GSI JOURNALS SERIE A: ADVANCEMENTS IN TOURISM, RECREATION AND SPORTS SCIENCES

Volume: 2, Issue: 1, p. 122-136, 2019

VISITOR CARRYING CAPACITY FOR RECREATION TREKKING ROUTES IN PROTECTED SITES: ULUDAĞ NATIONAL PARK SAMPLE

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(Received 12.03.2019 Published 05.08.2019)

Abstract

This paper suggests an approach for calculating the visitor carrying capacity in protected sites with the example of Uludağ National Park (UNP) which is one of the major touristic and recreation destination in Turkey. First phase of the approach includes landscape character analysis and assessment work. Secondly, visitor carrying capacity calculation was carried on an ecological basis.

Bursa city was founded on the mountainside of Uludağ, with a height of 2543 m., which was declared as a national park in 1961. There are numerous projects with the aim developing touristic activities in Uludağ implemented by local and central administration in recent years. These projects have been initiated with the idea of opening UNP to use not only in winter, but throughout the year. Also there is a long term protection plan of the UNP with three different protection categories such as absolute protection zone, limited

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development zone and controlled development zone; and trekking routes are within the limited development zone area. The present study examines the use of one of the eight different trekking routes (***TG-2.Sarıçayır Peak - German Meadow Location- Çobankaya - Softaboğan Location***) defined in long term development plan. The result shows that real visitor carrying capacity of the studied trekking route is 38% less than actual physical carrying capacity due to the limitations indicated by the landscapes characteristics. It can be assumed that the studied 4.5 km trekking route is faced with landscape deterioration problems due to trekking activities in future, and requires landscape management and monitoring resolutions. This paper contributes that, the estimations for visitor carrying capacity should be based on landscape character analysis and assessment with the purpose of preventing ecological deteriorations in trekking routes used for recreation.

Keywords: Uludağ, Protection, Recreation, Trekking, Visitor Carrying Capacity

1. INTRODUCTION

Factors such as the emergence of phenomena of leisure time and vacation, as well as the facilitated travel to far lands in short amount of time and unstoppable increase of car ownership in the aftermath of industrial revolution paved the way to the concept of recreational use of natural landscape. Today, majority of the world live in urban spaces and the urban population increases rapidly (Wiskerke, 2015; Mumford, 2007; EEA, 2006). Recreation demand of ever-increasing urban population increases the recreational pressure on natural sites.

The study area is Bursa Province; established on the skirts of UNP, which has experienced a rapid urban population growth since 1970s (Moradi and Görer Tamer, 2017). This huge increase in the population also had an impact on the spread of urban spaces. The city is very close to biggest metropolitan and capital cities of Turkey; Istanbul and Ankara. The spatial plans, highways and similar big investments which will be made to the region involving Bursa in the upcoming years indicate that population increase tendency will continue. It is noted that the natural sites on the periphery of city are utilized more and more day by day.

UNP takes its name from Mountain Uludağ with a height of 2543 m. UNP has 12,762 ha field. It was proclaimed as a national park in 1961 and its first plans were drafted by experts from USA (Ministry of Environment and Forestry, 2018). The park also has a skiing site which was the first of its kind in Turkey. This quality of UNP; which has a significant role in the emergence of winter tourism movement, has also created a brand value and become an integral part of the city. UNP has served as a national skiing resort to big, metropolitan cities around it, but also has started to experience certain problems in time due to the launching of new ski resorts. National park has always attracted attention within the changing recreational expectations over the years; but it has been criticized for use over capacity.

In 2009, a long-term development plan aimed at the management of UNP in the use of conservation balance was made.

A long term development plan has been devised in 2009 aiming to manage protection and utilization balance of UNP. Purpose of Long Term Development Plan on 1/25.000 scale is to protect the natural and cultural resource values of UNP and ensure continuity of National Park as a source value by respecting use and utilization balance and considering the new demands of use besides existing ones to meet mandatory and basic needs of the visitors but only allowing limited and controlled use (Ministry of Environment and Forestry, 2009).

