Journal of Applied Sciences 4 (1): 164-170, 2004
ISSN 1607-8926

A Naturalness Quality Assesment; In the Case of Spil Mountain, Turkey

Şerif Hepcan and Çiğdem Coşkun
Department of Landscape Architecture, Faculty of Agriculture, Ege University, Izmir, Turkey

Abstract: This study was undertaken to asses the naturalness quality of the Spil Mountain National Park, Turkey, through using four naturalness indicators. In this process the study area was separated into 1 km x 1 km (survey) grid cells. Total naturalness quality (TNQ) values were calculated by addition of the four indicators, weighting the biophysical naturalness and uniqueness by a factor 2, in order to increase their contributions in total naturalness quality. Results indicated that total naturalness quality received moderate (between 35 and 50%) and lower scores in the fringes of the study area with the contribution of settlements and main transportation routes. Particularly remote parts, where is relatively free from human exploitation, took higher scores (between 50 and 65%). In addition, the highest scores generally appeared in the central and remote parts of the study area, where canyon valleys with cover of undisturbed natural vegetation and temporary streams were common (between 65 and 75%).

Key words: Naturalness, naturalness indicators, assessment of naturalness quality

INTRODUCTION

Naturalness is essentially a function of the absence of human impact. Indicators of human impact include the presence of exotic species, soil compaction and disconnection from original location and form[1]. As the product of geological and biological processes, naturalness defines the state to which natural landscape is completely free of human disturbance or is slightly modified by human occupation or exploitation. In a more specific example, Schnitzler and Borlea[2] described the term of naturalness as vegetation owing its features strictly to natural factors and not to the action of people.

Natural area may be defined as an area that is, or is capable of being restored; of sufficient size to enable long term preservation of its biological diversity; substantially undisturbed by modern technological society; and remote at its core from points of mechanized access[3].

A number of key threatening processes, that stems from the impact of modern technological society such as changing hydrological regimes and natural vegetation, introduced species, roading etc[4], may be regarded among the main threats to naturalness and naturalness quality.

Naturalness is a key concept in many views. Particularly, in order to provide a framework to develop a nationwide system of protected areas, the key point must be assessing the naturalness quality and preparation of a national naturalness inventory in order to reduce the confusions and to guide nature conservation policies and principles. Because areas with a high naturalness quality will provide for larger reserve areas, support better connectivity among the habitats and be less fragmented and make a critical contribution to ecological integrity.

At the same time, naturalness is one of the four dimensions of recreational experiences[5]. Absence or degree of human impact on natural areas may be measured through a combination of different attributes such as remoteness, biophysical and aesthetic naturalness etc (Robertson *et al.*[3] and http://www.heritage.gov.au/anlr/nwi/handbook.html, 2003.).

This study, through a simple methodology with four indicators, was undertaken to assess the naturalness quality of the case area in the Spil Mountain, mainly occupied by the boundaries of the Spil Mountain National Park.

MATERIALS AND METHODS

In data collection and analysis topographical maps and black and white aerial photographs were utilized. The interpretation of the actual aerial photographs was supported by repeated field surveys.

The study area is delineated mainly by the boundaries of the Spil Mountain National Park in Manisa province. It is one of the four major national parks in Ege Region of Turkey covering an area of 6895.5 ha (Fig. 1).

Corresponding Author: Dr. Şerif Hepcan, Department of Landscape Architecture, Faculty of Agriculture, Ege University, Izmir, Turkey

Table 1: Remoteness indicators and their ranking scores (4= highest, 1= lowest)

Remoteness from access						Remoteness from settlements	
	0-1	1-2	2-3	>3			
Walking time /defined structure	1	2	3	4		Walking time / defined structure	
Four wheel drive roads	1	1	2	3	4	1	City
Two wheel drive roads	2	2	4	6	8	2	Town
Stabilized roads	3	3	6	9	12	3	Village
Forest (dirt) roads	4	4	8	12	16	4	Other

Table 2: Biophysical naturalness-uniqueness and their ranking scores (4= highest, 1= lowest)

