

Recreation Carrying Capacity Estimations to Support Forest Park Management (Case Study: Telar Forest Park, Ghaemshahr, Iran)

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Abstract: Expanding recreational use of forest parks can strongly effect on natural resources and the quality of visitor experience. Deciding how much recreational use can extremely be adjusted in a park is stated by the concept of Carrying Capacity. Evaluation of Carrying Capacity as a management tool for forest park management in the North of Iran was presented in this study. Four factor including tourist flows, the size of the area, the optimum space available for each tourist and the visiting time were employed for evaluating physical Carrying Capacity. Results showed that the physical carrying capacity should be 54.8 ha 320visitors/day and real carrying capacity should be 31.6 ha 177 visitors/day. When total visitors to the park in 2012 were 220 visitors per day that actual average park visitation are higher than the estimated Carrying Capacity. The expanding recreational use would also unfriendly affect production and other forest benefits in long term. Therefore this study suggests that a recreational forest use plan must be adjusted by the planner to keep the park from heavy use and also optimum number of people without an unacceptable change in physical environment (Carrying Capacity) can be applied for ecosystem management, keeping of the high quality and quantitative of forest park and securing the ecological benefits stable for future.

Key words: Recreation • Forest park management • Carrying Capacity • Telar • Ghaemshahr • Iran

INTRODUCTION

Forest parks are resources of national and international significance that contains great importance to the nation community. The Telar forest park now adapts nearly 80000 visits annually. One of the most threats to forest parks is crowded and this decreases from the quality of experience. Also, natural resources could be degraded by extreme visitor use. In more formal conditions, utilize of around forest parks have exceeded their Carrying Capacity [1-6]. Carrying Capacity was first suggested in the 1930s as a park management concept in the context of national parks [5], even if systematic application did not happen until the 1960s. The initial focus was on ecological issues and it came from population growth theory by ecologists as an upper limit

of maximum population from of an individual species which can be kept without any unacceptable change of ecosystem Lee *et al.* [7]. Munar [2] suggest that the Carrying Capacity provides the optimum level on which resources can damage to the ecosystems are irreversible, providing a mathematical formula of how many tourists are enough. Mexa and Coccossis [8] showed that Carrying Capacity assessment remains a powerful concept that can be used for planning and management of sustainable tourism. Many studies calculated Carrying Capacity using physical, ecological, psychological and economical approach [9,10]. Because of expanding of degree of environmental treat with growing tourism, sustainable method need to carry out and Carrying Capacity stay one of the applied and affective method Zacarias *et al.* [11]. Later, social view of

Carrying Capacity issue as environmental resources were not the only resource traits that were influenced by recreational use. These social views were based on theory that expanding numbers of people make huge social impacts [12]. Thus, Carrying Capacity has two elements: environmental capacity and social capacity [3,4,13-15].

The aim of this research is to calculate recreational carrying capacity as a tool for forest park management in North of Iran, based on the Carrying Capacity assessment for protected areas framework introduced by Cifuentes [16]. This framework attempt to establish the maximum number of visits who can use a forest park without an unacceptable change in the physical condition. Therefore, this study implemented to establish a balance between number of visits and potential limit of current condition in Telar forest park and focused on physical Carrying Capacity.

MATERIALS AND METHODS

Research Method

Study Area: This research was conducted at Telar forest park, located in the south western of GHAEM SHAHR in north of Iran and thus lying between the latitudes $21^{\circ} 23' 36''$ and $30^{\circ} 24' 36''$ North of the Equator and between the longitudes $58^{\circ} 49' 52''$ and $11^{\circ} 50' 52''$ east of the Meridian

of Greenwich (Fig.1) It has total area of 160 hectare and 180.6 m above the sea level. The study area has broad popularity as recreational destination for people that consist of particular diversity deciduous species, close to main road with public access, Permanent River, fishery resources and beautiful landscape. Forest covers large areas in this park with 80% of the surface and plays an important role in the area and 20% taken up by shrub and herbaceous vegetation association. Telar forest park has a population of more than 10000 inhabitants within the borders of the park, the population within a distance of 50 km from the park comprises 70000.