According to the Long Term Development Plan there are three different category of areas under protection as absolute protection zone, limited protection zone and controlled utilization zone.

Absolute protection zone covers 84% of the total national park area (10,830 ha). There are endemic plant vegetation and wild life zones which must be protected for sustainability of natural flora and fauna, forest zones with pure Uludağ Abies stands, forests with a slope of more than 40%, entire European larch zones sensitive to fire and glacier lakes.

Limited Use Zones covers areas that constitute integrity with the natural characteristics and ecological structure which is open to use on a limited level; they are also in natural connection with absolute protection zones and may act like a buffer zone. Forests zones outside the absolute protection areas, transitioning regions from absolute and controlled use areas (which are also not sensitive or under protection) are under the category of limited use zones. Limited use zones cover a land of 1732 ha which corresponds to 14% of total land.

Controlled use areas cover 2% of the National Park area (200 ha). These areas cover the lands where the human activities impacts are felt more in comparison with the areas of absolute and limited use; and tourism and recreational activities are maintained.

Many projects have been implemented recently with the aim of improving the touristic activities in Uludağ by central administration. There are also projects to encourage using UNP not only in winter, but in all seasons. There are utilities such as numerous picnicking areas, daily accommodation sites, trekking routes etc. New cable car lines and widened roads have tripled the annual number of visitors which used to be 500.000.

These utilizations are within the limited and controlled use zones in the national park. The great increase in the user intensity necessitated an assessment on the carrying capacity of this natural site. Recreational carrying capacity is identified on a selected route within the study and sustainable use suggestions are developed for the trekking routes in the national park.

2. STUDY AREA

UNP-Long Term Development Plan identifies eight trekking routes on the National Park (Ministry of Environment and Forestry, 2009). This route selected as the study area is the route number two in the plan (Figure 1). This route is defined as follows in UNP-LTDP.

"TG-2.Sarıçayır Peak – German Meadow Location– Çobankaya - Softaboğan Location: *This route starting from Sarıçayır Peak which lays between Sarıalan Camping and Daily Recreation Site and Kızpınarı location reaches Softabağı Location is approximately 4.5 km and is categorized in the very difficult degree. Çobankaya Camping and Daily Recreation Site, forestry and*

mountainous landscape are seen on the route. Access is only possible via a path and it is not possible to use any vehicles on this route.

National Park officials indicated that this TG2 route is heavily used by the users of the national park, and added a visitor carrying capacity study might be useful (Gencer 2018).

Observations from the field also reveal that this route passes from a camping and daily recreation site; and it is detected that this route has a high potential of representing the variables that have an impact on the carrying capacity. Thus, TG2 is selected as the example route."

According to the Landscape Character Types Map of Şahin et al (2011) demonstrated at Figure 2 the travel route crosses through five different landscape characters mentioned below in terms of climate, stone structure, geomorphological main unit and landscape design structure.

Figure 1. Study Area

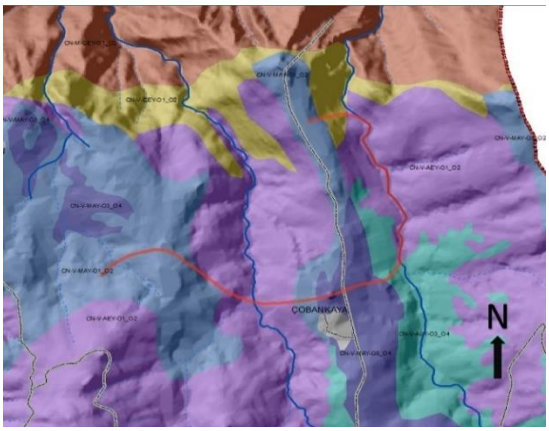

Figure 2. Landscape Character Types of the Study Area

3. METHOD

Carrying capacity analyses involves three important steps (Şahin et al, 2014): (1) Ecological Carrying Capacity, (2) Visitor Carrying Capacity and (3) Economical Carrying Capacity. This study covers the 2nd step. On the other hand, each step is the determiner of the next step. The data related to 1st step were previously realized by Şahin et al. (2011) and there were used in this study as they were. For biodiversity data, UNP-LTDP was used.