Biophysical naturalness		Uniqueness
Completely modified	1	Common
Relatively modified	2	Relatively unique
Moderate protected	3	Moderate
Protected	4	Unique

Table 3: Optimum scores for the indicators

Indicator	Optimum score
Remoteness from access	16
Remoteness from settlements	16
Biophysical naturalness	4
Uniqueness	4

Table 4: Distribution of quality scores of naturalness indicators

Indicator	Quality score (%)	Quality class
Remoteness from access	12.5-20	Lowest
	21-30	Moderate
	31-40	High
	41-50	Highest
Remoteness from settlements	6.25-12.50	Lowest
	13-25	Moderate
	26-40	High
	41-50	Highest
Biophysical naturalness	25	Lowest
	26-50	Moderate
	51-75	High
	100	Highest
Uniqueness	25	Lowest
	26-50	Moderate
	51-75	High
	100	Highest

Table 5: Total naturalness quality classes

Quality score (%)	Quality class
17.5-25	Lowest
26-35	Low
36-50	Moderate
51-65	High
66-75	Highest

The national park was established primarily for the conservation of unique geological and geomorphological characteristics, including canyon valleys, dolin lakes and numerous caves and richness of natural flora and fauna in 1968[6].

Spil Mountain, as a complementary part of Yamanlar Mountain massive, begins in Gediz Plain at about 60 m and reaches to 1513 m altitudes in 3 km horizontal distance. Therefore, rough topography, steep and bare

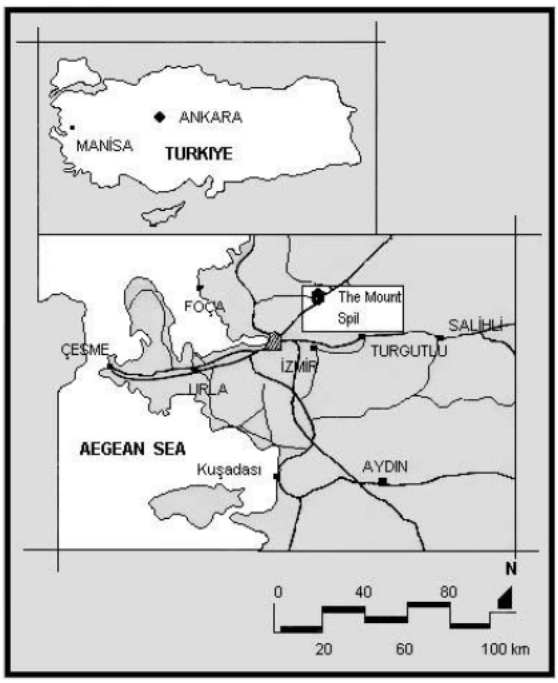

Fig. 1: Location of the study area (modified from Hepcan, 2000)

slopes are common geomorphological features of the Spil Mountain. The study area is mainly characterized by the karst topography that consist of calcareous lands with a large number of deep cracks that enable a large amount of surface water to infiltrate into deeper layers[7].

Spil Mountain has an average annual precipitation ranging from approximately 750 mm (at 79 m altitude) to 1500 mm (at 1500 m altitude). The average annual air temperature varies from 9.5°C to 16.6 °C[8].

Spil Mountain National Park has a significant floral richness with 81 families, 329 genuses and 539 species of which are 78 endemics. *Pinus brutia* (about up to 700 m) and *P. nigra subsp. Pallasiana* (between 700 and 1500 m) are the main tree species of forest cover in the Spil Mountain[9]. Nearly 40% of the national park area is covered by forests[10]. In addition, Maquis and Mediterranean Mountain Steppe are the other major vegetation types in the study area.

The relief of "Kybele" and relicts of the ancient settlements in the northeast are some of the archeological features of the study area.

Most of the national park area is under the ownership of government, while private properties of small extend located in the northern part are scattered and used agricultural purposes[10].