Carrying Capacity: The concept of recreational carrying capacity has been around since the 1930s [5]. The concept has been both the subject of academic studies and the basis for management decisions. In this study Carrying Capacity is the maximum number of people who can use a forest park with optimized enjoyment to visitors without undergoing deterioration. The Carrying Capacity method proposed here was Carrying Capacity evaluation for protected area framework. Physical, real Carrying Capacity was evaluated by using Countess's methodology [16]. Which was suggested by IUCN. This framework considering main levels: the physical Carrying Capacity (the maximum number of visits that can physically fit into a defined site, over a particular time)

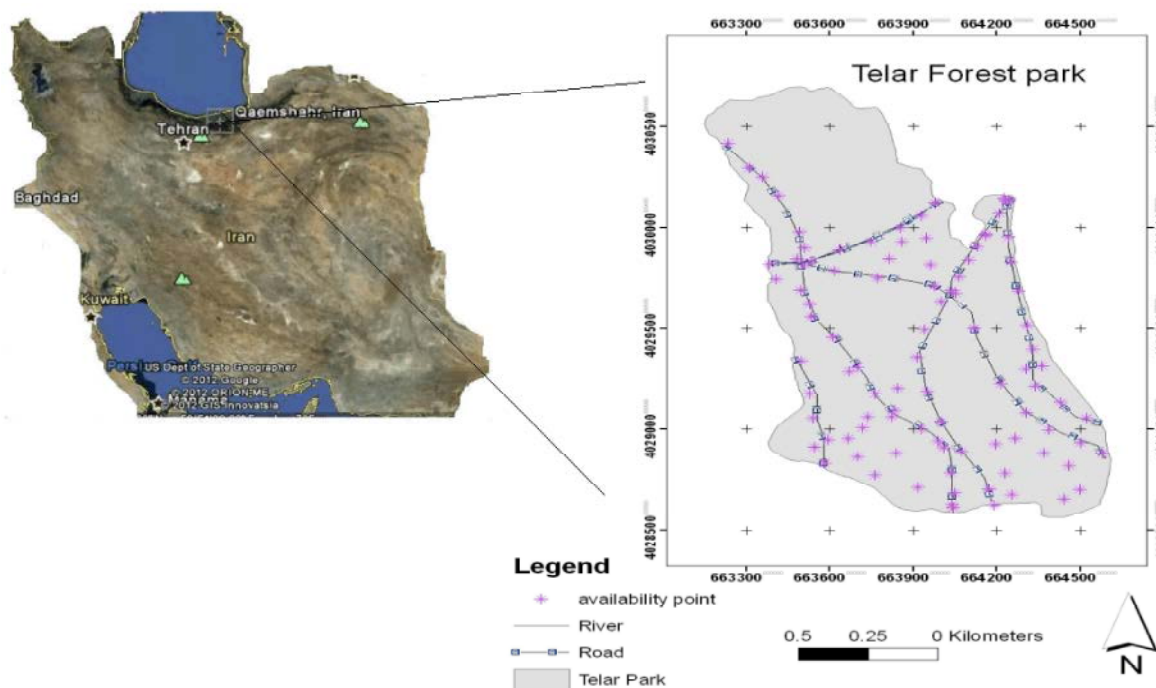


Fig. 1: Case Study

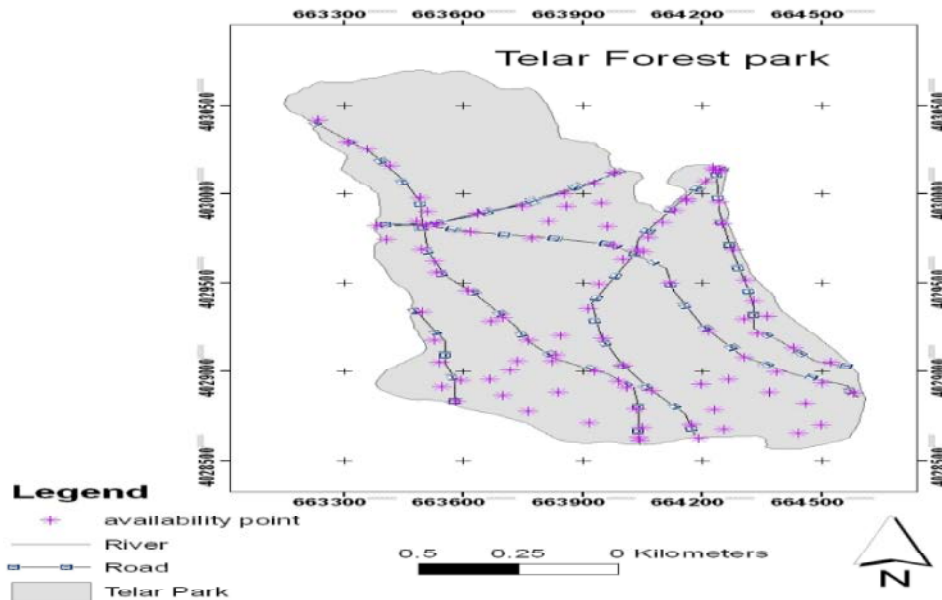


Fig. 2: Global Positioning System coordinates on the site and road

and the real Carrying Capacity (the maximum permissible number of visits to the site, once the corrective factor derived from the particular characteristics of the site have been applied to the PCC) [16]. In this method, factors used to calculate capacity including tourist flows, the size of the area, the optimum space available for each tourists to move freely and the visiting time [16]. Trace data were gathered by Global positioning system (GPS) receivers more than 200 GPS coordinates (including attractions on site and the road) were taken and shifted on to the digital map which was depicted using Arc GIS 9.2 software on a 1:25000 scaled topographical base map (Fig 2).

This study determined the physical carrying capacity and real Carrying Capacity to Telar forest park based on the capacity calculation equation 1, 2 and 3.

$$PCC = A / A_u \times R_f \tag{1}$$

Equation 1, where PCC is the physical Carrying Capacity, A is available area for public use, A_u is the area required per user and R_f is the number of permissible daily visits to a forest park. The real Carrying Capacity was determined using Equation 2.

