full Length Research Paper

Mapping of biotopes in urban areas: A case study of the city of Bartın and its environs, Turkey

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Biotope mapping is one of the planning elements playing an important role in detection of ecologically valuable areas. It is obligatory to consider urban biotopes in point of protection and management of natural and cultural structure especially in the development processes of urban areas. However, urban planning in Turkey where 75% of the population lives in urban areas is done without considering existing biotopes. For this reason, the cities lose their identity and gradually lose their quality of being a livable environment. In this study, the cultural and semi-natural biotopes in the City of Bartın and its environs, one of the smallest provinces of Turkey, were examined. First land use types were determined and later biotope types were classified and mapped. After determining all land usage types, comprehensive mapping method was applied. However, representative mapping method was also used in areas where land usage and biodiversity were similar. Geographical information systems were used to map urban biotopes and store the ecological data. Varieties in land use types and plant species combination were used as indicators in determination of the areas that show ecological differences. A database were formed in order to provide basis for ecological planning approach in urban areas by mentioning plant species found in each biotope.

Key words: Biotope mapping, land uses, comprehensive method, urban planning, Bartın.

INTRODUCTION

Nowadays, rapid increase in population of cities and pressure from structural changes towards meeting human needs cause a rapid consumption and destruction of nature and natural resources. As a result, there can be disruptions in ecological balance. As a member of the ecosystem, human is affected directly or indirectly from such impairments. Change rates between rural and urban population in Turkey have had essential differences since 1950s. By the date 31st December 2008, the population of Turkey was 71.517.100. The urban population, which was about 25% in 1950s, has reached to 75% in 2008 (TURKSTAT, 2009).

This case reveals that natural lands in restricted amounts in urban areas and neighborhood are under serious threat. Because of such unfavorable negative developments affecting not only Turkey but also the whole world, 'environment protection and nature protection' concepts have become permanently discussed issues.

Urban and regional planning tendency giving priority to economic targets in the past has left its place to ecological planning tendency aiming at the protection of environment. The key target of the ecological planning is the protection of natural environment, development of it in optimum level and in productive manner for the existence of human (Buchwald, 1980). Protection of biological creatures and biotopes, which are the living environment of them, constitutes one of the prerequisites for ensuring ecological balance.

"Biotope" is the living environment of both plants and animals (Odum, 1973; Altan et al., 1988); physical environment of the organism or the community of organisms (Koseoglu, 1981); it is a living place which can be separated from the physical environment around it by features like land shape, structure and even living communities within it, which has a certain size and homogenous characteristic (Çepel, 1992). In general, "biotope"

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is used for defining natural lands. However, the living areas, which lost naturalness with effect of the human together with natural lands constituting the living environment of local flora and fauna, are also covered by the "biotope" term. Consequently, the term “urban biotopes” has emerged (Yılmaz, 1997; Ayaşlıgil, 1997).

Biotope mapping and assessment play important role in nature conservation and landscape planning (Bastian, 1996). Initially, biotope maps that were produced for protection of native species and habitat focused usually on the protection of the endangered plants and animals. However, biotope maps have wider and more comprehensive uses, such as environmental management in the urban ecosystem (Byun et al., 2002; Mun et al., 2005; Hong et al., 2005). In these maps, the word biotope is synonymous with the word habitat, and is defined as any demarcated area in which animals and plants can live and thus primarily represents different land-use classes (Löfvenhaft et al., 2002). By biotope mapping in urban areas, the existing status of distributions and functions of both habitat environments for native species and natural resources are being able to assess. Biotope mapping in urban areas has become an important policy tool which provides data for urban planning as well as an implementation to forecast the urbanization impact on the ecosystem, enabling us to evaluate the ecosystem elements more objectively (Hong et al., 2005).

First biotope mapping studies were carried out in Germany by Sukopp et al. (1974), Kaule (1975), Blume et al. (1978), Kaule et al. (1979), Kunick (1980) and Bichlmeier et al. (1980). In Germany, biotope maps have been used in the urban planning for a long time (Sukopp et al., 1984; Sukopp and Weiler, 1988; Löfvenhaft et al., 2002). Today, biotope maps of all major cities in Germany such as Bayern, Berlin and Frankfurt, which also include detailed information about the geology, water, climate, land use, traffic/noise, energy and the like, have already been prepared and are widely used as fundamental references in urban planning and management (Mansuroğlu et al., 2006).

As a general rule, urban biotope mapping methods have been carried out in three different ways (Sukopp and Weiler, 1986; Sukopp et al., 1990; Schulte et al., 1993; Freeman, 2003):

i. Selective mapping: It is a method used for the detection of only the biotopes, which are worth protecting and sometimes potential worth protecting biotopes to realize this there should be evaluation framework prepared beforehand. It can be decided whether a biotope is worth protecting and mapping by such an evaluation framework.

ii. Representative mapping: In biotope maps prepared according to this method, sample areas are selected for all land use types covering certain areas and the researches are carried out in such areas. The results obtained from selected areas are related to other areas showing the same use structure.

iii. Comprehensive mapping: In this method, the detection and interpretation of biological and ecological characteristics of the area are carried out in all biotopes at the place of research. Biotopes are detected beforehand independently from the evaluation.

There is a continuous transition between these methods used in biotope mapping and each method has some advantages and disadvantages compared to others. The advantage of the selective mapping carried out in order to detect biotopes worth protecting or potentially, is that it can be carried out in a very short time and with lowest expenditures. Its disadvantage is the point that only the areas, which have special value, are taken into consideration for species protection in residential areas by selective mapping and some biotopes which cover large areas and which can be an important element of the biotope systems network can be overlooked. Other two methods developed in parallel to selective mapping aim at the mapping of all biotopes at the residential areas. The results obtained from researches made in sample areas selected for all land use types in representative mapping are correlated with other areas showing the same use structure. On the contrary, in comprehensive mapping, the areas contained by all land use types are examined separately.