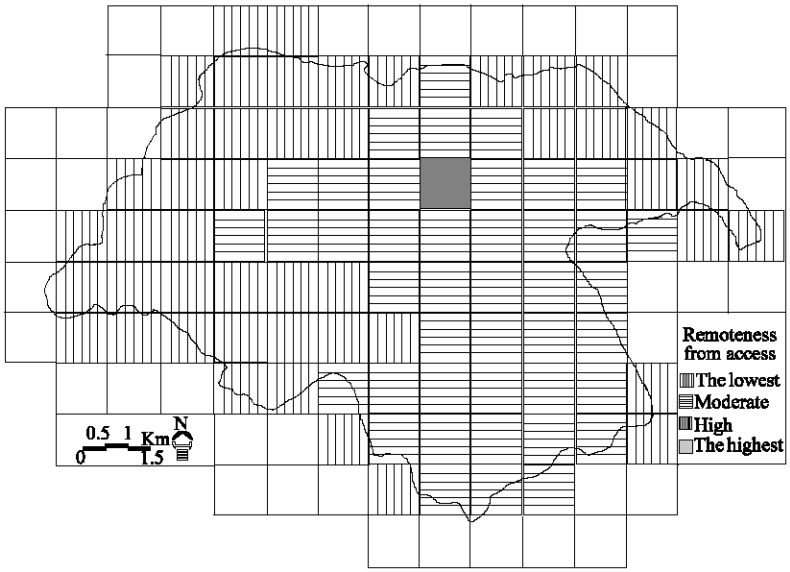

Fig. 2: Naturalness quality classes of remoteness from access

Fig. 3: Naturalness quality classes of remoteness from settlements

Determination of naturalness indicators and assessment of naturalness quality in the study area were made by modifying the approach and the method developed and implemented by Lesslie and Taylor[11] . The principles of this methodology have been widely used in describing wilderness resources, assessing the potential for wilderness restoration and wilderness loss and wilderness area designation in Australia. In order to assess naturalness quality, based on its biophysical and visual landscape characteristics the study area was separated into 1 km x 1 km grid cells in a topographic map, updated through aerial photographs. The entire procedure may be summarized under four major stages;

1. Determination of naturalness indicators
2. Ranking scores of indicators
3. Assessment of indicators
4. Determination of total naturalness quality

Determination of naturalness indicators: Four indicators of naturalness quality were used in the methodology:

1 - Remoteness from access (RA): remoteness from established mechanized access routes.

