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Full Length Research Paper

Evaluation of habitat and bio-diversity in landscape planning process: Example of Suğla Lake and its surrounding area, Konya, Turkey

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Landscape planning is a tool that creates a balance between human and nature in terms of protection and improvement. With the use of landscape ecology based approaches in landscape planning process, from the point of structure, function and changes of the landscapes, planning decisions can be taken more easily and scientifically. Within this concept, it is important to examine the function of habitat and bio-diversity of the landscape in order to state the function of landscape in landscape planning. The purpose of this study is to state the habitat and bio-diversity function of landscape within the scope of landscape planning in Lake Sugla and its surrounding area and to develop planning decisions in terms of protection-utilization. The habitat and bio-diversity function of the landscape has been formed by using the patch corridor matrix model and field researches in geographical information system (GIS) environment. While habitat function is evaluated according to the measure and number of patch, the shape of patch, the side of patch and patch classifications in terms of core areas, species diversity is taken into consideration in bio-diversity function. As a result of the study in which data entry analysis and evaluation and geographic information system are used, it has been stated that the mixed patch class consisting of coniferous and leafy plants, is pointed as very high habitat function areas, leafy plants patch class is pointed as high habitat function areas, mixed coniferous patch class consisting of various coniferous plants is pointed as medium habitat function areas and single coniferous patch class is pointed as low habitat function areas. The bio-diversity function has been pointed with the use of books and articles and field studies that have been carried out at different times. The areas that have high habitat and bio-diversity function show parallelism with each other. Moreover, evaluation of both functions has shed light on the forest patches that should be given priority to be protected. The methodology approach which is the first landscape planning study that is based on landscape functions in our country, has been in use both in various regions of our country and various regions of different countries.

Key words: Landscape planning, landscape ecology, patch corridor matris model, habitat function, biodiversity function, Konya.

INTRODUCTION

European landscape convention (ELC) defines landscape planning as strong forward-looking action to enhance, restore or create landscapes (Şahin, 2003). In the first phase of landscape planning, the balance of protection and utilization is created, ecological properties are examined, utilizations and therefore, ecological relations are evaluated and also inventory and analysis for cultural

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landscape are carried out. Thereafter, by defining the acts, an environment from which people would benefit at top level but also which would hurt other creatures at minimum level is planned (Uzun, 2003). The landscape planning studies in Turkey can be examined under four periods (Uzun and Kesim, 2009): studies formed together with the first structuring of Landscape Architecture Departments between the years 1933 and 1970; in parallel with landscape planning approaches abroad in 1960s; the studies that came into prominence under the skin of ecological units and grids in the overlay studies that were introduced in the country between the years 1970 and 1990. Stockholm Human and Environment Conference in 1972 were also very effective during this period. Moreover, the effects of the studies of Lewis (1964), McHarg (1967), Buchwald et al. (1973), Hills (1976) and Kiemstedt (1967) were seen in this period; the landscape planning studies showed great diversity with the effect of 1992 Rio Conference between the years 1990 and 2000. In this studies, environmental impact assessment (EIA) (Peker, 1995), examples for landscape planning in different areas such as basin planning and methodology (Şahin, 1996), wetland (Karadeniz, 1995), biotope mapping (Orkide, 1991) and use of natural plants in cities were given. It can also be said that this is the period in which the function of landscape was started to be examined. Landscape planning studies that were conducted in 2000s were mostly intended for specialization. The studies in this period contain approaches concerning the use of landscape types evaluated with the structure and function of landscapes (Uzun, 2003; Tuncay et al., 2009) in landscape planning. This period also gains importance as a result of the first formal landscape planning study in Turkey following European landscape convention (Uzun et al., 2010).

In most countries where landscape plans are prepared formally and executively, some of the main purposes of landscape planning are sustainable resource management and nature conservation. The landscape plans that are made nationally, regionally or locally give important clues to the users of that area about sustainability of natural resources and the effect of the other plans on environment. For this reason, landscape plans are combined with the other spatial and sectoral plans and they are generally used in decision process in countries such as Germany and England.

Landscape planning could not find a place legally in Turkey. However, the studies concerning protection, management and defining of landscapes have been given importance with ELC. One of these is Lake Sugla site, landscape management, protection and planning study that has been carried out by Uzun et al. (2010). In this study, six-staged landscape planning methodology as determination of planning targets, data collection and examination (together with the participation of related groups), landscape analysis, landscape character type analysis, landscape function analysis (water function of landscape, soil conservation function of landscape, habitat function of landscape, cultural function of landscape, bio-diversity function of landscape), visual landscape analysis, landscape improvement strategies (together with the participation of related groups), landscape plan, landscape management have been followed. Landscape ecology approaches have had a dominant effect in every phase of this methodology.

In recent years, landscape ecology based approaches have been seen frequently in landscape planning (Dramstad et al., 1996; Hobbs, 1997; Opdam et al., 2002; Leitao and Ahern, 2002). Landscape ecology includes landscape pattern studies, interaction between the patches in landscape mosaic and the changes in these patterns and interaction in the course of time. Landscape ecology focuses on three characteristics which are the structure of landscape, function of landscape and change in landscape. Landscape ecology is a reference point that influences ecologic processes strongly for landscape element patterns. Spadework is required for landscape function and change in the metrics of landscape structure (McGarigal and Marks, 1994). The pattern structure of an area or a landscape consists of three type elements which are patches, corridors and matrix. These universal elements are used for the development of general principles and comparison of really different landscapes. There is also an area of usage in “land use planning” and “landscape architecture”, because spatial patterns have a strong control over movements, courses and changes (Dramstad et al., 1996). The model that is used in this context can also be called “patch-corridor-matrix”.