3.1. Ecological Carrying Capacity

Ecological carrying capacity, was identified with Landscape Analysis and Assessment carried out previously by Şahin et al (2011). Ecological carrying capacity is considered as the limiting factor in visitor physical carrying capacity calculations (Şahin et al, 2014). In this

calculations landscape function analysis in Figure 3 identified by Şahin et al (2011) (erosion risk, water permeability, surface flow potential, visual landscape value and landscapes with protection value) were taken into consideration.

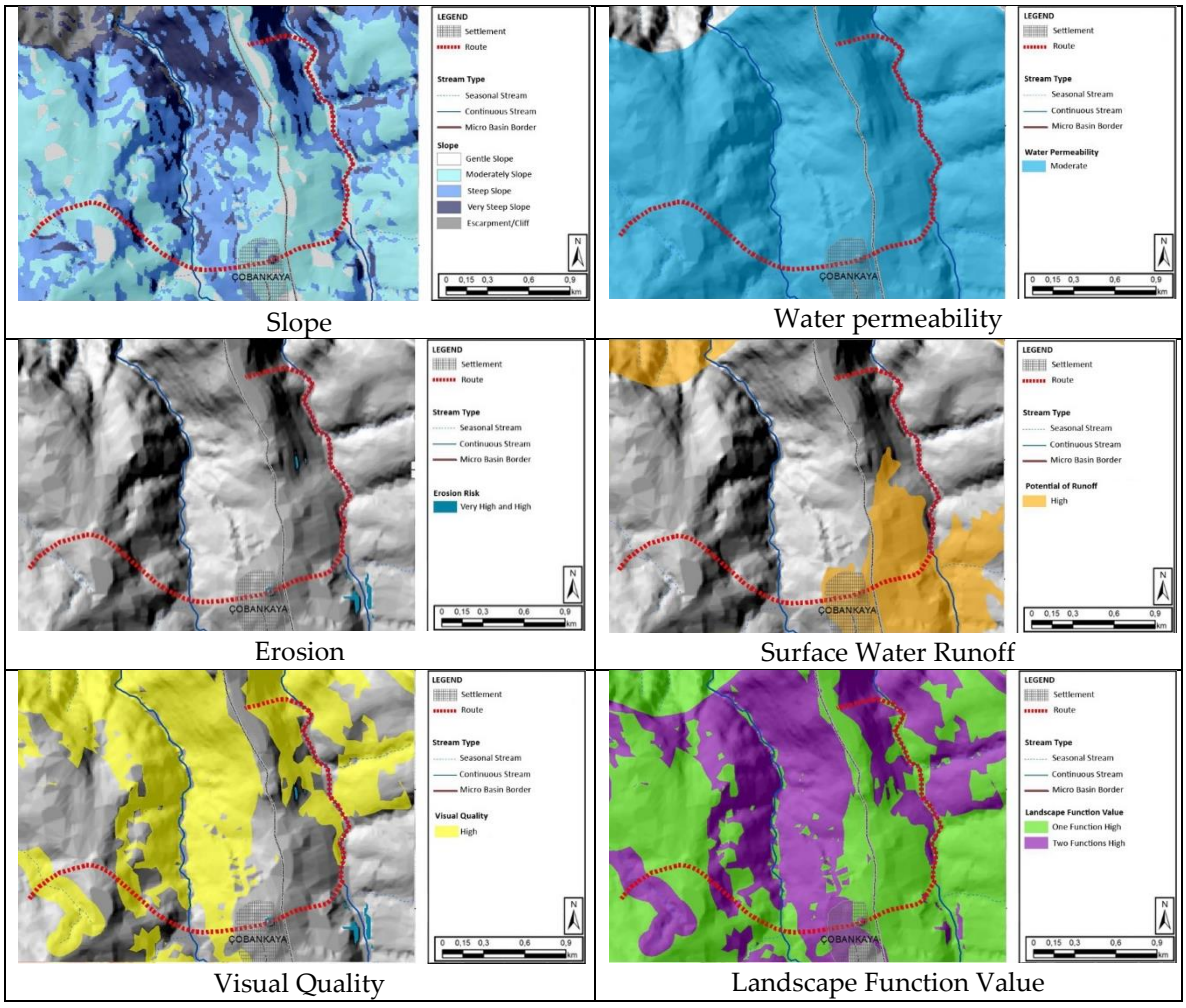

Figure 3. Landscape functions (Şahin et al 2011)

3.2. Visitor Carrying Capacity

The following considerations were taken into account in the visitor carrying capacity calculations (adapted from, Şahin et al, 2014).

1. Calculations are made for weekend use.
2. It is assumed that the conditions that meet infrastructure, personnel and equipment requirements affect visitor satisfaction.

3. It is assumed that the use of visitors will cover a total of 8 hours between 10.00 and 18.00 hours.
4. Trekking tours are planned with the guide.
5. The average walking speed of a person (5 km/h) and the stopping times for observation purposes were taken into account in the calculation of the walking times. These periods also include the time for groups to come together and act as guide.
6. The walkway is not suitable during all seasons due to the climatic conditions. It is assumed that there will be no walk on snowy and frosty days. According to these conditions, when the climate data is examined, 5 months usage between May-September is foreseen.

