A method of carrying capacity for alternative recreation areas: Towards conservation thresholds and recreational potential

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Introduction

Although Turkey is not a member of the European Union, the city of Istanbul won the award of "2010 European Capital of Culture" and more importantly has become a mega city model of 21st century (Birch, 2011). Becoming a mega-city creates new opportunities but also carry new threats and risks.

The population of Turkey has shown an increase of 4.1 million in the last four years. In this process, Istanbul had the fastest growing population with a 8.5 % growth rate. Today, 18.2 % of Turkey's population lives in Istanbul (Turkstat, 2012). By transforming the city into a highly populated metropolitan area, open space requirements have also increased. Due to lack of open space, inhabitants of the city head towards the forests in order to meet their recreational demands. 47.7 % of Istanbul is covered by forests. According to the forest management plan of The General Directorate of Forestry, the total forest area of Istanbul is 257.451,4 ha. and 13817,79 ha. of these forest areas are classified as existing and proposed recreational areas.

In accordance with present-day planning studies and daily visitor numbers that are set by the Ministry of Environment and Forest, it is observed that existing forest recreation areas are being damaged. Elements of pressure on forest areas as growing population, legal regulations and inappropriate-unrestrained recreational use increase the requirement of new recreational planning models.

Within the scope of this study, the aim is to analyze Azizpasa Forest with regard to natural resource protection. The study also identifies factors that have positive and negative impacts on recreation potentials of the area and to determine carrying capacities and usage priorities of these areas.

Azizpasa Forest is *located geographically* in the region of Thrace (the European part of Istanbul). This forest is spread over a major parcel of land (7398.7 hectare) which is surrounded by the Alibeyköy Dam Basin and the Bosphorus. The geographical alignment of the research area is 45°60'23" – 45°51'47" north latitude and 40°42'44" – 41°82'45" east longtitude. Azizpasa Forest is one of the alternative areas to be opened for recreational use.

Method

In the first stage, "The Conservation Thresholds Method Intended for Recreation" is established for identification and assesment of Istanbul-Azizpasa Forest's restrictive natural resource values intended for recreation (water, soil and topografic structure). The main reason to use the "threshold" concept is the methodology identifies borders, limits and thresholds in land characteristics. (Pérez and Pérez, 2008). In the second stage, "Recreational Potential Analysis for Forest Lands in Urban Areas" is established for the determination and assesment of positive (vegetation and transportation) and negative (state of preservation, closeness to settlements and conservation areas) factors that affect recreational potential of the area. In the last stage, the outcomes of the first and second methods are compared. Distribution of areas are examined within different conservation threshold regions, as per the level of their recreational potential, From this analysis, priorities of the areas that will be open for use are determined. Depending upon the usage and conservation priorities, the usage density is selected and carrying capacity is calculated (figure 1). The synthesis of data relies on ArcGIS and Goal Programming (for calculating the carrying capacity) (Bekdemir, 2010).

Conservation thresholds method intended for recreation

Composed data sets such as water resources (surface water, dam lake and dam basin), land resources (soil, land use capability classes) and topography (slope analysis) were evaluated as part of existing constraints. All data in each of these data sets were transferred to the assessment matrix of conservation thresholds. By obtaining the experts' opinion and considering the main principles of environmental sustainability, a subjective scoring was done in the assesment matrix. All data were rated in 5 interval scale (less important to extremely strong importance).

The maps of mentioned data sets were overlayed using GIS and layer of total values was generated. A three-class Natural Breaks Classification method was applied to this new layer in order to determine the area's conservation thresholds. Depending on these threshold values, natural resource characteristics were categorized into 3 groups named as areas with extremely strong, strong and less importance (Bekdemir, 2010).

Recreational potential analysis for forest lands in urban areas

Three main data sets that affect recreational potential as positive factors (vegetation and transportation), negative factors (state of preservation, closeness to settlements and conservation areas) and conservation thresholds values were evaluated in this analysis.

These data sets contribution levels to Azizpasa Forest's recreational potential were processed in a subjective scoring matrix. Contribution levels were rated in 5 interval scale (having very low to very high recreational potential) on the basis of previous recreational potential studies.