Biotope mapping studies are generally carried out in highly industrialized countries and they are new research field for Turkey. Primary studies by Köseoğlu (1981 and 1983) were detected and mapped biotopes ecologically important in Aegean Region and Bornova District of İzmir Province in years. Mapping studies carried out in İzmir-Buca by Yılmaz (1986) were followed them. Altan et al. (1993) applied a biotope mapping method for the tourism investment area in the South of Antalya. Uzun et al. (1995) mapped biotopes contained by coast ecosystems by examining them in the example of Çukurova Delta. Furthermore, Mansuroğlu et al. (2006) detected and mapped urban biotopes in the City of Antalya which is located into the Mediterranean Region of Turkey.

Open lands which are found rarely in the cities and their environs and which are valuable resources undergo changes by the pressure of private and public sectors for commercial and heavy recreational usages. In this way, natural life is affected through intensive use of urban biotopes (Johnson, 1995). The City of Bartın has rich biological diversity and its natural resources are not impaired. The reason of such preservation is the fact that Bartın has the least populated province and province centers in Turkey with 32.2% (TURKSTAT, 2009).

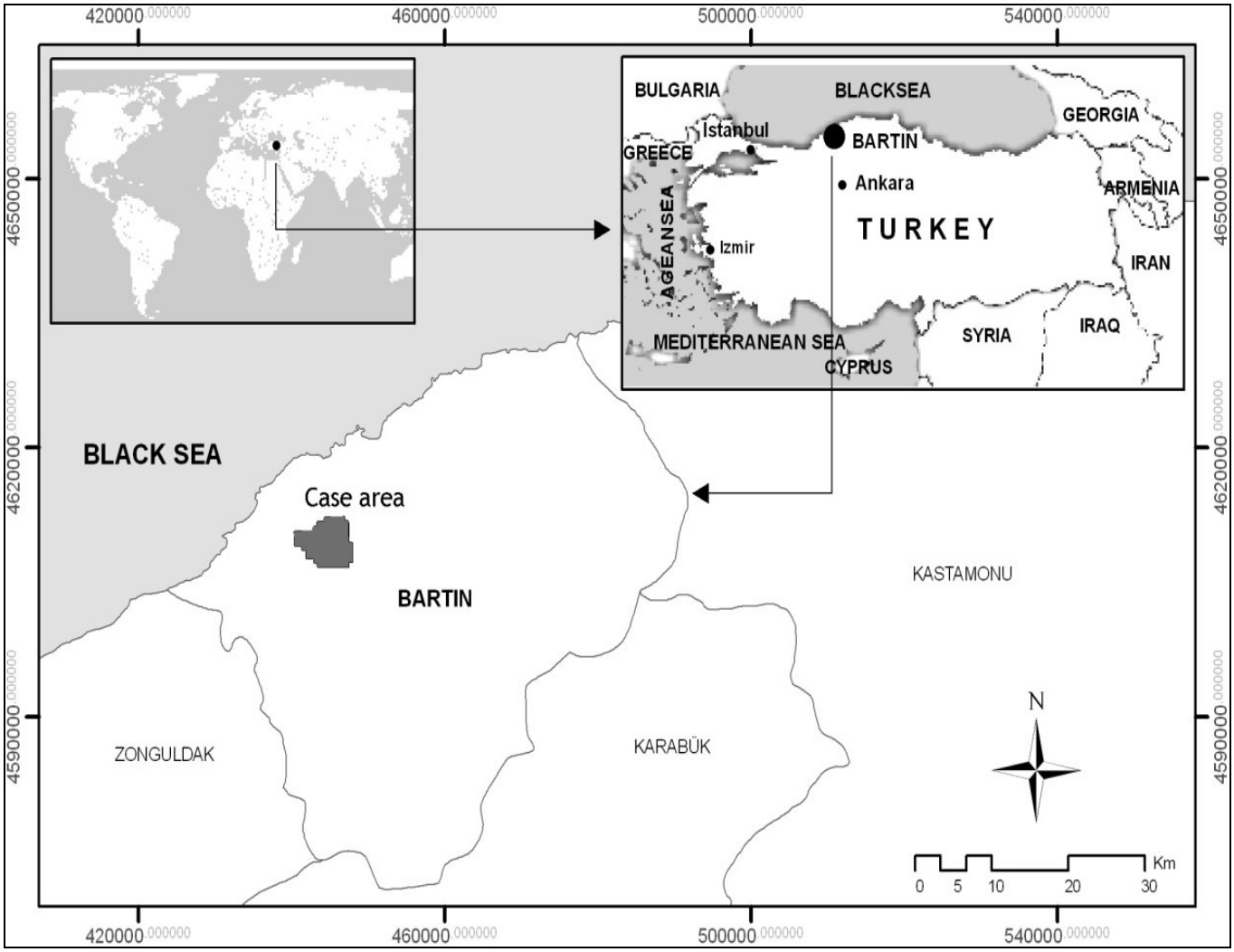

Figure 1. Location of case area, the City of Bartın.

However, it is obvious that the city will be faced with many ecological problems in the near future because of rapid and unplanned urbanization and beginning of the unconscious destruction of nature.

The key target of mapping of the biotopes of the City of Bartın is evaluating the urban and rural ecosystems and forming necessary data for planning with ecological approaches. It is also aimed to create a database based on ecological basis in urban planning studies.