Patch-corridor-matrix model is used in landscape planning, evaluation of landscape, management, restoration, protection and improvement policies and landscape structure, function and change analyses (McGarigal and Marks, 1994; Forman, 1995; Dramstad et al., 1996; Hobbs, 1997; Opdam et al., 2002; Leitao and Ahern, 2002; Uzun, 2003). Below is some landscape metrics used within this context: Patch density, size and variability metrics. Although, these metrics do not explain the metrics spatially, they usually state landscape structure by far the best. The number of patches of a special habitat type may have an effect on variability in ecologic process depending on the content of the landscape (McGarigal and Marks, 1994). The patch metric and patch number are some of the important metrics (McGarigal and Marks, 1994; Forman, 1995; Dramstad et al., 1996; Helzer and Jelinski, 1999; Leitao and Ahern, 2002; Winter et al., 2006; McGarigal et al., 2009). Form metrics that are in the level of patch, class and landscape are used in the metric of landscape structure. The interaction between patch shape and metric may have an effect on a range of important ecologic processes (McGarigal and Marks, 1994). Patch shape is one of the important metrics that are evaluated in patch-corridor-matrix model (McGarigal and Marks, 1994; Forman, 1995; Dramstad et al., 1996; Marzluff et al., 2004; Munroe et al., 2007; McGarigal, et al., 2009). Patch shapes are important ecologically as they affect movements and courses (food, energy, etc) in landscape. A long patch is more effective in the protection of the species that live in internal habitats than a round patch. Books and articles state that round patches have the optimum shape ecologically (Forman, 1995). Another metric that is used in landscape metrics is Edge metric (McGarigal and Marks, 1994; Forman, 1995; Dramstad et al., 1996; Olson and Andow, 2008; McGarigal et al., 2009). Core area metrics reflect both the landscape composition and landscape configuration metrics (McGarigal and Marks,1994). Core area is one the important metrics that is used in landscape metrics (McGarigal and Marks, 1994; Forman, 1995; Dramstad et al., 1996; McGarigal et al., 2009). Core areas are defined as some spaces with some special edge distances inside the patch (McGarigal and Marks, 1994).

Landscape ecology based studies are also important for the assessment and evaluation of bio-diversity of a region (Ugustl et al., 2002; Fischer and Lindenmayer, 2007). Bio-diversity of the patches of patch classes inside the landscape has special importance for studies concerning the protection of nature. The protection of an identified type or an ecosystem legally and executively becomes easier by stating the importance directly. It is concluded that, the more the eco-system diversity, the more the landscape diversity within the context of bio-diversity. Within the scope of landscape diversity, not only natural landscapes but also quality and quantity of the cultural landscapes formed by people have gain importance. The character type and the quality of landscape of an area or region are also important for stating the landscape diversity in that area. There is close relationship between landscape character type diversity and eco-system diversity (Swanwick, 2002; Wascher, 2005; Verkerk et al., 2008).

The purpose of this study is to state the habitat and bio-diversity functions of landscapes in landscape planning study in Lake Sugla and its surrounding area and to bring forward some proposals concerning conservation to the natural resource managers. Decisions that are based on the functions of landscape have highly been supported by landscape ecology based planning approaches. The following steps are taken for the purpose of the study: Determination of the patch classes by a landscape ecology based approach in Lake Sugla and its surrounding area, interpretation of landscape structure in the level of patch classes by using patch analysis for ArcGIS, determination of bio-diversity functions as a result of the field study, formation of conservation target decisions following the identification of patch classes and bio-diversity function. The main reason for choosing the stated area as the research area is because it is located within the borders of Konya closed basin in Konya city, Bozkir, Seydişehir, Ahirli, Yalihüyük districts and Lake Sugla site landscape management, conservation and planning project that is carried out by Turkish Republic Ministry of Environment and Forestry, Directorate of Nature and Conservation and Natural Parks, Department of Nature Conservation, Landscape Conservation Office. The first identification of landscape by a formal establishment is in the form of an ongoing project concerning landscape planning, formation of landscape management and conservation policies.

MATERIALS AND METHODS

The research area is located on Lake Sugla and its surrounding area which are within the borders of Konya closed basin which is one of the twenty five major basins identified by General Directorate of State Hydraulic Works (GDSH) throughout the country. The research area is situated within the borders of Bozkir, Seydişehir, Ahirli and Yalihüyük districts of Konya, which is in the south of Central Anatolia. The area that covers Lake Sugla and its surroundings is surrounded by South Taurus Mountains and Deer Mountains in the south and southwest, Esenler Mountain in the southeast and Erenler Mountain and Alacadag in the northeast. The project site is located in 31°52' 43'' to 32°16' 02'' east meridians and 37°10' 46'' to 37°29' 46'' north latitudes. It covers 74.152 ha area (Figure 1).

The method that has been formed with landscape ecology based approaches by using geographic information system (GIS) is composed of four stages. Patch classes are stated in the first stage of the method (Forman and Godron, 1986; Forman, 1995; McGarigal and Marks, 1994; Leitao and Ahern, 2002; Uzun, 2003; Rempel, 2010, Uzun and Gültekin, 2011). Forest development maps prepared by Ministry of Environment and Forestry are used as a base within this context. The obtained patch classes have been digitized in ArcGIS 9.3 which is a GIS program (GCM, 2005; ÇOB, 2010). The patch classes within the forest matrix in Lake Sugla basin have been evaluated in terms of habitat patches within the frame of four criterions: patch size and number, patch form, patch edge and core areas. This approach has supported the studies of Forman and Godron (1986), McGarigal and Mark (1994), Forman (1995), Leitao and Ahern (2002), Uzun (2003), Rempel (2010) and Uzun and Gültekin (2011). The related criteria are given points on the basis of patch classes by the help of five point liker scale on the scale of five points. Landscape habitat function maps of Lake Sugla and its surrounding area have been obtained by the help of overlay analyses of the maps formed according to four criteria. "Patch Analysis 4" program (it contains analysis and modeling functions for polygons) which was created by Rempel (2010) and performed under ArcGIS 9.3 program has been used (Table 1). Fragmentation process has been taken as a base in the assessment of patch size and number. The amount of fragmentation in patch classes has been stated depending on the related statistics and the habitat values have been evaluated within this scope. While evaluating the patch form criterion, the statistics about the straight, round and pressed patches and folded, lobed and long patch classes have been used. The habitat values have been evaluated according to the fact that, patch classes that have straight, sound and pressed forms create opportunities mostly for interior habitats and hence for the species that live in interior habitats. While evaluating patch edge criterion, it has been stated that the patch classes that has little density would probably shelter interior habitat species depending on the patch edge densities. While evaluating the core areas criterion, it has been observed that much density for core areas would increase the habitat value and the habitat function has been evaluated accordingly (Forman and Godron, 1986; McGarigal and Marks, 1994; Forman, 1995; Leitao and Ahern, 2002; Uzun, 2003; Rempel, 2010).