In the calculation of visitor carrying capacity in the project area Cabellos (1992)'s "Tourism, Ecotourism and Protected Areas" book was used. This book is one of the series published by the IUCN and it was published following the 'IV. World Congress on National Parks and Protected Areas' which was held in 1992 in Caracas, Venezuela. Numerous works and papers presented in two tourism related workshops that were held during the above-mentioned Congress were used in the preparation of the Book. The 10th Annex of the book is titled "Method for Calculating the Carrying Capacity in Protected Areas" and it constituted the basis of the project carrying capacity analyses mentioned below. Cabellos (1992) used Cifuentes (1992) while elaborating this part.

First of all, the following three carrying capacity levels were calculated (Cifuentes, 1992; Cabellos, 1996; Bera et al, 2015).

1. Physical Carrying Capacity (PCC)
2. Real Carrying Capacity (RCC)
3. Effective or Permissible Carrying Capacity (ECC)

PCC is always bigger than RCC. RCC is either greater than or equal to ECC.

(PCC> RCC and RCC≥ECC)

3.2.1. Physical Carrying Capacity (PCC)

The maximum number of visitors that can be physically located in a certain place and within a certain period of time is defined as PCC. PCC is calculated according to the following equation.

$$PCC = A \times V/a \times Rf \quad (1)$$

PCC: Physical Carrying Capacity

A: Available area for public use

V/a: Area required per user (1 m²)

Rf: Open period / Average time of one visit

To measure PCC, the following basic considerations should be considered:

- Generally, a space of at least 1 m² is required for a person to move freely.
- In calculating the value A, it is necessary to take into consideration the spatial constraints (rocky area, precision, etc.) in the area. A line size is the limiting factor for the trip or tours, the number of groups and the distance between the groups.
- The rotation factor (Rf) is the number of permissible visits per day and can be calculated by the following equation.