MATERIALS AND METHODS

Material

The City of Bartın, is an old Anatolian settlement located in the Western Black Sea Region of Turkey and the center of Bartın Province, is on 41°53' North latitude, 32°22' East longitude and the city center is 12 km away from the coast. The location of Bartın in its region; Zonguldak on West, Kastamonu on East, Karabük on East and South and the Black Sea coast, 59 km, on North exist (Figure 1) (Bartın Governorship, 2008; Kaya and Aytekin, 2009).

The surface area of the city is 1151 sq km with its towns Arıt and Kozcağız. Average height of the city is 25 m. Despite this fact, topographic structure changing between 13 - 110 m has caused different visual effects on the city silhouette (Anonymous, 1995). Halatçıyaması hill (109.71 m), Orduyeri hill (110 m), Kırtepe (61.6 m) and Ömer hill (65 m) constitute the four hills on which the city is built. Plain lowlands (5 - 11 m) increase as to draw attention as stepped down to the city center. The city is surrounded on three sides by branches Kocaçay and Kocanaz of Bartın River, which is also used for water transportation. The city land divided deeply by the river and its branches has an uneven appearance. Bartın has been a home for many civilizations from 14 BC up to the present. For this reason, there are many historical artifacts which date back to Paphlagonia, Roman, Byzantium, Genoese and Ottoman periods (Yılmaz and Memlük, 2001).

Bartın has rich surface and groundwater potential. Such richness arises from the fact that about half of the province surface is covered by forests and consequently it leads to vast rainfalls. There are many surface waters as rivers and/or streams within the province. As they do not have permanent flow, they cause floods especially in the spring (Yılmaz and Cengiz, 2003).

Being 12 km away from the sea, the city has a typical sea

climate. It was detected that the province has high humidity and it has nearly no deficiency of water according to the Thornthwaite method (Yılmaz, 1998). The annual average temperature in the region is 12.5C°, annual average rainfall is 1032 mm, annual average wind velocity is 1.4 m/second and annual average relative humidity is 78% according to the measurement of Bartın Meteorological Station between the years 1968 and 2000 (TSMS, 2001).

The population change in Bartın between 1970 and 2000 continues with the increase of urban population as in the whole country. Main urban growth in Bartın which became a province in 1991 accelerated after this year. While in 1970, 14.92% of the population lived in the city, this ratio increased to 21.21% in 1990, 24.23% in 1997 and 26.06% in 2000 (Çelikyay, 2005; Cengiz, 2007).

Method

Biotopes within the City of Bartın which is a small size and developing city and its neighborhoods are interlaced with each other. Moreover, the residential areas expand day by day to the rural areas in the neighborhood of the city and the biotopes in the neighborhood of the city are under intense pressure of the residential areas. For this reason, when restricting the case area, a belt of 1 km width around the jurisdiction boundaries were included in the mapping by especially taking into consideration but also the expansion possibility of urban settlement and ecological characteristics, not only the administration borders of the city (Schulte et al., 1986). Grid system of 1: 25000 scale topographic map of the research area was taken into consideration when designating this belt.

In this study, comprehensive biotope mapping method was implemented. However, researches were realized with an approach similar to representative mapping by selecting samples from some areas showing similar features by the point of land uses and biodiversity. For this reason, differences in land uses and species combination of the flora were used as indicators in determination of the areas showing differences ecologically in the City of Bartın and its environs.

Development of remote-sensing technologies and geographical information systems (GIS) offers new possibilities for very accurate and quick mapping of biotopes. The data obtained are more reliable and easy to update (Cousins and Ihse, 1998; Ehlers et al., 2003; Mansuroğlu et al., 2006). Therefore, GIS have been used to create urban biotope maps and to store the ecological data in this study.

1: 25000 scale topographic maps, 1: 35000 scale air photographs of the area and 1/1000 and 1/5000 scale development plan sections were used in determination of land use types. Land usage determined from air photographs and development plan maps were checked by observations made on site in the land. Criteria which can be a matter of concern in mapping land use types in urban areas mentioned by Schulte et al. (1986) in determination of land use types in the city and its neighborhood were taken into consideration. Main land use types in the case area were grouped as follows: residential, public institutions, commercial, industry, public green lands, transportation, water streams, agriculture, forest and rural residential. The results have been evaluated by ArcGIS 9.2 computer software.

A research method based on parcel or block system has been implemented in parts where built-up zone is located in research area. Built-up areas were divided into 349 separate parcels with about 2 ha size appropriate to the road or building block borders. If the areas separated by road system are smaller than 2 ha in residential two neighbor areas are taken together, the ones bigger then such areas are divided into smaller parcels. Other land uses (cemeteries, areas belonging to health and education institutions, parks, picnic areas, etc.) out of residential areas within the city were examined by considering the whole area covered by them.

Three step scale recommended by Schulte et al. (1986) was applied when mentioning the amounts of species determined in sample areas. According to this scale, the ratio of plant species are expressed with numbers as follows: 1- Rare (1 - 10 individuals), 2- Few (10 - 100 individuals) and 3-Many (over 100 individuals). Besides, information about dominant species is also recorded.

The development conditions of planted woody species in residential lands were signed with three development steps (Kunick, 1983): Y – Young or planted in recent years, M – Middle aged and O – Old.

It is observed that different land use types with features similar to the natural environment have emerged in areas where there are not residential buildings within the city and its environs. Such areas have been determined by examination of 1: 35000 scale air photographs and on-site land observations. 2 to 10 reference areas, which can represent each biotope type, have been selected from biotopes showing different structuring in terms of ecological features (geological and soil structure, slope, aspect, etc.) and where flora component shows diversity. Reference areas have generally been numbered with first letter of land use type.