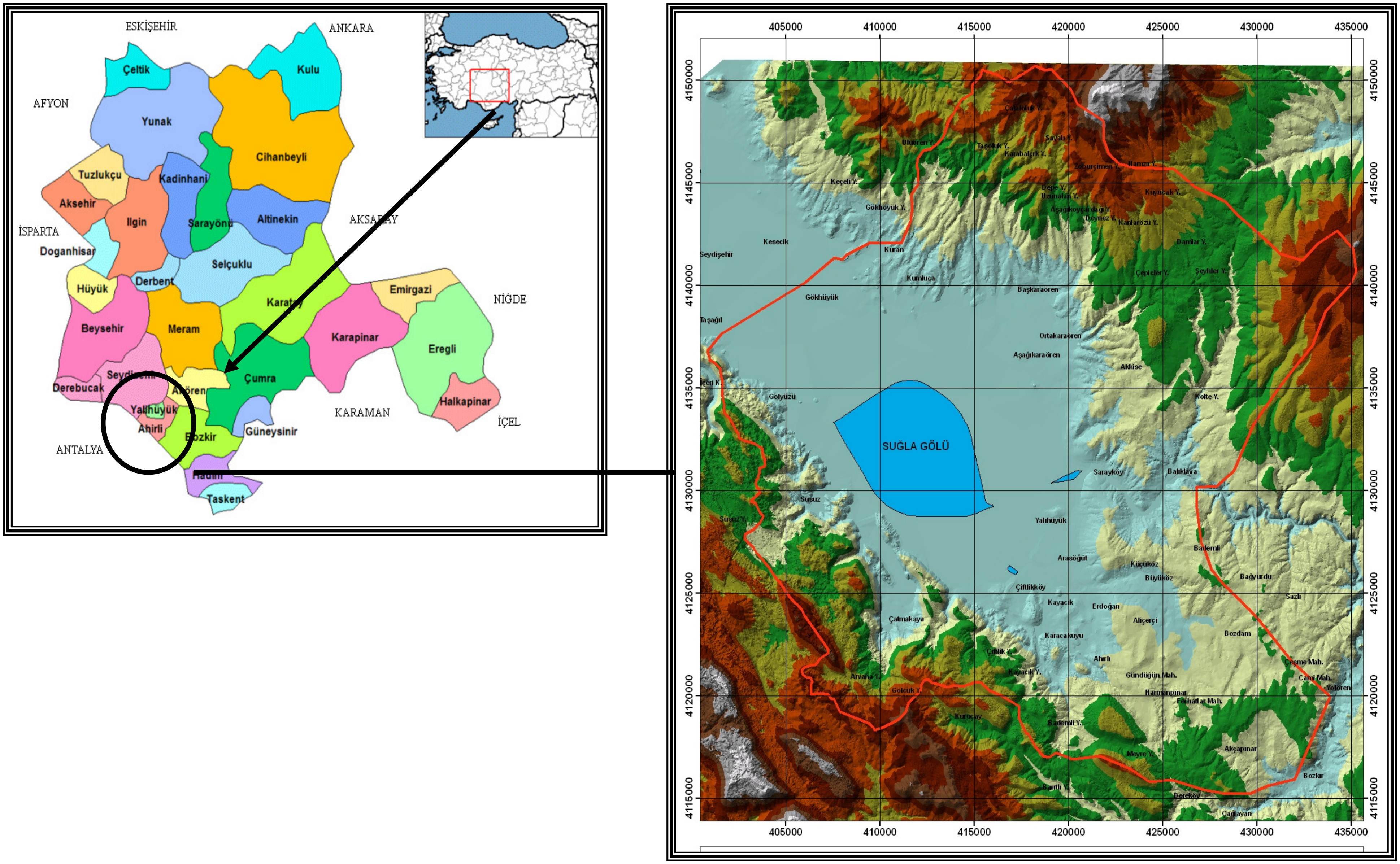

Figure 1. Study area

Table 1. The criteria that are used for stating habitat functions of Lake Sugla basin.

Criterion	Exist situation	Function	Score
Patch size and number	Patch classes of little fragmentation	Very high valued function	5
		High valued function	4
		Medium valued function	3
	Patch classes of much fragmentation	Low valued function	2
		Very low valued function	1
Patch form	Straight, round and pressed	Very high valued function	5
		High valued function	4
		Medium valued function	3
		Low valued function	2
	Folded, lobed and long	Very low valued function	1
Patch edge	Little density for patch edge	Very high valued function	5
		High valued function	4
		Medium valued function	3
	Much density for patch edge	Low valued function	2
		Very low valued function	1
Core area	Much density for core areas	Very high valued function	5
		High valued function	4
		Medium valued function	3
		Low valued function	2
	Little density for core areas	Very low valued function	1

(Forman and Godron, 1986; McGarigal and Marks, 1994; Forman, 1995; Rempel, 2010; Leitao and Ahern, 2002; Uzun, 2003).

Landscape bio-diversity function" map for Lake Sugla and its surrounding area has been formed in the ArcGIS 9.3 GIS program by the help of overlay analysis of the maps that were created by the fauna (Mergen, 2010) and flora (Duran and Şanga, 2010) reports prepared in the research area. Landscape habitat and bio-diversity function map has been formed by the help of overlay analysis of landscape habitat function maps and landscape bio-diversity function maps that were created as a result of the research area data in ArcGIS 9.3 GIS program (overlay analysis). Lastly, the patch classes that should be conserved have been shown and some suggestions about sustainable use of natural resources have been made.

RESULTS

Lake Sugla and its surrounding area are composed of two matrixes which are agriculture and forest matrix. These two matrixes stand out of the borders of water basin. However, owing to the borders, only the forest matrixes sites that exist within the borders of the area have been included in the evaluation. It has been avoided to make an evaluation for agriculture matrix in terms of patch classes as product pattern changes in the agricultural areas around Lake Sugla every year. Besides, making an analysis for agriculture matrix in the level of patch classes will not increase the value of the research in terms of habitat function. When the forest matrix is examined, six patch classes have been identified in the forested lands in basins of Lake Sugla and immediate surroundings: rocky areas, open areas in forestry, coniferous plant types; areas having coniferous plants (single type), mixed coniferous, areas having mixed coniferous plants (two or more than two types), leafy, areas having leafy plants, mixed, areas having coniferous and leafy plants.

Forest map and road map have been superposed to define the exact borders of patch classes. Four 4 m tampon zone (the forest roads are generally 4 to 5 m, so the tampon zone has been created according to minimum metrics) has been formed from linear data that have been obtained from 1:25000 scaled topographic maps for the roads. The patch classes in the forest sites have been formed in this way. Another factor for the borders of patch classes is energy transmission lines. Patch classes have been separated into sub polygons by creating a 5 m tampon zone in the direction of right and left from the energy transmission lines (while passing an energy transmission line, generally a 5 m forest cover is separated). The map that is formed by superposing with the road data has also been superposed with energy transmission line data. As a result of this, the exact borders of the patch classes in the research area have been defined.

As a result of all these overlay analyses, 866 polygons for six patch classes have been defined and analyses have been made for those polygons by using "patch analysis for ArcGIS". The analyses have been carried out in the level of patch classes (Table 2). The habitat quality

Table 2. Lake Sugla basin, patch-corridor-matrix model and patch analysis results.