Rf= (open time for visit)/(average time required for a visit)

The basic information and criteria for the physical carrying capacity calculation are given below:

- The visitor entry can also be from either beginning of the route. Access to the starting points is planned using the existing roads. The carrying capacity calculation was made for one direction. For two directions calculation, the number found will be doubled.
- A length of 1 m is required for each person on the route.
- The walkway is at least 1.2 m wide as the route cross section. In this case, each visitor will occupy 1.2 m² area.
- The minimum distance between tour groups is estimated to be 50 m (Ceballos Lascurain H, 1992).
- The maximum number of people in each group is 20 people.
- When observations and rest intervals are added, the average walking time is 2 hours and 45 minutes.
- The area is open 8 hours a day (10:00 - 18:00)
- The average length of the sightseeing line is approximately 4500 m.

20 meters long trip line will be needed for 20 visitors. When a distance of 50 m is planned between groups, 65 groups can be found on the same route.

(65 × 20) + (64 × 50) = 4500 m (total route distance)

These 65 groups will occupy a total of 1560 m² (65x20x1,2=1560 m²) of sightseeing area while they are on the same route.

A person can visit this area 2,91 times a day (8/2,75) since the sightseeing line is open 8 hours and each visit lasts 2 hours and 45 minutes (total 2,75 hours).

PCC = A × V/a × Rf

PCC=1560 m^2x1/1,2m^2x2,91

PCC=3783 daily visitors

3.2.2. Real Carrying Capacity

The real carrying capacity (RCC) is the maximum number of visitors obtained by applying the correction factor determined by taking into account the landscape character of the area to the PCC value. These correction factors include; physical, environmental, ecological, social and managerial variables of the area. Maps elaborated during the process of Landscape Character Analysis and Assessment (especially assessments made through the function analysis of landscape) must be used here.

The RCC value can be expressed by the following equation.

$$RCC = PCC\text{-}Cf_1\text{-}\ Cf_2\text{-}...\ Cf_n \quad (2)$$

C is the correction factor expressed as a percentage. In this context, RCC equation can be expressed as follows.

$$RCC=PCC \times(100\text{-}Cf\_1)/100 \times (100\text{-}Cf\_2)/100 \times (100\text{-}Cf\_n)/100 \quad (3)$$

Correction factor can be calculated as a percentage by the following equation.

$$Cf=M\_1/M\_t \times 100 \quad (4)$$

M_1 = limiting magnitude of variable

M_t = total magnitude of variable

Correction factor analysis is given below. Correction factors related to landscape function analyzes as ecological constraints are taken into account in the analysis of carrying capacity. For climate data Türkeş and Öztürk (2008) and Öztürk (2010) were used.

Extreme Sun Correction Factor

In the study area, the walking route is in the dense and very dense range of the vegetation cover level (Özsoy, 2009). Therefore, since there is no extreme sunny day, this factor did not participate in the calculation.

Foggy Days Correction Factor

M_1 = 28,5 foggy days (Between May-September, 5 months)

M_t= 150 total days in a five month period (30x5)

Cf_fd= (28,5×100)/(150)=**% 19**

Snow-Covered Days Correction Factor

M_1 = 15,1 snow-covered days (Between May-September, 5 months)

M_t = 150 total days in a five month period (30x5)

Cf_scd= (15,1×100)/(150)=**% 10**

Snowy Days Correction Factor

M_1 = 2,9 snowy days (Between May-September, 5 months)

M_t = 150 total days in a five month period (30x5)

Cf_sd= (2,9×100)/(150)=**% 1,9**

Wildlife Threat Correction Factor

The study area is the habitat of the Apollo Butterfly (*Parnassius apollo* L.) and the Bearded Vulture (*Gypaetus barbatus* L.) (Figure 4)

The bearded vulture is laying in March. For this reason, it was assumed that during the route visit there would be no disturbance of these raptor birds.

The Apollo butterfly begins to appear in the field at the end of June and at the beginning of July. So July and August were taken as protection period (Kovancı et al, 1999).