The area size in vegetation taking points has been examined as 100 m^2. Physiognomy of vegetation formations have been expressed as tree layer (T), bush layer (B) and herbaceous layer (H) and the closeness conditions of the layers were determined in percentages (%). If tree and bush layers include more than one layer they are classified as T1, T2 or B1, B2, B3. The covering degree for each species recorded in taking point has been given in Table 1.

RESULTS AND DISCUSSION

Biotope types have been classified as cultural and semi-natural biotopes if existing land use types, floristic composition and vegetation structure of areas having these land uses are taken into consideration (Table 2). Biotope map of the City of Bartın and its environs have been illustrated on 1: 25 000 scale map (Figure 2). 23 biotopes have been detected in the case area. 12 of them have been examined as cultural biotopes and 11 of them as semi-natural biotopes. Total area of the biotopes is 2942.5 ha.

Cultural biotopes

Cultural biotopes in the City of Bartın have an area of 766 ha and cover 25.9% of the case area. The biggest share in this ratio is of low dense residential areas with 10.5% and of middle dense residential areas with 6.9%. The smallest biotopes are health institutions, parks and playgrounds with ratio of 0.2%. Dominant plant species related with cultural biotopes are given in Table 3.

Table 1. Meaning of covering degree for each species (Braun Blanquet, 1964).

Abbre.	Meaning
r	Very rare; (1-5 individuals) covering a little area.
+	Rare; covering a little area.
1	Abundant but covering less than 1/20 of the area or very rare but having much bigger covering value.
2	Covering 1/20-1/4 of the area regardless of the number of individuals.
3	Covering 1/4-1/2 of the area regardless of the number of individuals.
4	Covering 1/2-3/4 of the area regardless of the number of individuals.
5	Covering more than 3/4 of the area regardless of the number of individuals.

Table 2. Biotope types of the City of Bartın and its environs.

Biotope type	Land use type	Area (ha)	%
Cultural biotopes			
Downtown (do)	Commercial	17.5	0.6
Very dense residential (vdr)	Residential	50.1	1.7
Middle dense residential (mdr)	Residential	203.7	6.9
Low dense residential (ldr)	Residential	307.8	10.5
Education institutions (ei)	Public institutions	15.9	0.5
Health institutions (hi)	Public institutions	7.2	0.2
Other public institutions (opi)	Public institutions	41.8	1.4
Industrial areas (ia)	Industry	89.1	3.0
Parks and playgrounds (pp)	Public green areas	6.9	0.2
Picnic areas (pa)	Public green areas	10.3	0.4
Cemeteries (ce)	Public green areas	15.7	0.5
Road verge (rv)	Transportation	-	-
Semi-natural biotopes			
River and banks (rb)	Water streams	160.6	5.5
Arable fields (af)	Agriculture	150.0	5.1
Moist meadow and grazing (mg)	Agriculture	491.3	16.7
Dry and semi-dry grass (dg)	Agriculture	636.4	21.6
Poplar plantations (po)	Agriculture	217.9	7.4
Hedgegrows (he)	Agriculture	-	-
Mixed decidious forest (mdf)	Forest	91.1	3.1
Woodlands (wo)	Forest	268.5	9.1
Coniferous plantations (cp)	Forest	79.7	2.7
Scrub groups (sg)	Forest	34.5	1.2
Rural residential (rr)	Rural residential	46.4	1.6
Total area		2942.5	100.0

The downtown having an area of 17.5 ha (0.6%) consists of two important axles where commercial and administrative activities are dense. The structures in this section usually have historical features. Therefore, the downtown is examined within the scope of urban site. Housing structure in the downtown where commercial activities are dense generally consists of two to three floors buildings usually located adjacent to each other on both side of the streets. In addition to historical housing reflecting the old city structure in the downtown, there are historical buildings with monumental and religious attributes. Streets are covered with firm ground totally and there are no green areas. There are few green lands with very small scales besides monumental and religious structures.

The residential structure of Bartın consists of single or multiple floor houses in mixed order. Other houses out of downtown are houses with garden. Usually, multiple and