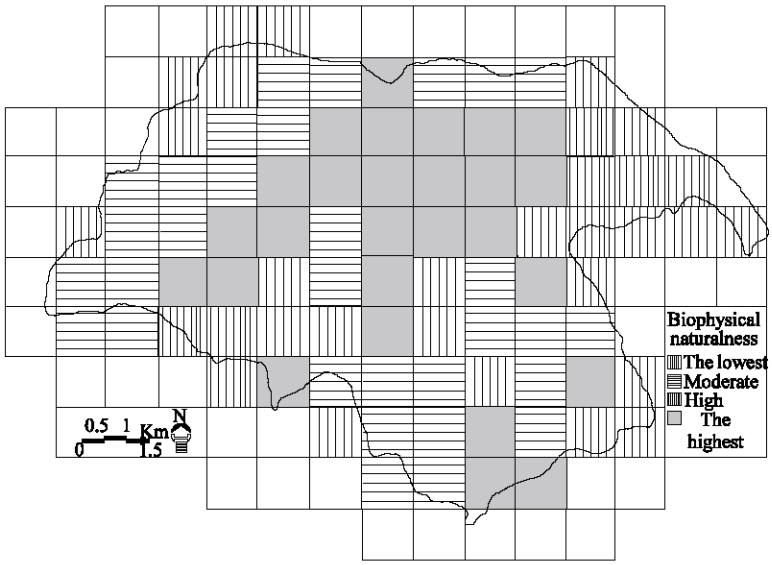

Fig. 4: Naturalness quality classes of biophysical naturalness

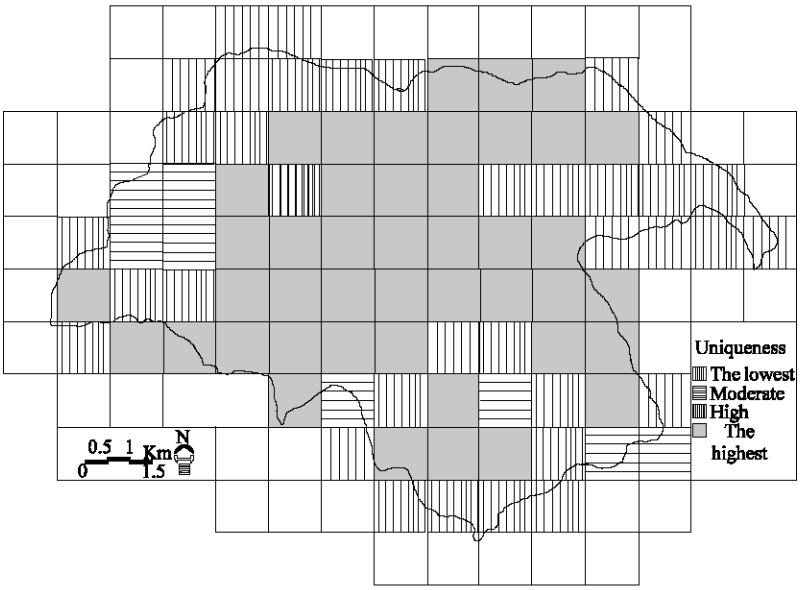

Fig. 5: Naturalness quality classes of uniqueness

2 - Remoteness from settlements (RS): remoteness from points and areas of permanent human occupation
3 - Biophysical naturalness (BN): the degree to which the natural environment is free of biophysical disturbance due to human occupation or exploitation
4 - Uniqueness (U): uncommon or rare natural vegetation cover and / or physical characteristics

Ranking scores of indicators: Distance-based two remoteness indicators were obtained briefly by calculating distance from the highest point in each (survey) cell to the nearest defined structure. The distance measured between the highest altitude and the defined structure was converted into walking time regarding the average walking / trekking times (km h^{-1}) in the Spil Mountain. In order to assess remoteness indicators a matrix was developed taking into account the relationship between the nearest defined structure and walking time. In this matrix by using numerical values from 4 (the highest) to 1 (the lowest), one ranking score was assigned to both defined structure and walking time (Table 1).

By contrast to distance-based indicators, BN was measured (more subjectively) by assigning a numerical value ranging from 4 (the highest) to 1 (the lowest) to

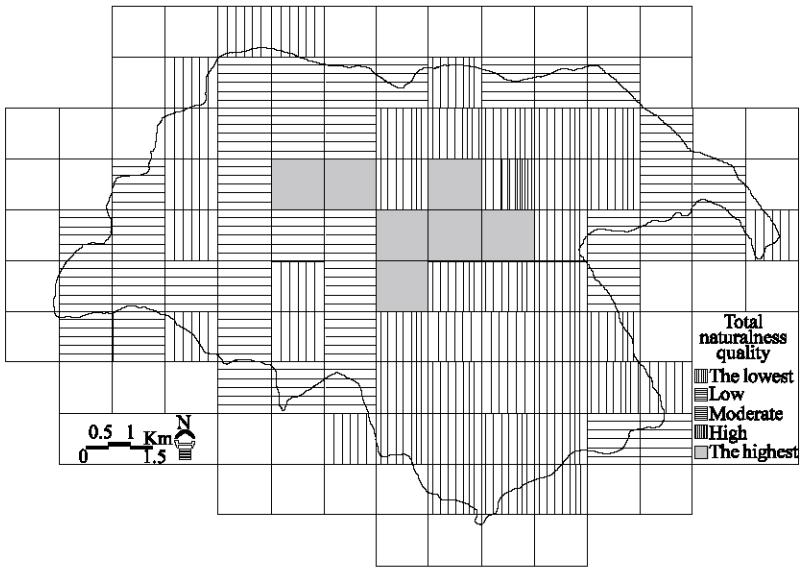

Fig. 6: Total naturalness quality classes

each cell based on a degree of landuse chance. Thus intensity and degree of change due to human intervention were used as a tool of estimating biophysical naturalness (Table 2).