M_1 = 60 wildlife threat days (Between May-September, 5 months)

M_t = 150 total days in a five month period (30x5)

Cf_wt= (60×100)/(150)=**% 40**

Figure 4. Left: Apollo Butterfly (*Parnassius Apollo* L.) and Right: Bearded Vulture (*Gypaetus barbatus* L.)

Temporary Closed Days Correction Factor

It is assumed that the project area can be used for maintenance purposes for up to 2 weeks per year.

M_1 = 14 temporary closed days (Between May-September , 5 months)

M_t = 150 total days in a five month period (30x5)

Cf_tcd= (14×100)/(150)=**% 9,3**

A summary of the different correction factors is given below:

Foggy Days Correction Factor: %19

Snow-Covered Days Correction Factor: %10

Snowy Days Correction Factor: %1,9

Wildlife Threat Correction Factor: %40

Temporary Closed Days Correction Factor: %9,3

The equation used in the calculation of RTK values is as follows

RCC=PCC ×(100-Cf_fd)/100 × (100-Cf_scd)/100 × (100-Cf_sd)/100×(100-Cf_tcd)/100×(100-Cf_wt)/100

RCC=PCC ×(100-19)/100 × (100-10)/100 × (100-1,9)/100×(100-9,3)/100×(100-40)/100

RCC=PCC ×0,81 × 0,9 × 0,981×0,907×0,6

RCC=PCC ×0,39

RCC=3783 ×0,39

RCC=1475,37

The number of persons identified is for one-way trekking route. Considering the fact that the trekking route is two-way, visitor the carrying capacity of the trekking route is **2950 people.**

4. RESULT AND CONCLUSION

In long term development plan, there are provisions related to the obligation of calculating the carrying capacity of trekking routes and to the essentiality of preserving the natural structure during activities to be carried out on trekking routes. By taking into account this legal basis, calculation of carrying capacities of all national parks and updating them periodically will allow sustainable use of national park values.

The visitor perceptions positioned Uludağ with its tourism superstructure means and entertainment opportunities (Evren & Kozak, 2018). Actually, the total visitor of the studies

destination is 800.000 person, of which %35 is winter visitor, %50 is summer visitor, and, %15 is spring visitor (Ministry of Environment and Forestry, 2009). When those numbers are taken into account, demand for trekking routes might be higher in future. Nevertheless, research shows that the trekking routes has a very low carrying capacity. We can conclude from this fact that if the nature management does not take the carrying capacities into account, the expected tourism income might be et the expected level at first but in the long run it will create problems due to nature deterioration and tourism income will drop.

On the other hand the ecological carrying capacity is higher if the management authority or customer makes efforts to save the soil, as well as habitats on trails when trekking other recreational activities over sensitive landscape (Manning, 2002). So that, landscape management efforts must be well prepared and monitored with respect to predefined performance indicators both for nature protection as well as visitor satisfaction.

The visitor carrying capacity estimation of this paper is lacking the social carrying capacity estimations which can make even more decreased the acceptable visitor number. There are a large number of researches on the social carrying capacity of tourists regions, in particular for protected natural areas, in which the best known is Shelby and Heberlein's study (1984). The crowding (encounter) norms among the indicators used for social carrying capacity, describing what is the visitor number could be acceptable to encounter in certain area of trekking route are often applied to protected areas (Vaske et al, 2016, Bingül, et al, 2017).

Even though trekking might seem like a harmless recreational activity, in case they surpass the optimum level, many risks can emerge. In case of surpassing the usage capacity, first there are changes in the structure of the earth due to pressure and treading. Also, due to stamping effect, there are negative changes in the vegetation characteristics. When we consider these negative developments together with the vital rituals of the fauna, wildlife can also be negatively affected by the trekking activities. A busy trekking route has negative psychological effects on users and undermines user satisfaction. Visitor management with carrying capacity analysis can help to produce better vision for the future of the target areas.

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