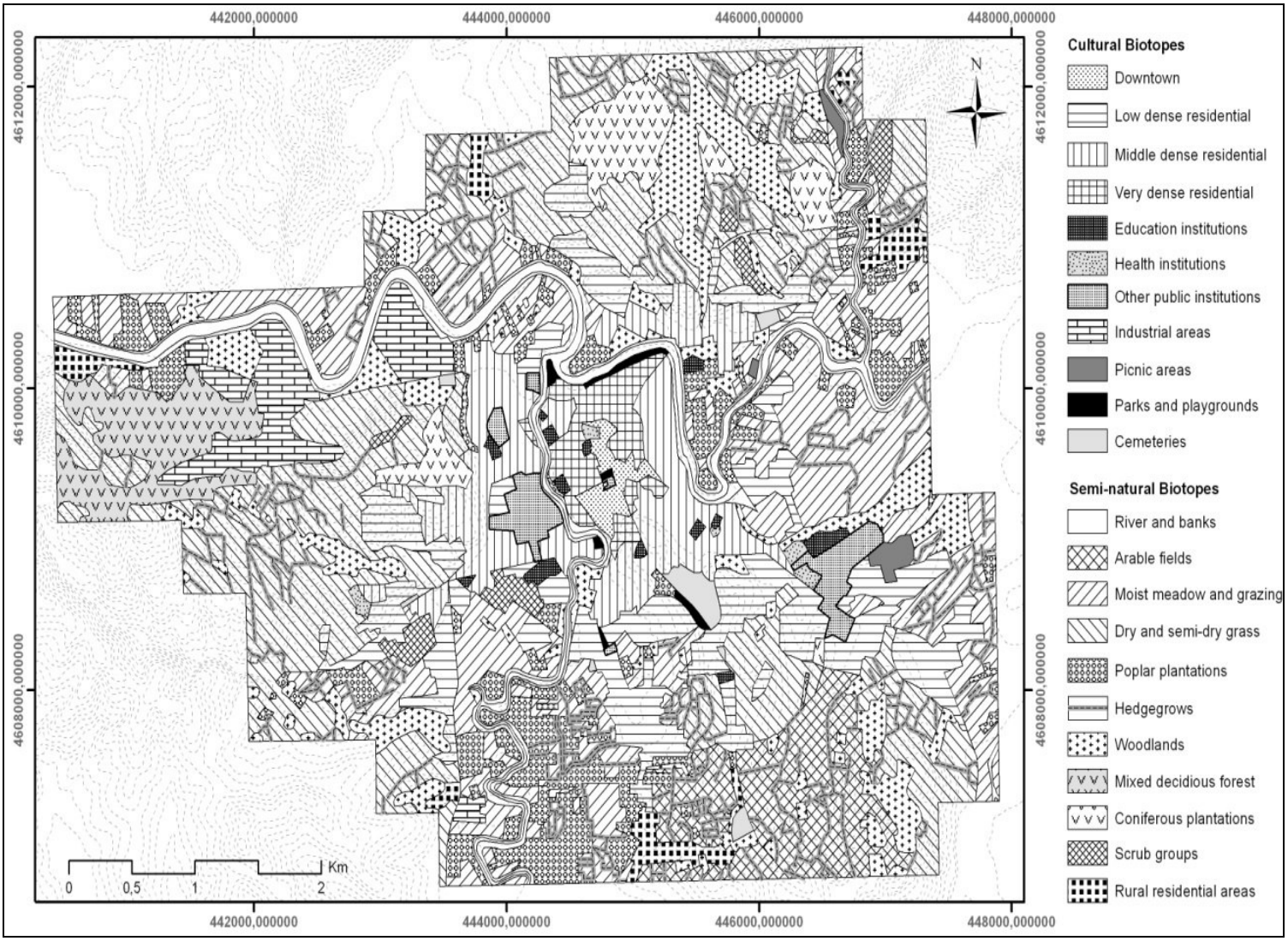

Figure 2. Biotope map of the City of Bartın and its environs.

one to two floor houses are located in parcels in a mixed manner. The housing structure is very dense in sections near the downtown. There are woody species in small gardens belonging to the houses and in spaces between houses in these residential areas. On the other hand, residential characteristics in many quarters are middle dense and consist of houses with garden. In these areas, one to two floors and three to five floors houses are located in a mixed order. Moreover, there are two to three floors, historical wooden Bartın houses reflecting the civil architectural samples of Ottoman period and many of them are used as housing even today. The houses with garden of middle dense residential cover more areas than very dense residential. Gardens are not used with full potential, generally jerrybuilt pergolas, sitting units and closed garages are contained. Fruit tree species and rapid growing tree species generally cover an important place in gardens and in open lands between houses.

Housing density is not much in quarters around city borders. Residential structure usually consists of two to three floors houses with garden. These areas forming transition zone between urban and rural residential include typical samples of urban agricultural activities. The people living there are usually involved in vegetable agriculture in their houses with large gardens. Meadows and small size tree communities occupy an important place in gardens and in spaces between gardens. Meadows are rich in point of species and they are also used for grazing. In meadows, hygrophilous vegetation elements occupy important place in sections where water accumulations are found, besides Gramineae taxons and other herbaceous.

There are no green lands with sufficient size and quality around health and education institutions in the city. 90% of their gardens and even 100% of their gardens are overed with firm ground. Green lands forming about 10%

Table 3. Dominant plant species in cultural biotopes.

Plant species	Cultural biotopes											
Woody species	**do**	**vdr**	**mdr**	**ldr**	**ear**	**hi**	**opi**	**ia**	**pp**	**pa**	**ce**	**rv**
Abies bornmuelleriana Mattf.					+			+			+	
Acer campestre L.								+			+	
Acer negundo L.					+	+						
Aesculus hippocastanum L.									+			+
Carpinus betulus L.								+		+	+	
Cedrus atlantica (Endl.) Carr.					+		+		+			
Celtis australis L.			+									
Cupressus sempervirens L.									+		+	
Fraxinus angustifolia Vahl. subsp. *oxycarpa*			+									
Fraxinus excelsior L.							+					
Pinus nigra Arnold. subsp. *pallasiana*					+	+	+			+		
Pinus pinaster Ait.					+			+				
Platanus orientalis L.								+	+		+	
Populus nigra L.			+	+				+				
Quercus cerris L. var. *cerris*											+	
Robinia pseudo-acacia L.						+			+		+	+
Salix alba L.				+				+		+		
Salix babylonica L.			+					+				
Salix matsudana Koidz. var. *tortuosa* Rehd.							+					
Tilia argentea Desf. ex DC.			+									
Ulmus minor Miller subsp. *minor*								+				
Fruit-tree species												
Ficus carica L.			+									
Juglans regia L.		+	+							+	+	
Malus communis Pois		+	+	+			+					
Prunus x domestica L.			+	+								
Scrub species												
Buxus sempervirens L.							+					
Chaenomeles japonica (Thunb.) Lindl.		+	+	+								
Cornus sanguinea L.				+				+		+		
Crataegus monogyna Jacq. subsp. *monogyna*										+		
Eriobotrya japonica (Thunb.) Lindl.			+	+								
Ligustrum japonicum Thunb.									+			
Ligustrum vulgare L.								+				
Nerium oleander L.												+
Philadelphus coronarius L.		+										
Pyracantha coccinea Roemer								+				
Rhododendron ponticum L. subsp. *ponticum*										+		
Rosa canina L.				+						+		
Rubus sanctus Schreber				+								
Syringa vulgaris L.			+									
Climbing species												
Lonicera japonica Thunb.			+									
Parthenocissus quinquefolia Plancton								+				
Vitis vinifera L.		+	+	+								

Table 3. Contd.