$$RCC = PCC \times (C_{f1} \times C_{f2} \times C_{f3} \times \dots \times C_{fn}) \tag{2}$$

Equation 2, where RCC is the real Carrying Capacity, PCC is the physical Carrying Capacity and $C_{f1} \dots C_{fn}$ are the correction factors, determined using the Equation 3.

$$C_{fx} = 1 - L_{mx} / T_{mx} \tag{3}$$

Equation 3, where C_{fx} is the correction factor of variable X, L_{mx} is the limiting magnitude of variable X and T_{mx} is the total magnitude of variable X [11]. Based on visits are dependent on environmental condition, three correction factors were considered for this study: Rainfall, strong winds and frost. Data for three factors was obtained from Ghaemshahr meteorological organization and the calculations are showed below:

Rainfall: The limiting magnitude of this factor was 120 days/year (120 days with high rain pattern) and the total magnitude was 365 days. Thus, rainfall corrective factor was 0.64 (64%). Strong winds: The limiting factor was 7 days/year and the total magnitude was 365 days and the corrective factor was calculated as 0.98 (98%). Frost: Frost 27 days/year was excessive frost as limiting magnitude and the total magnitude was all days of the year. 0.92 (92%) were excessive frost corrective factor.

RESULTS AND DISCUSSION

Physical Carrying Capacity: Because of expanding in forest park recreational use and control recreational use to hamper ruin of environmental area mid visits enjoyment, managers are greatly considered. Also because of more than 20 species of plant have been reported in Telar forest park including *Parotia persica*, *Quercus castanifolia*,

Crataegus Crataegus embigua, *Punica granatum* on the medicinal trees list of species as well as many specially birds and national obligation related to conservation of species in forest park, thus a new management system like Carrying Capacity assessment is necessary. In order to recreational use have potential for damage to the area, the amount of visits that a forest park can absorb without negative effect is determined by the Physical Carrying Capacity.