Landscape metric		Patch classes					
		Coniferous	Coniferous and leafy	Mixed coniferous	Leafy	Open area in forestry	Rocky
Class area	CA	9460.16	4472.18	2182.90	15072.96	3291.52	253.93
Total landscape area	TLA	34733.68	34733.68	34733.68	34733.68	34733.68	34733.68
Number of patches	NumP	221.00	102.00	68.00	242.00	232.00	1.00
Mean patch size	MPS	42.80	43.84	32.10	62.28	14.18	253.93
Median patch size	MedPS	1.22	5.91	4.27	8.30	4.00	253.93
Patch size coefficient of variance	PSCoV	473.26	215.88	337.50	255.52	225.87	0.00
Patch size standard deviation	PSSD	202.58	94.65	108.34	159.15	32.04	0.00
Total edge	TE	475949.74	281172.61	170858.70	840471.26	419921.48	12664.77
Edge density	ED	13.70	8.09	4.91	24.19	12.08	0.36
Mean patch edge	MPE	2153.61	2756.59	2512.62	3473.02	1810.00	12664.77
Mean shape ındex	MSI	1.99	1.96	1.85	1.86	1.78	2.24
Area veighted mean shape ındex	AWMSI	2.14	1.78	2.61	2.21	2.06	2.24
Mean perimeter area ratio	MPAR	4018.20	1730.09	2720.26	2708.05	1628.47	49.90
Mean patch fractal dimension	MPFD	1.46	1.41	1.41	1.39	1.38	1.28
Area veighted mean patch fractal dimension	AWMPFD	1.26	1.25	1.30	1.27	1.30	1.28

Table 3. The evaluation of patch classes in terms of habitat function.

	Patch classes			
Assesment criterion	Coniferous	Coniferous and Leafy	Mixed Coniferous	Leafy
Patch size and number	3	3	2	4
Patch form	2	5	3	4
Patch edge	2	4	5	1
Core area	4	3	2	5
Total	11	15	12	14

of each patch class has been evaluated. As there is only one patch class for stony areas, this patch class has not been included in the evaluation. As the open areas are suitable, some certain patch edges are subjected to the human acts frequently with statistical analyses been made. However, the four habitat patches called as “coniferous, mixed coniferous, leafy and mixed” have been focused in the evaluation of habitat patches.

The studies of Forman and Godron (1986), McGarigal and Marks, (1994), Forman (1995), Uzun (2003) and Rempel (2010) have been used while evaluating the patch analysis results. The points that the related patch classes get as a result of five point likert scale can be seen in Table 3.

As for patch size and number, a rise in patch size will generally increase the habitat function of the landscape. Contrarily, a decrease in patch size will decrease the habitat function of the landscape. From this point of view, while an increase in patch size is considered as a gain, a decrease in patch size is accepted as a loss. As the increase in patch would probably cause fragmentation, this situation is not generally preferred for the natural sources and conservation of them. In this situation, an increase in patch size will decrease the habitat function, the other way round will increase the function. However, an examination of patch class and size with related statistics will give more valid results (Uzun, 2003).

When the patch sizes are evaluated in percentages, the patch size for the least leafy forest cover is 1.6% and for the most mixed coniferous forest cover is 3.11%. According to this, the habitat function of the patches decreases in order of leafy, mixed, coniferous and mixed coniferous forest covers. When the patch size functions are taken into consideration, the leafy forest covers have the biggest average patch size. For this reason, the highest function is on the decline from the leafy forest cover to the mixed coniferous forest cover, respectively. The leafy forest cover that has patch classes in which the average patch size is high also has high habitat function (Tables 1, 2 and 3).

MSI, MPAR and MPFD values have been examined within the scope of patch forms. The fact that MPAR has low value and MPFD value is close to 1 show that, the patches in these classes has a more pressed structure (Forman and Godron, 1986; McGarigal and Marks, 1994; Forman, 1995; Uzun, 2003; Rempel, 2010). The analyses that have been made with vectorial data have taken the circle form as a base. So, the patches that have more pressed and circular forms are more suitable for interior species as seen in the researches. In evaluating that in which MPAR value is taken as a base, patch forms show deviation in the order of mixed, leafy, mixed coniferous, coniferous forest covers and the patches are in more complicated, complex and longer shapes (Tables 1 and 2). The interpretations in Table 3 have been made according to the fact that, the interior habitat species that live in wildlife and patches can take more parts in more pressed and circular patches in the evaluation of this information in terms of habitat function of the landscape.

The patch edges form the areas where the most intense mutual relationships between living beings take place and the transmission zones that are called ecotone are close to each other. The metrics of the edges or the borders that are formed as a result of the neighborhood between patches identified in Lake Sugla basin and both of the evaluations of same patches and different patches have been made and these metrics have been used as a criterion for the fragmentation of that patch type or class (Tables 1 and 2). Three metrics stand out in the landscape metrics for patch edges; Total edge (TE), edge density (ED) and medium patch edge (MPE). However, the edge density from these indexes is more important. The less the density, the less the patch classes have edges, so they can shelter more interior type habitats and so the habitat function of the landscape has been defined (Forman and Godron, 1986; McGarigal and Marks, 1994; Forman, 1995; Uzun, 2003; Rempel, 2010) (Tables 1, 2 and 3).

The existence of the core areas in a patch is about the interior habitat livings that will settle in that area and a large enough core area will provide survival easily without being affected by the environment. For this reason, the habitat function has been evaluated as high value will create a more sheltered and balanced environment. The landscape units that stand out of those core areas have been considered to have low habitat function value. That is, if the core areas are extensive, then the landscape function of that patch class will be higher (Uzun, 2003) (Tables 1, 2 and 3). As the core areas are the same for the patches that take place in the forest matrix of Lake Sugla basin, the core areas have been defined by taking a 100 m edge tampon as a base and the analyses have been made and evaluated. The reason for the fact that the edge zone is taken as 100 m in the formation of the core areas is that, the forests in the area are generally rough and the possible human effect on humans that live in interior habitats is considered (Figure 2). Although the statistical values for patch size and number, patch form and patch edge of the core areas have been recalculated, only the statistical values that are about core areas have been evaluated according to the method of Forman and Godron (1986), McGarigal and Marks (1994), Forman (1995), Uzun (2003) and Rempel (2010) (Table 4).

Total core area (TCA), core area density (CAD) and total core area index (TCAI) have been examined firstly in the analyses that were made by taking a 100 m tampon zone in the formation of the core areas. The density of the core area has been reached as leafy 1.18, open areas 0.77, coniferous 0.60, mixed 0.37 and mixed coniferous 0.28. Much density means that patch class has much more interior type habitats. In this situation, the patch classes that have much density will also have higher habitat function. (Forman and Godron, 1986; McGarigal and Marks, 1994; Forman, 1995; Uzun, 2003; Rempel, 2010) (Tables 1, 3 and 4).