Wall plants												
Cymbalaria longipes (Boiss. and Heldr.) Cheval.	+	+										
Parietaria judaica L.	+	+		+	+							
Herbaceous species												
Arum maculatum L.											+	
Bellis perennis L.			+	+		+						
Calystegia sepium (L.) R.Br. subsp. *sepium*			+			+						
Capsella bursa-pastoris (L.) Medik	+	+										
Cardamine hirsuta L.	+											
Carex flacca Schreber subsp. *serrulata* (Biv.) Greuter				+								
Coronilla varia L. subsp. *varia*						+						
Geum urbanum L.			+	+	+			+				
Lamium purpureum L.		+	+									
Medicago arabica (L.) Huds.			+			+						
Medicago lupulina L.												+
Mercuralis annua L.			+									
Nasturtium officinale R. Br.										+		
Oenanthe pimpinelloides L.			+									
Pteridium aquilinum (L.) Kuhn											+	
Plantago lanceolata L.				+								+
Psoralea bituminosa L.							+					
Ranunculus constantinopolitanus (DC.) d'Urv.	+	+										
cabiosa atropupurea L. subsp. *maritima* (L.) Arc.							+					
Senecio vulgaris L.		+										
Sophora jaubertii Spach.				+								
Trifolium pratense L. var. *pratense*						+						
Trifolium repens L.												+
Gramineae species												
Alopecurus arundinaceus Poiret			+									
Dactylis glomerata L.							+				+	
Hordeum bulbosum L.			+			+					+	
Hordeum murinum L. subsp. *glaucum* (Steudel) Tzvelev		+		+							+	+
Lolium perenne L.			+	+		+						
Poa pratensis L.						+						
Setaria viridis (L.) P. Beauv.				+								
Forest cover species												
Euphorbia amygdaloides L.										+		
Galium aparine L.			+									
Geranium asphodeloides Burm. fil.										+		
Geranium robertianum L.										+		
Hedera helix L.	+		+		+	+	+	+		+		
Potentilla reptans L.				+	+							
Trachystemon orientalis (L.) G. Don	+	+								+		

Table 3. Contd.

Ruderal species							
Anthemis cotula L.			+				
Centaurea iberica Trev. Ex Sprengel			+				
Cichorium intybus L.				+		+	
Conyza canadensis (L.) Cronquist	+		+	+			+
Helminthotheca echioides (L.) Holub			+				
Plantago major L.	+	+					+
Polygonum aviculare L.					+		
Sonchus asper (L.) Hill subsp. *glaucescens* (Jordan) Ball	+					+	

of the area are generally restricted with barriers and small size areas in front of the buildings. Areas of other public institutions consist of restricted green areas of service buildings and their neighborhood.

Industrial facilities in Bartın are dense in plain areas located between Bartın-İnkumu roadway and Bartın River. Floods occurring in the river when rainfall is abundant affect these facilities. The cement factory, raw material producing area and small industrial site constitute the main industrial area of the city. Hazardous wastes of industrial facilities have important effects in pollution of the river. Moreover, harmful gases coming from the chimneys of the factories and residential complexes affect the development of flora of the neighborhood negatively.

Industrial areas cover 3% of the case area with 89.1 ha.Parks other than few parks rearranged within the case area are places which do not provide much possibility for different activities and emerged after making use of spaces between quarters. It is observed that parks and playgrounds do not exhibit different point of view both structural and planting design.

There are Karaçay, Çağlayan and Balamba picnic areas in the city. These areas have been converted from woods to picnic areas. Karaçay and Çağlayan picnic areas do not have any structural elements other than picnic tables. There are no special planting in these picnic areas and plant cover are completely natural.

Semi-natural biotopes

The surface area of semi-biotopes is 2176.5 ha (74.1%). The widest surface area of 636.4 ha (21.6%) is covered by dry and semi-dry grass. Next moist meadow and grazing areas cover with 431.3 ha (16.7%). While mixed deciduous forest covers the area of 91.1 ha (3.1%), woods cover the area of 268.5 ha (9.1%). Arable fields cover 150 ha (5.1%). Scrub groups (1.2%) and rural residential areas (1.6%) have the smallest area within semi-natural biotopes. Dominant plant species in these biotopes are given in Table 4.

The most important water flow of the City of Bartın is Bartın River. The river is fed by two branches and water streams connected to them. It reaches the sea by flowing in a wide and deep bed passing through the city. When Kocaçay and Kocanaz branches of the river reach the city, a bottomland appears because of alluviums accumulated in the neighborhood. Even if the river provides possibility for transportation, it is not used for such purpose in recent years. The river has an important potential for recreation needs. However, there are no recreational facilities except for few parks and picnic areas in the neighborhood. The river having rich aquatic fauna is used for fishing.

Floods occur frequently after heavy rainfalls due to non-continuous regime of the river and its branches and narrowing of the beds by anthropogenic factors in time. Floods also threaten the flora in the city and its environs. The plants in flood areas are covered by water and materials coming with water and undergo mechanical damages because of heavy flow of water. Organic and chemical pollution resulting from residential, industrial and agricultural activities in the river bed negatively affect water quality, fauna and the flora. Especially, wastes from factories, slaughterhouses and other industrial sites have been major pollutant to the water in the City of Bartın and its environs.

The agricultural lands in the city show distribution in plains formed by Bartın River and its branches. Today, the agricultural lands are decreased because of the residential, commercial and industrial development in the citywide. Horticulture is done restrictively. As the city is not separated from the rural life totally, fruits and vegetables are grown in the houses with small gardens by urban residents.