Similarly U indicator was calculated by assigning a value to each cell by taking into account uniqueness of its vegetation cover and / or physical features (Table 2).

Assessment of indicators: In this stage total scores for each indicator in 1 km x 1 km grid cell resolution were obtained by multiplying values assigned for each cell in the matrix. Total scores were converted into percentage values by using optimum scores (Table 3). For example the best possible score for RA in entire study area was 16 (100%). Overall, the highest score obtained in entire study area was 8 (50%), the lowest score was 2 (12.5%). Thus in the process of RA ranking, percentage scores were grouped into four quality classes between 12.5 and 50%. And then, maps showing classes depicted with different hatches were prepared (Fig. 2-5). Distribution of quality classes of four quality indicators were given (Table 4).

Determination of total naturalness quality: TNQ values were calculated by addition of the four indicators weighting the BN and U by a factor 2 in order to increase their contributions in the methodology. Equation indicated below gives the TNQ values for each grid cell. However, distance-based remoteness indicators are still dominant variables in determination of TNQ values due to their objective characteristics compared to BN and U.

$$TNQ = RA+RS+(BNx2)+(Ux2)$$

The best possible score for TNQ in the study area was 40 (100%). While the highest score obtained for TNQ was 30 (75%), the lowest score was 7 (17.5%) in the study area. Therefore, like the calculation procedure in the stage of assessment of indicators, percentage scores grouped into five TNQ classes between 17.5 and 75% so that they would be able to be evaluated as a whole (Table 5). Regarding the quality classes a map were prepared depicting TNQ for each grid cell in the entire study area (Fig. 6).

RESULTS AND DISCUSSION

Results showed that the highest value RA obtained was 50% in just one cell, which had also the highest scores in terms of remaining three indicators and TNQ. However, 46 survey cell (nearly half of total 89) in the study area received the lowest scores (12.5%) indicating that most parts of the study area were easy to reach by motorized vehicles only less than one hour. 42 grid cells took values between 20 and 25%. A double drive roadway providing connection between national park and the city center seems to have the main responsibility in decreasing RA scores as well as two main roadways which bounded the study area from the north and the east due to their significant role in transportation. On the other hand, 95% of the entire study area had lower RA scores, which indicates a negative impact on naturalness quality. Because this figure shows that national park is easily accessible for the visitors regarding the recreational attitudes and uses.

It appears that total scores for RS mostly concentrated below 25% in the study area. Whereas, a total of 12 survey cells received the lowest scores (between 6.25 and 12.50%), 33 cells took values between 12.50 and 25%. Only 3 cells deserved the highest scores (more than 40%). It is clear that RS values were influenced by the different settlements ranging from urban areas to little villages in and around the study area. According to results of RS the settlement pressure and its potential and existing outcomes should be taken seriously in such a way that naturalness quality will not be able to damaged. However, borders of the national park provide a legal barrier against the development of settlements which is effecting the naturalness quality characteristics of the area a great deal. Total scores for BN were higher in the study area compared to above mentioned two indicators. The number of cells deserved the highest scores (100%) were 27 which is nearly one third of the entire study area. Only 8 cells took the lowest scores (equal to 25%). These figures showed that up to now degree of human occupation or exploitation in the area was not significant. Probably the main reason why the scores for BN were higher than remoteness indicators was the steep and rough topography of the Spil Mountain, which is acting as a natural barrier to human intervention. Taking into account the results of BN, it is possible to say that study area was relatively free of intense biophysical disturbance generated by human occupation.

The last indicator in the process of qualifying the naturalness in the study area was U, which received high scores similar to BN. 44 cells (approximately half of the grid cells) took 100% score. More than 75% of the cells in the study area received more than 50% score. Only 5 cells stayed below 25%. According to these total scores, it seemed that vegetation cover and / or physical features of the study area was more or less well-protected and uncommon without substantial human intervention, which are regarded as important for the factors that contribute to recreational potential and value of wildlife habitat in the study area.

Moreover it occurs that there was relatively a positive correlation between BN and U values.