A simple analysis has been made to find out if the patch core areas have enough core areas for big vertebrates such as bear and wolf in the evaluation of patch classes within the frame of the habitat function of the landscapes with the intention of supporting the core areas analyses. In books and articles (Arkive, 2010), it is stated that, there is a 200 to 2000 km^2 area for male bears and 100 to 1000 km^2 for female bears as living spaces. Within this context, the existence of the patches that are bigger than 20 ha has been questioned, for the patches that have core areas. There are 119 patches that are bigger than 20 ha. Ten of these patches in open areas in forestry, twenty nine of them in coniferous forests, seven of them in mixed coniferous forests and fifty four of them take place in leafy forests. The results obtained from this fact, support the data on core area density. Helzer and Jelinski (1999) stated that, when the patch size is bigger than 50 ha, grassland breeding birds reach maximum species richness and there no species in interior areas.

The evaluation of habitat functions is related with the fact that, patch classes have interior habitats. Within this context, the evaluation of four patches relatively has been made and it has been transferred to the map. Additionally, open areas in forestry and stony areas have been defined as the areas that have very low habitat function. Open areas in forestry are active area of use for the species that are called edge species in the middle of the patch classes. As the main purpose in this analysis is to identify the areas that have habitat value for the species, mainly the patches with forest covers were evaluated. As a result of this, the map in the Figure 3 was

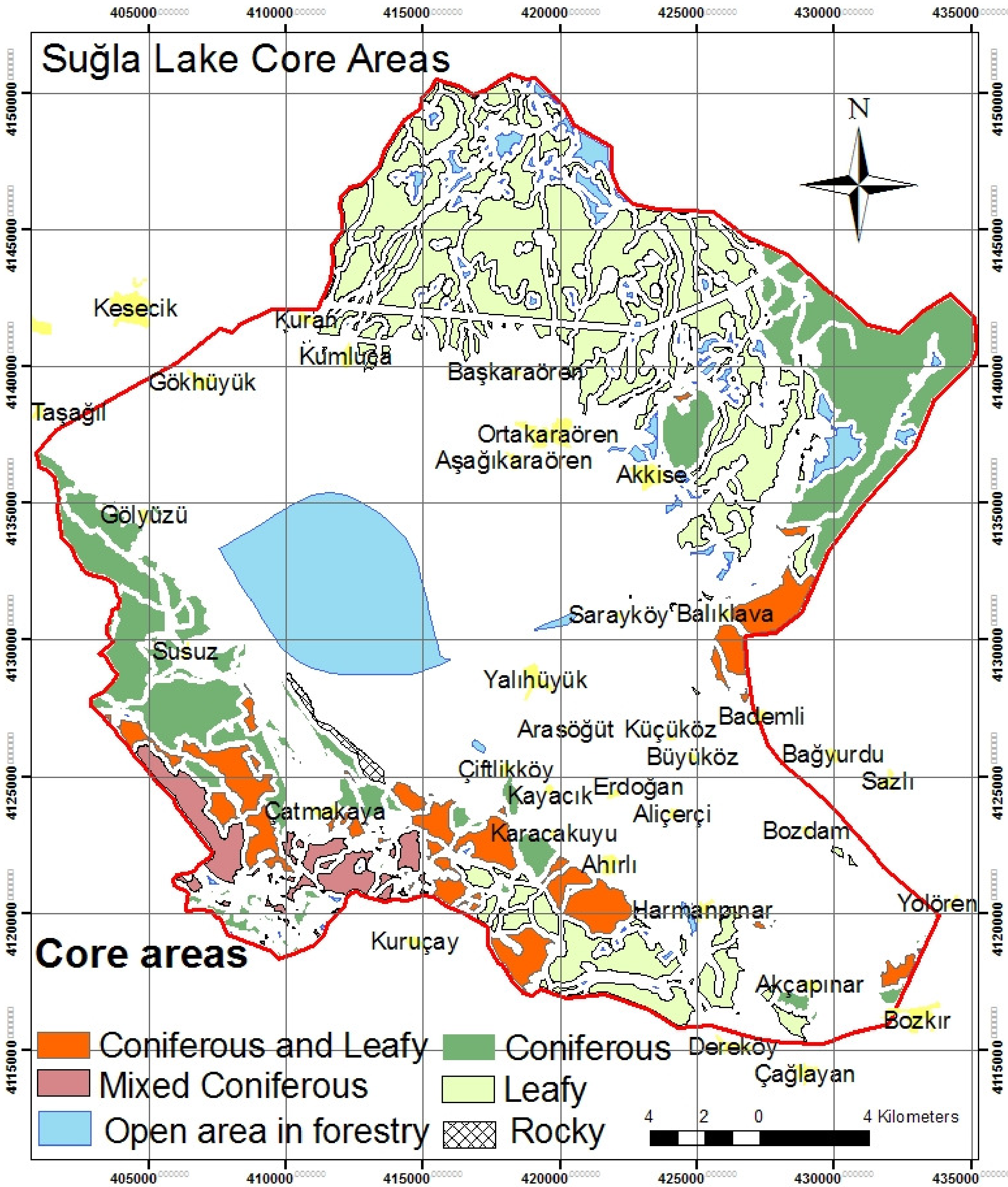

Figure 2. The core areas in Lake Sugla and its surrounding area.

obtained according to the points in Table 3. As a result of the overlay analysis that has been made according to the four criteria, it has been stated that the patches that get 15 points have very high habitat function, the patches that get 14 points have high habitat function, the patches that get 12 points have moderate habitat function and the patches that get 11 points have low habitat function value. The points that each patch class gets as a result of habitat function evaluation in the level of patch classes and the habitat function of the landscape can be seen in Figure 3.

The field reports (Mergen, 2010; Duran and Şanga, 2010; Uzun et al., 2010) which have been prepared to explain the habitat patches evaluation better have been used in the formation of "bio-diversity function of landscape" maps.

Table 4. The statistical values formed by taking 100 m as a base in forest matrix.

Landscape metric	Core area patch classes					
	Coniferous	Coniferous and leafy	Mixed coniferous	Leafy	Open area in forestry	Rocky
Total core area (TCA)	18886.31	18886.31	18886.31	18886.31	18886.31	18886.31
Total core area ındex (TCAI)	52.78	54.66	56.34	61.34	10.22	52.32
Core area density (CAD)	0.60	0.37	0.28	1.18	0.77	0.00

The maps that are prepared by the experts who do researches on plant and animal existence within the scope of the project have been used to explain the bio-diversity function of the landscape. Bio-diversity function of landscape has been stated not for genetic or eco-system but for species. The point scoring system that has been performed according to five point Likert scale by the experts in Table 5 has been used to put forward the landscape bio-diversity function maps by making use of the maps of important plant areas and important bird and insect areas that are prepared by the experts (the units on the maps can be seen in Table 5) (Uzun et al., 2010; Mergen, 2010; Duran and Şanga, 2010).