Agricultural lands are mostly allocated to the arable lands. However, arable lands have decreased in recent years. The reason of such decrease is the abandoning of agricultural activities by local people and transformation of arable lands in the plains to residential areas, popular

Table 4. Dominant plant species in semi-natural biotopes.

Plant species	Semi-natural biotopes										
Woody species	**rb**	**af**	**mg**	**dg**	**po**	**he**	**mdf**	**wo**	**cp**	**sg**	**rr**
Carpinus betulus L.							+	+			
Castanea sativa Miller							+				
Fraxinus angustifolia Vahl. subsp. *oxycarpa*						+				+	+
Pinus nigra Arnold. subsp. *pallasiana*									+		
Pinus pinaster Ait.									+		
Pinus sylvestris L.									+		
Populus nigra L.	+					+					
Quercus cerris L. var. *cerris*								+			
Salix alba L.	+		+			+					+
Tilia argentea Desf. ex DC.							+				
Typha latifolia L.			+								
Ulmus minor Miller											+
Fruit-tree species											
Corylus avellana L.											+
Juglans regia L.											+
Malus communis Pois											+
Scrub species											
Chaenomeles japonica (Thunb.) Lindl.											+
Cistus creticus L.									+		
Cornus sanguinea L.						+					+
Cotinus coggygria Scop.						+					
Crataegus monogyna Jacq.								+			
Euonymus europaeus L.								+			
Ilex colchica Poj.							+				
Juniperus oxycedrus L. subsp. *oxycedrus*									+	+	
Ligustrum vulgare L.									+		
Ostrya carpinifolia Scop.						+					
Osyris alba L.									+		
Phillyrea latifolia L.						+	+		+	+	
Prunus spinosa L.						+					
Pyracantha coccinea Roemer										+	
Rhododendron ponticum L.							+				
Rubus sanctus Schreber						+					+
Herbaceous species											
Agrimonia eupotaria L.			+								
Arum maculatum L.						+					
Asperula tenella Heuffel ex Degen			+								
Convolvulus arvensis L.			+								
Daucus carota L.			+								
Euphorbia amygdaloides L.								+			
Euphorbia stricta L.											+
Galium cruciata (L.) Scop.						+					
Geranium asphodeloides Burm. fil. subsp. *asphodeloides*						+					
Geum urbanum L.											
Globularia trichosantha Fisch. And Mey.				+					+		
Hedera helix L.							+	+			

Table 4. Contd.

Helianthemum nummularium (L.) Miller				+										
Helleborus orientalis L.						+								
Hypericum perforatum L.		+												+
Knautia orientalis L.					+									
Lamium purpureum L.														+
Lithospermum purpureo-caeruleum L.						+								
Medicago arabica (L.) Huds.														+
Melampyrum arvense L.		+												
Mentha longifolia (L.) Hudson subsp. *longifolia*					+									
Oenanthe pimpinelloides L.			+		+									
Origanum vulgare L. subsp. *vulgare*				+										
Ornithogalum fimbriatum Willd.				+										
Polygala anatolica Boiss. and Heldr.				+										
Potentilla reptans L.			+									+		
Pteridium aquilinum (L.) Kuhn														
Scilla bithynica Boiss.									+					
Sophora jaubertii Spach.			+											
Teucrium chamaedrys L.				+							+			
Thymus longicaulis C. Presl. subsp. *longicaulis*				+										
Trachystemon orientalis (L.) G. Don						+								
Trifolium ochroleucum Huds.		+												+
Verbena officinalis L.					+									
Veronica chamaedrys L.														
Veronica multifida L.				+		+								
Hygrophilous species														
Carex pendula Hudson	+							+						
Carex otrubae Podp.			+		+									
Equisetum telmateia Ehrh.	+													
Juncus articulatus L.			+											
Juncus inflexus L.			+		+									
Orchis laxiflora Lam.			+											
Rumex conglomeratus Murray					+									
Gramineae species														
Alopecurus arundinaceus Poiret			+											+
Alopecurus myosuroides Hudson var. *myosuroides*			+											
Dactylis glomerata L.				+										
Holcus lanatus L.			+											
Lolium perenne L.														+
Ruderal species														
Anthemis cotula L.	+													
Conyza canadensis (L.) Cronquist	+													
Datura stramonium L.	+													
Sambucus ebulus L.												+		

plantations and grazing. Generally, corn (*Zea mays*) and wheat (*Triticum aestivum*) are planted in hillside having slopes changing between 10 - 30%. There are grazing areas whose agricultural use was abandoned, hedgerows and deciduous woods among arable lands. There is floristic composition diversity consisting of wild herbaceous species in the arable lands. Meadow vegetation elements and Gramineae taxons are also seen together with wild herbaceous plants.

Forests in Bartın are generally normal and degraded wood and degraded coppice forests. In addition to forest lands showing natural distribution, afforestation activities are still going on. Afforestation activities are carried out by transforming degraded areas to wood lands. Forests in the city and its environs generally have deciduous and coniferous trees in culturally afforested. These species are encountered on the hillsides of the city. While forest lands do not cover much area in the city, they increase substantially in North, North-East and North-West directions from the city.

Rural residential areas are composed of Ağdacı village in the South of the city, Karaçay quarter in the North-East and Çakırağa quarter in North-West of the city. These areas have rich biological diversity as they contain various use types like agriculture, livestock and forestry. Villages have usually residential units in harmony with agricultural activities. Although arable lands are prevalent as agricultural activity in such areas, house owners are also involved in fruit and vegetable agriculture widely in the houses with their gardens.