Results show that Telar forest park covers 160 hectare, with tourist moves focused in summer season. Based on the area of the park, optimum area available per user (16.5 m² considering Lee *et al.* [7] and Physical Carrying Capacity was 54.8 ha, 320 visits/day. This capacity indicates the maximum number of visits at the Forest Park can apply visits' enjoyment without detriment to ecosystem. Based on correction factors and utilization of Equation 2 and 3, the real Carrying Capacity was 31.6 ha, 177visits/day. Total visitors to the park in 2012 were 220 visitors per day that actual average park visitation are higher than the estimated Carrying Capacity and until now no precaution was taken to decrease the number of visitors coming to the park. Maybe, a quota system that would only allow a absolute number of daily visits to the site maybe develop to protect the area from heavy use [12]. In practice there is a risk of Carrying Capacity overload especially in the spring and summer seasons and forest park management and preserve without detriment is important. The Physical Carrying Capacity use for forest park management and decrease affect from visits. Application of Physical Carrying Capacity found the number of people at one time in the Telar forest park to be a significant indicator of quality and research achieving produced a basis for scoping a suitable standard of quality at this area. This study calculated Capacity based on tourist flows, the size of the area, the optimum space available for each tourist and visiting time [1-9, 11-16]. Some management operations such as Carrying Capacity and Allocation Park that only allow a specific number of daily visits to the park could be protected park from heavy use. Although Carrying Capacity estimated but to manage the visitor flow, zoning park and allocating partial of park to nature reserve, recreation and the rest for economic zone is requirement. In relation to an expected increase of visitors (in the vicinity of the Babol-Ghaemshahr main road) several recreational activities (walking, visit parking, bicycling, fishing, education and picnic) are located together and in general all over the park the necessary visit infrastructure (parking places, toilet facilities, waste treatment, etc) need to develop in capacity. In study of

Telar forest park it has been found that natural splendour ancient *Quercus castanifolia*, high value *Gleditschia caspica* and river plays an important role on the visitor's attraction and establish appropriate capacity for recreation opportunity can be an especially useful source of information to manager.

CONCLUSION

Preservation the natural characteristic of each use site, increase user's capability to move freely and to fully enjoy the natural environment without spoiling it, through preventing overcrowding are most fundamental instance in all of environmental management. Because of parks have always been popular sections of the public use. Now in several parks, the number of visitors looking for outdoor recreation exceeds the space allocation of the public use site and more of forest park in Iran have a large concentrations of people during the holiday and summer months thus Carrying Capacity as a new management system could be establish and preserve users' experience by limitation on the number of visitors to utilize each area to at a given time. Because of visits expanding, grade of environmental danger is also increasing and sustainable method requirement to be applied to avoid dealing with the overcrowding at forest park. Between multiple methods, Carrying Capacity assessment stays one of the beneficial and applied methods to ensure the protection of the area. Also, the equilibrium between safeties of the natural resources, quality of visitor experience and economic stability can be appointed using Carrying Capacity. This study has addressed how this method applies to parks and protected areas, with special attention to the Telar forest park. At Telar forest park, Physical Carrying Capacity is 54.8 ha 320 visits/day. Visits flow focused during summer season and favor 16.5 m distance between visits. Methods utilized in this study are proper for the physical ranges of Carrying Capacity and is the first management forest park based on Carrying Capacity method in Iran and for better management of forest park, expanding the number of studies on Carrying Capacity is needed. Also this study may produce conduct for future applications of Carrying Capacity. More pragmatic Capacity Calculation and identify level of effect on forest park will maintain, need to be taken socio-environmental factors, other framework including upper limits of acceptance. Also study can concentrate on the subject about intensive recreation may increase soil bulk density and decrease the capacity of soil to do its major ecological functions. The research has found that

the current management structure for the Telar forest park is weak and need of improvement and accommodates visitors and park capacity before major problem develop. The major theoretical contribution of this research is an attempt to develop tool for management to access and improve capability to recreational areas. This new tool is an example of how theoretical concept and ideas can be expanded and how research can benefit management of outdoor recreational resources. It is the hope of the researcher that this framework made serve as a resource for future management Telar forest park and other similar outdoor recreational areas.

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