In the new map that has been prepared by overlaying important vegetation maps and important animal existence maps, it has been shown that the areas that get 9 points have very high biodiversity function, the areas that get 5 points have high biodiversity function and the areas that get 3 points have medium biodiversity function (Figure 4).

In the last stage of the method, the patch classes that should be conserved in the structure of landscape have been shown by the help of overlay analyses of "land-scape habitat function" maps and "landscape bio-diversity function" maps that are prepared in regard to research area in ArcGIS 9.3 environment (Figure 5).

There are some areas that have very high habitat and bio-diversity function in the southern part of the research area. The function of this area of very high and high land-scape function has been decreased by the settlement of Çatmakaya. In the southern part of the research area, the areas have very low habitat and bio-diversity function.

DISCUSSION

The method that has been used in the research is a part of the method that has been developed in the studies of Steinitz (1995), Ahern (1999), Steiner (2000) and Ahern (2006) within the context of Konya city, Bozkir, Seydişehir, Ahirli and Yalihüyük districts and Lake Sugla site landscape management, conservation and planning project. The method is one of the first studies in our country in that different landscape functions are used in landscape planning. In the research, a landscape ecology based approach that has been used in various stages of landscape planning since 1990s has also been used in the evaluation of landscape habitat function. This ap-proach has supported the research findings of Forman and Godron (1986), McGarigal and Marks (1994), Forman (1995), Hobbs (1997), Uzun (2003), Opdam et al. (2002), Leitao and Ahern (2002) and Rempel (2010). The comparison of patch classes from different periods has not been made and a situation assessment has been made only for the patch classes in the research. These kinds of comparisons will give ideas about the question which patch classes are pressurized (Tunçay et al., 2009; Dilek and Şahin, 2005; Dilek and Uzun, 2007).

To determine the core areas in the patch classes, a 100 mm buffer zone was used by taking the territory observations as a basis. Saab (1999) also used buffer zone in his study. But the ideal one is forming detailed buffer areas by taking the living species inhabiting in the patch class in the sub-scales and the characteristics of the patch class. The presence of the 119 patches bigger than 20, as stated before, in the research area has the quality of a guide especially to increase the protection function in these areas. Tuncay et al. (2009) emphasises that, the vegetation pieces which are big and high in quality have an important role in reducing the oppression towards other living species in the landscapes gradually changing; these kind of areas should be protected as effectively as possible. There are some studies about habitat and biodiversity in which patch corridor matrix model and different methods are used (Noss, 1999; Shifley et al., 2000; Longino and Colwell, 1997). In the research area, the habitat function of the landscape and the biodiversity function of it are assessed together in the scope of the method. The data gained have the quality of a guide for the administrators of natural resources locally. In the frame of the data gained in the study, carrying out more detailed studies for the living (bird, vertebrate species, etc.) and plant species living in the area will increase the quality of the administration. In the models of patch – corridor - matrix, in addition to the method followed in the study, carrying out studies for such kinds of processes as connectivity, Schadt et al. (2002) and fragmentation Tewksbury et al. (1998) increase the validity of the method followed in the study.

In Lake Sugla and its surrounding area, the areas whose habitat function is high take place in the Northern part of the site. This area is located in an area which is away from human factor and there are fewer breakups between patch classes here. It is required that one

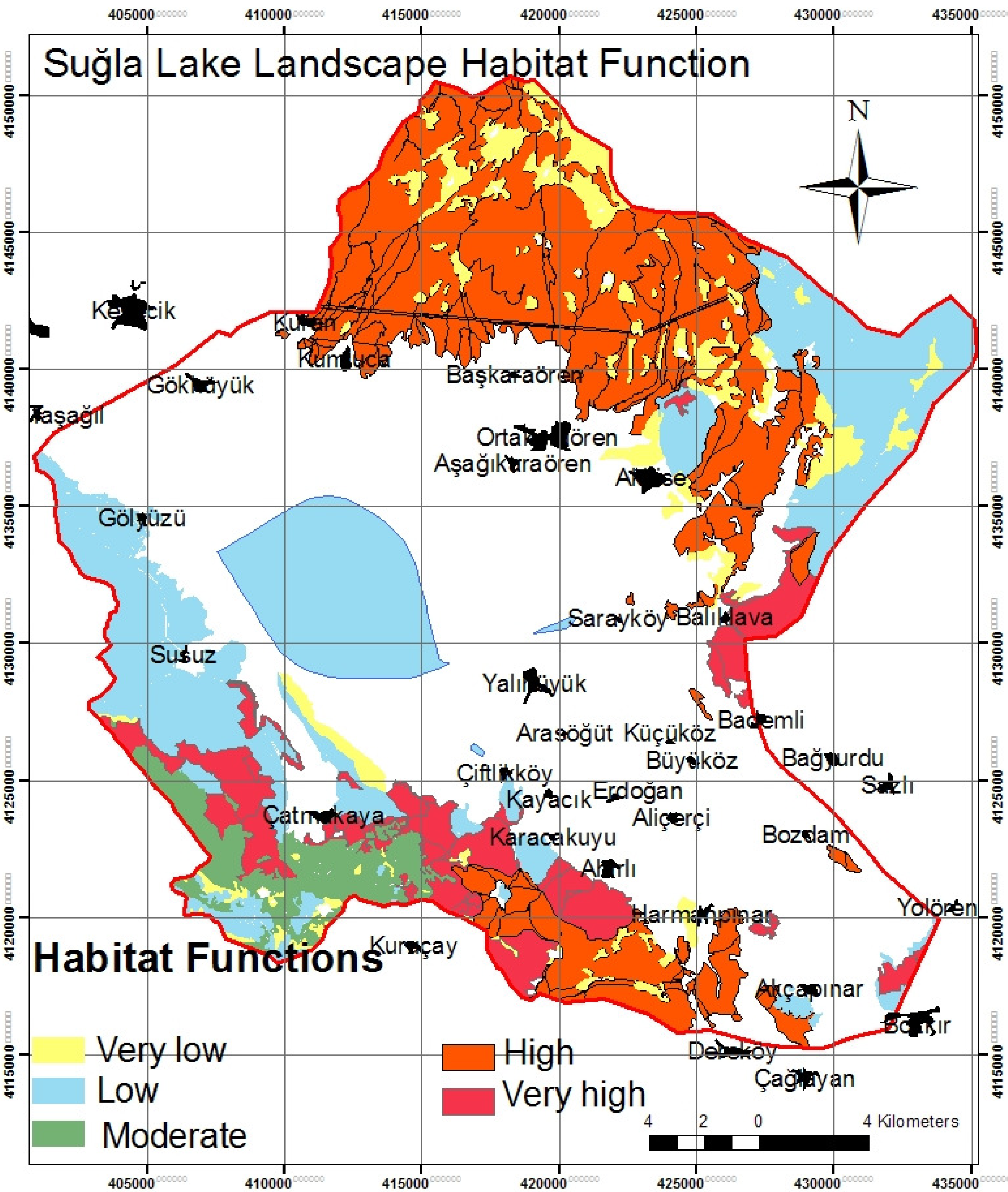

Figure 3. Habitat function of landscape in Lake Sugla and its surrounding area.