Conclusion

In this study, biotopes of the City of Bartın are discussed in point of plant life and current use conditions of biotopes, plant species contained in them and pressures on biotopes were examined. Biotopes of the city were classified in two main groups as cultural and semi-natural biotopes. The land observations were carried out in order to cover the whole area with purpose of determining all biotopes, which can be ecologically important in the city. When classifying biotopes in the case area, plant species in biotopes were used as indicators. During flora and vegetation analyzes made in the case area, natural and exotic plant species were determined in cultural biotopes in built-up areas and semi-natural biotopes in non-built areas.

The city is located into the European-Siberian flora zone in the point of phytogeography and in A4 square according to the grid system of Davis (1965 - 1985). 629 samples of plants were collected in Bartın locality by Kaya et al. (1999). These plant samples were determined to be 357 genera and 448 species of 96 families and 136 subspecies and 45 varieties were detected for these species. Moreover, 2 endemic and 13 rare species were encountered in the locality, 179 new taxa were recorded in A4 square. The families having the most number of species are classified as follows: Asteraceae (90 species), Compositae (90 species), Leguminosae (46 species), Labiatae (38 species), Gramineae (37 species) and Rosaceae (27 species).

265 plant taxa of 68 families were determined in flora study made in Amasra locality of Bartın province by Yatgın (1996). Compositae (29 species), Leguminosae (25 species), Gramineae (19 species), Rosaceae (17 species), Labiatae (14 species) and Liliaceae (10 species) are the families which have the most number of species.

In this study, 540 plant taxa were detected, 384 of which are herbaceous and 156 of which are woody plants belonging to 101 families. Compositae family has the highest number of species with 52 species. It is followed by Leguminosae (51 species), Gramineae (43 species), Rosaceae (34 species), Labiatae (28 species), Cruciferae (16 species), Scrophulariaceae (16 species), Umbelliferae (16 species), Boraginaceae (14 species) and Liliaceae (14 species) families. Such a high valued quantity of species shows that the many plants have possibility of living in the city and its environs. Moreover, it reveals that the locality represents the flora elements and vegetation types in wide section of our country because of characteristics like geographical location, climate, geological and geomorphologic structure and it is very important for biological diversity by such characteristic.

The species, *Ferulago plathycarpa* Boiss. and Bal. and *Allium olympicum* Boiss. found in dry and semi-dry grass and partially distributed dry grass in the area where cement factory raw material producing plant is located, *Crocus ancyrensis* (Herbert) Maw detected in dry and semi-dry grass and mixed deciduous forest areas, *Veronica multifida* L. and *Onobrychis armena* Boiss. and Huet found in dry and semi-dry grass, *Galanthus plicatus* Bieb. subsp. *byzantinus* (Baker) D. A. in mixed deciduous forest areas are the endemic species for the locality. Areas where these species are spread in Kanlı hill and Gölleryanığı hill should be cleaned off the pressure of residential activities and should be absolutely taken under protection.

In the development plan prepared for the City of Bartın until now it is observed that firstly structural usages are taken as basis and small scale areas left after such usages are considered as green lands. The ratio of green lands changes from center to city borders and its environs. Downtown is the most lacking biotope in point of vegetation (green land ratio is less than 10%). The ratio of green lands reaching to 50% from very dense residential to middle dense residentiall reaches 80% in low dense residential areas and 100% in semi-natural biotopes in the neighborhood of the city.

The settlement beginning in a land with bowl shape in the city is distributed in a disordered manner towards to the neighborhood. Urban biotopes like residential, public institutions, industrial and commercial areas, public and private green lands show a random structuring without any system and planning. If the existing and future use

conditions of the city are analyzed according to the development plan, it can be seen that it will be a densely residential area without agricultural lands, forests and woods in the future. Urban biotopes are used unconsciously because of urbanization movements started in 1991 and rapidly increasing in the city. For example, garden houses in low dense residential areas leave their places to multistoried buildings. Green lands are restricted with only small parks and playgrounds with quarter scale.

Vegetation formations represented more densely in terms of species in the case area are forests and woods, moist meadow and grazing, dry and semi-dry grass. These types of biotopes are important reserve areas in point of natural and cultural history of the city as they contain many samples belonging to native plant cover. Rapid disruption of these areas, which have not lost their natural identity yet, destroys the natural structure and causes environmental problems increasing day by day. Biotopes having ecologically important in the city and its environs should be secured for protection of the diversity of nature and landscape, benefiting of the residents from natural assets, their living in a healthier environment and meeting their recreational needs.

In this study, following benefits can be obtained from the created biotope maps:

(1) Protection of urban ecosystem characteristic.
(2) Transferring biological richness of the city to future generations without disruption by analysis and interpretation of biological assets.
(3) Obtaining data for multi-purpose area planning studies on ecological planning and nature protection.
(4) Detection, protection and keeping of living environments which can house natural life and its elements in the city.
(5) Protection of rural areas surrounding the downtown.
(6) Taking optimum and sustainable plan decisions related with urban development.

It is a known reality that urban development plans in Turkey lack of ecological data. Especially local governments take into consideration structural elements initially in their development studies. They carry out in the cities and do not consider ecologically important biotopes.

Existing Turkish legislation concerning urban planning (the Construction Law of 3194) does not mandate the consideration of biotopes in structural planning (Mansuroglu et al., 2006). The most important indicator of this fact is the restriction of ecological studies with only some provinces in Turkey. Turkey does not have a desired level in implementation even if it has signed many international agreements on environment. Although many agreements were passed on environment in adaptation process to the European Union, it is urgently necessary to prepare regulations orientated to implementation by giving due importance to “Biodiversity and Natural Resources Management” which has insufficient data by today. For this reason, gaining importance of ecological studies in Turkey having 81 provinces will be an important indicator.

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