Based on the findings of four indicators, the following outcomes appeared for TNQ in the study area;

- In general TNQ received relatively moderate (between 35 and 50%) and lower scores in the fringes of the study area with the contribution of settlements and main transportation routes. Particularly remote parts where is relatively free from human exploitation took high scores (between 50 and 65%).
- The highest scores generally appeared in the central and remote parts of the study area, where canyon valleys with cover of undisturbed natural vegetation and temporary streams were common (between 65 and 75%).
- It is possible to conclude that one of the primary reasons why TNQ could not obtain the higher scores (more than 75%) was the lower values of remoteness indicators depending on the size of the study area. The larger areas of similar characteristics with the study area may probably take higher scores in terms of TNQ.
- The rough topography of the Spil Mountain seemed to be a positive factor contributing to TNQ values in general.

The method utilized in this study was a simple and systematic approach in the process of determining the naturalness quality. This method considers that naturalness is the state to which natural landscape is significantly free of human disturbance and is functioning without active intervention for management purposes in order to meet its own ecological requirements.

This study may be regarded as a starting point for further studies aiming at assessing naturalness quality of the natural landscapes and predicting the impacts of human exploitations such as road construction, land clearance etc in Turkey. Moreover naturalness quality databases and maps may be correlated with other natural and cultural features to guide future nature conservation policies. Because a landscape of high naturalness quality may better promote nature conservation objectives.

TNQ values determined in the Spil Mountain should not be underestimated because most naturalness studies giving higher scores than that of Spil Mountain require much more larger areas than the study area. Therefore biophysical naturalness and uniqueness indicators took part in this method so that disadvantages of distance-based remoteness indicators could be mitigated in the area. However for TNQ, conducting further studies using GIS in larger reserves will be more significant and advisable due to many recreational and ecological requirements can easily be detected. Moreover, future studies may also benefit a great deal from the utilization of more detailed and less subjective indicators of TNQ.

ACKNOWLEDGMENTS

I gratefully acknowledge the useful comments on the manuscript from Dr. Hayriye Eşbah TUNÇAY (Adnan Menderes University, Turkey).

REFERENCES

6. Anonymous, 1970. The General Management Plan of the Spil Mountain National Park. The Ministry of Forestry General Directorate of Forestry, National Parks Service. Ankara, pp: 41.
8. Anonymous, 1995a. The Meteorology Records of Manisa Province 1945-1995. The Turkish State Meteorological Service, Izmir.
10. Anonymous, 1995b. The Aerial Photographs of Izmir-AyvalIk-BalIkesir Regions 995-7815 General Command of Mapping (1/35.000), Ankara.
1. Cook, E.A., 2000. Ecological Networks in Urban Landscapes. Wageningen University Press. The Netherlands, pp: 201.
9. Duman, H., 1985. A Research on the Vegetation and the Flora of Spil Mountain, M.Sc Thesis. Gazi University Graduate School of Natural and Applied Science Ankara, pp: 141.
7. Hepcan, 2000. A Methodological Approach for Designating Management Zones in Spil Mountain National Park, Turkey. Environmental Management 26: 329-338.
11. Lesslie, R.G. and S.G. Taylor, 1983. Wilderness in South Australia: An Inventory of the State's Relatively High Quality Wilderness Areas. Occasional Paper No:1 Center for Environmental Studies, University of Adelaide.
5. Lynn, N.A. and R.D. Brown, 2003. Effects of recreational use on hiking experience in natural areas. Landscape and Urban Planning 64: 1-2, 77-87.
4. Mackey, B.G, R.G. Lesslie, D.B. Lindenmayer, H.A. Nix and R.D. Incoll, 1998. The Role of Wilderness in Nature Conservation. A report to The Australian and World Heritage Group, Environment. Australia, pp: 88.
3. Robertson, M., K. Vang and A.J. Brown, 1992. Wilderness in Australia: Issues and Options. Australian Heritage Commission. Australia, pp: 183.
2. Schnitzler, A. and F. Borlea, 1998. Lessons from Forests as Keys for Sustainable Management and Improvement of Naturalness in Managed Broadleaved Forests. Forests Ecology and Management 109: 1-3, 16, 293-303.