All layers were overlayed by using GIS. Layer of total values was generated and with the help of three-class Natu-

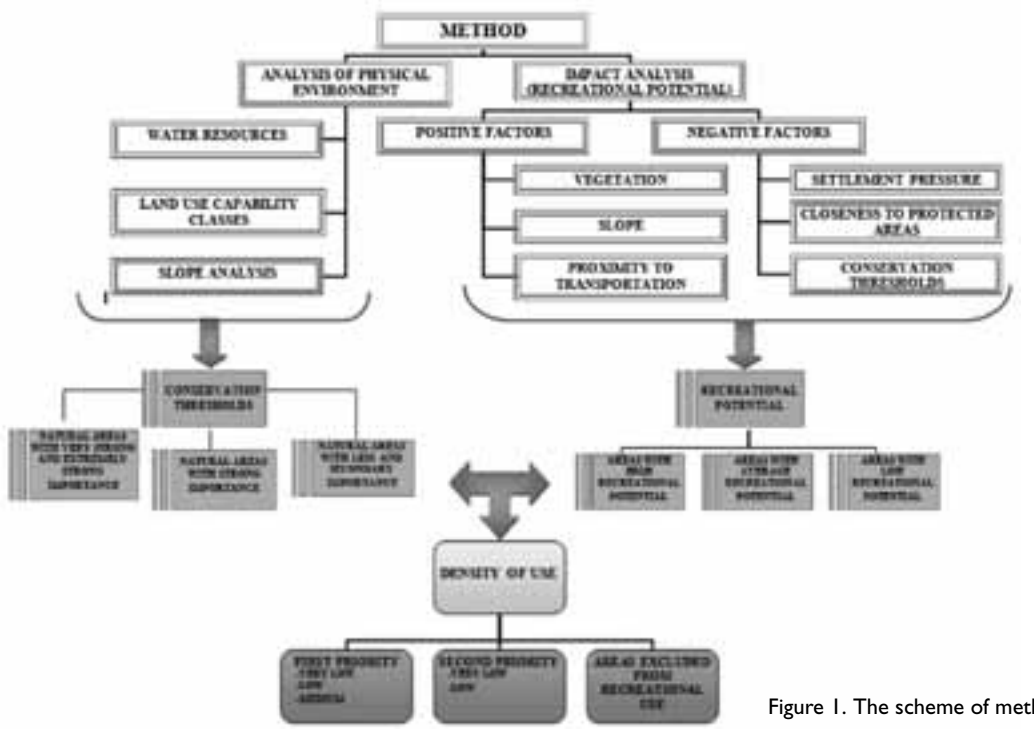

Figure 1. The scheme of method

ral Breaks classification method, forest area was categorized into 3 groups named as areas with low, average and high recreational potential (Bekdemir, 2010).

Resource based on carrying capacity method

Two new attribute classes named as THRESHOLD and REC_POTENTIAL were created on the synthesis layer of the Recreational Potential Analysis map (including the Conservation Threshold values) by using GIS. To identify the areas that can be opened for use and for calculating their carrying capacities, queries are done between these attribute classes.

Areas with high recreational potential have the first priority to be opened for use. But the intensity of use varies depending on the conservation thresholds of the area. Areas with average recreational potential will have the second priority to be opened for use. Areas with low recreational potential are excluded from recreational use. Spatial distribution and proportion of the areas are calculated by their recreational potential within each priority region.

Our first goal in this planning model is to maintain the forest resource and its' structure; to ensure the sustainability and long-term function by low-density recreational use. Therefore the objective function can be written as;

$$\text{Minimize } Z = d1+ + d2+ + d2- + d3-$$
$$4X1 + 50X2 - (d1+ - d1-) = VSNA * 4 * (\% N)$$
$$50Y1 + 300Y2 - (d2+ - d2-) = SNA * 50 * (\% N)$$
$$300Z - (d3+ - d3-) = LNA * 300 * (\% N)$$

VSNA: Area of planning in natural areas with extremely strong importance (ha.)
SNA: Area of planning in natural areas with strong importance (ha.)
LNA: Area of planning in areas with less and secondary importance (ha.)
% N: Distribution percentage of the planning area within the threshold region where it belongs.

Constraint values of our method's objective function were taken from the table of density of the use for recreational and nature-based activities according to Baud-Bovy and Lawson (2002).

Conclusion

In areas having first priority to be opened for use; carrying capacity for recreational areas stated by the Ministry of Environment and Forest should be reduced by %76.7 in natural areas with extremely strong importance and %75–%20 in natural areas with strong importance. It can be increased by %20 in natural areas with less and secondary importance. In areas having second priority it should be reduced by %75 in natural areas with extremely strong importance, % 84.5 in natural areas with strong importance and %75 in natural areas with less and secondary importance.

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