should be careful about keeping the breakup in the present patch classes less and pasturage, agriculture especially in the areas where there are human usage. Reducing the human inhabitancy and interventions in the patches in the North where habitat function is low will cause the habitat functions in the area to increase more. The sites where there is much biodiversity related to flora and fauna show parallelism with habitat function and located to southern parts of the area. The fact that biodiversity is higher in the middle and northern parts of the area, is caused by the endemic plant types which are determined during the territorial studies in the area. With the evaluation of habitat and biodiversity functions, determined in the research area, together, areas which

Table 5. Giving points for the qualities that will create a base for the bio-diversity function of landscape.

The qualities that will create a base for bio-diversity function of landscape	Value	Score
Important vegetation maps, legend data		
Plant diversity and endemic plant species	Very high valued function	5
Conserved/natural/old forest	Very high valued function	5
Endemic PLANT SPECIES	Very high valued function	5
Centaurea iconiensis conservation area	Very high valued function	5
Micro-climate area in canyon	High valued function	4
Important animal map legend data		
Important areas for insects	High valued function	3
Important bird areas.	High valued function	4

should be protected and administrated carefully. The gained maps and analyses have the quality of a guide for the natural resources administrators. It is required that the patch classes taking place in the areas where habitat and biodiversity function are high should be protected by laws and regulations. The sites where habitat function and biodiversity function are higher in the study area are the areas located away from the residents. The fact that agricultural activities and human interventions are high on the plain area around Lake Sugla caused the patch classes near the lake to be more pieced. It is required that the corridor located between the areas having high and higher functions on the southern part of the study area should be strengthened and the present patches liable to break up should be assessed more carefully. Some precautions should be taken by the natural resources administrators to strengthen the connection of the patches, having a very high quality function, with each other located on the southern part.

We can say that the forest patches located on the southern west and northwest of the study area stretch out of the area. The motorway, located on the northern west and South and outside of the area, is the most important human factor creating separation in the area. The barriers of the motorway separate the forests located around Taurus Mountains and Lake Sugla on the South. We can say that a big patch class has partly been formed in this area. This piece is becoming a state of an island day by day. Life in this area for some specific species is divided into two by the agricultural fields around the motorway and Lake Sugla. We cannot mention about any corridor or connectivity between northern and southern parts of Lake Sugla. Living activities are carried out just on the directions of east and west on the forest patches located on the North and the South of Lake Sugla. This situation may have caused important problems for the survival of the living species inhabiting the middle area for over the 50 to 100 year period.

In this scope, to enable connectivity between the south and the north parts of the study area, the corridors used between the agricultural fields will be benefited from. These hedgerow structures, which were built by the local people for their own aims, should be organised for supplying connectivity by assessing them in the upper measure. Similar suggestions were put forward by Tuncay et al. (2009). Habitat and biodiversity functions are low on the parts on which the study area and residents are located. But when you go towards the forest field, habitat and biodiversity functions increase. The areas where habitat and biodiversity are very high should be absolutely protected to provide present and future generations with more qualified life. It is required that, in high parts, protection based decisions should be taken and human interventions should be reduced as much as possible.

The legislation concerning protection in our country is quite broad in terms of laws and regulations; however, this frame prepared with an approach that do not consider nature protection as a part of the physical planning, should be formed to emphasis the priority of resources rather than the priority of the economy of the country by revising it (Tuncay et al., 2009). As a result, the patch corridor matrix model is an effective medium in putting forward the habitat function of the landscape and interpreting it during the process of landscape planning. The method forms a part of a study in which planning decisions are taken by putting forward landscape functions in Lake Sugla and immediate surroundings. Using landscape functions in planning decisions by interpreting it is a new approach for our country. Putting the mentioned method approaches and landscape planning studies into action legally in territorial measure is required for maintainable managing of the natural resources. Moreover, the approach followed with method has the quality of a guide for the administrators of natural resources in protection based planning studies in different regions of different countries.

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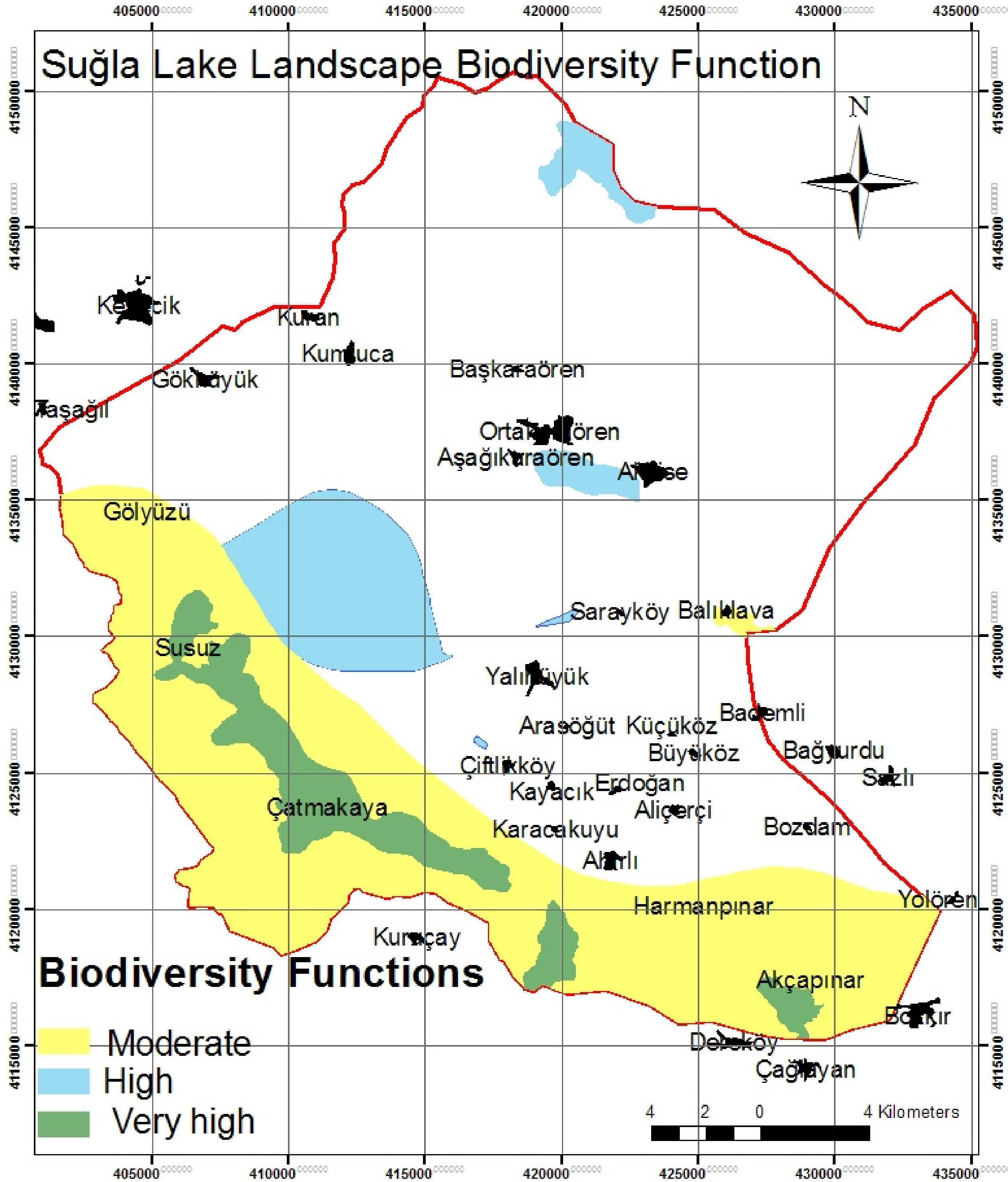

Figure 4. Bio-diversity function of landscape in Lake Sugla and its surrounding area.

ment, Protection and Planning Project for Konya Province, Bozkir-Seydişehir-Ahirli-Yalihüyük districts and Suğla Lake" being launched by the "Landscape Protection Branch" of the Nature Conservation Office of the General Directorate of Nature Conservation and National Parks under the Ministry of Environment and Forestry and executed by the AKS Engineering, which is one of the target areas defined in the Regional Development Program, an investment program preparation guide for the period of 2007 to 2009 in the 9th National

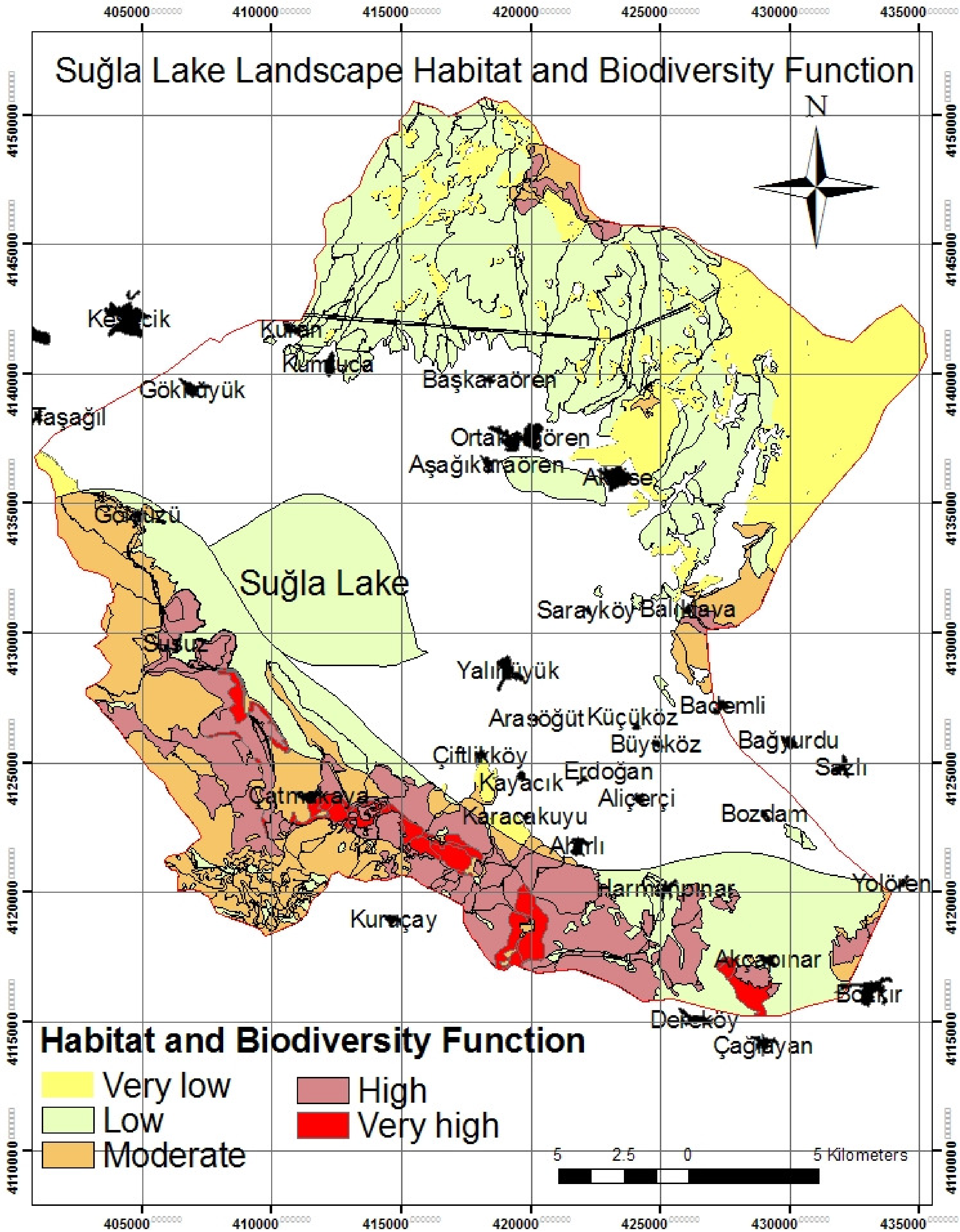

Figure 5. Habitat and bio-diversity function of landscape in Lake Sugla and its surrounding area.

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Abbreviations

ELC, European landscape convention; **EIA,** environmental impact assessment; **GDSH,** General Directorate of State Hydraulic Works; **TE,** total edge; edge density; **MPE,** medium patch edge; **GIS,** geographic information system.

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