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# Determination of The Physical Carrying Capacity of The Günpınar Waterfall Nature Park in Malatya Province

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**Abstract**

*In determining the physical carrying capacity of Günpınar Waterfall Nature Park; initially, a survey was conducted to ask visitors how many hours they spend in the area on average. The physical carrying capacities of the Controlled Use Zones of the Nature Park, the Landscape Viewing Terrace, and the walking paths and stairs within the nature park have been calculated. According to the findings, the Physical Carrying Capacity for Controlled Use Area-1 is 319 visitors/day, for Controlled Use Area-2 is 469 visitors/day, and the total is 788 visitors/day. The physical carrying capacity for the Landscape Viewing Terrace is 26 people, for Walking Paths is 760 people, and for Stairs is 66 people. Considering the balance between conservation and use, and considering the quality of recreation in the area, solution proposals have been presented for Günpınar Waterfall Nature Park.*

***Keywords:*** *Recreation, nature park, carrying capacity, physical carrying capacity.*

# Malatya İli Günpınar Şelalesi Tabiat Parkının Fiziksel Taşıma Kapasitesinin Belirlenmesi

**Öz**

*Günpınar Şelalesi Tabiat Parkı'nın fiziksel taşıma kapasitesi hesaplanırken; öncelikle ziyaretçilere anket çalışması uygulanarak alanda ortalama kaç saat süre harcadıkları sorulmuştur. Tabiat Parkı'nın Kontrollü Kullanım Bölgeleri'nin, Manzara Seyir Terasının ve tabiat parkı içerisindeki yürüyüş yolları ve merdivenlerin fiziksel taşıma kapasiteleri hesaplanmıştır. Elde edilen bulgulara göre, Kontrollü Kullanım Alanı-1 için Fiziksel Taşıma Kapasitesi 319 ziyaretçi/gün, Kontrollü Kullanım Alanı-2 için fiziksel taşıma kapasitei-2 469 ziyaretçi/gün ve toplam da 788 ziyaretçi/gün olarak hesaplanmıştır. Manzara Seyir Terası için fiziksel taşıma kapasitesi 26 kişi, Yürüyüş Yolları için fiziksel taşıma kapasitesi 760 kişi ve Merdivenler için fiziksel taşıma kapasitesi 66 kişi olarak hesaplanmıştır. Koruma-kullanma dengesine dikkat edilerek ve alandaki rekreasyon kalitesi göz önünde bulundurularak Günpınar Şelalesi Tabiat Parkı için çözüm önerileri sunulmuştur.*

***Anahtar kelimeler:*** *Rekreasyon, tabiat parkı, taşıma kapasitesi, fiziksel taşıma kapasitesi.*

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## 1. Introduction

Rapid industrialization and increasing urbanization have led to negative changes in both the society's own life dynamics and the physical environment they inhabit, directing individuals towards activities where they can be motivated and rejuvenate their energy. Recreation refers to the activity's individuals engage in to temporarily escape the pace of daily life and contribute positively to their physical and mental health (Mansuroğlu, 2002; Can, 2015; Koçak, 2023).

Recreation should be considered not only as an activity that individuals enjoy in their leisure time but also as a concept that contributes to the economic potential of society and represents a significant area of responsibility for governments. Furthermore, it should be regarded as a field that offers employment opportunities for the local population depending on their geographical location. In this context, the importance of recreation in terms of strategic planning, management, and sustainability becomes prominent (Bakır, 1990; Kaplan, 2019).

The concept of 'Carrying Capacity,' frequently used today, was initially employed in the maritime transportation industry to denote the load a ship could carry. The application of this concept in the natural sciences began with Malthus's work on the population principle, dating back approximately 200 years from today (Yılmaz, Yılmaz & Demircioğlu Yıldız, 2003). The concept of carrying capacity, which started to be used in natural areas following studies by Hadwen & Palmer in 1922 for pasture management, is not limited to these fields but is also employed in disciplines focused on recreation and tourism (McCool & Lime, 2001; Clarke, 2002; Göktuğ et al., 2017).

Carrying capacity refers to the number of people that can be present in the same tourist space at the same time without causing damage to the physical, economic, and socio-cultural values of the area, and without causing a decrease in visitor satisfaction levels that would lead to concern (Vujko et al., 2017; Suana et al., 2020).

Recreational carrying capacity is a concept aimed at determining the optimum number of visitors for activities conducted in natural areas, protected areas, or national parks. This concept, which includes ecological, physical, social, and managerial dimensions, aims to enhance the sustainability of biological and physical resources and the quality of visitors' recreational experience by accurately determining the carrying capacity of the used areas. Therefore, recreational carrying capacity is considered an important tool for providing suitable conditions and opportunities for recreation (Sayan & Ortaçeşme, 2005; Göktuğ, Bulut, Demircioğlu Yıldız & Demir, 2011).

Recreational carrying capacity is generally examined under four main headings: physical carrying capacity, social carrying capacity, ecological carrying capacity, and management capacity. Physical carrying capacity refers to the threshold beyond which a destination's natural and cultural values may be damaged due to intensive use (Rüzgar, Koçak & Demir, 2022). The physical carrying capacity of a destination is determined through the analysis of environmental components such as the amount of water, availability of water, presence of air pollution sources, etc., and the analysis of existing facilities required for visitors and local users (Castellani, Sala & Pitea, 2007).

Exceeding the physical carrying capacity limit can be exemplified by the deterioration of textures in historical structures, the inadequacy and neglect of roads, parking lots becoming unable to accommodate vehicles, and the difficulties experienced at intersections. From these statements, it is observed that the concept of physical carrying capacity encompasses the maximum number of visitors that can be hosted within the physical limits of a destination used for recreational purposes, as well as the degradation resulting from the use of facilities, infrastructure, and systems intended for service in the destination (Ceballos-Lascuráin, 1996; Cifuentes, 1992; Erdemir, 2018).

The purpose of this study is to determine the physical carrying capacity of Günpınar Waterfall Nature Park, which is located within the boundaries of Darende District in Malatya Province and was granted the status of a Nature Park on 26.06.2018 due to its natural resource values and recreational potential. The conscious use and management of protected areas, whose importance is increasing day by day in our developing world, are of great significance both for the living standards of the current era and for

the assurance of future generations' quality of life. This study aims to foster individual and societal awareness of protected areas.

## 2. Material and Method

The material for this study is Günpınar Waterfall Nature Park, located within the boundaries of Darende District in Malatya Province. Geographically, it lies between 38°33'35"-38°32'34" north latitude and 37°24'16"-37°25'8" east longitude. Günpınar Waterfall Nature Park was designated as a Nature Park on 26.06.2018 due to its natural resource values and recreational potential. The Development Plan prepared by the General Directorate of Nature Conservation and National Parks (GDNCN) in 2019 was examined, and based on this plan, the physical carrying capacity was calculated within the boundaries defined as the 'Controlled Use Zone' of the Nature Park. The geographical location of the area is presented in Figure 1 (Koçak, 2023).

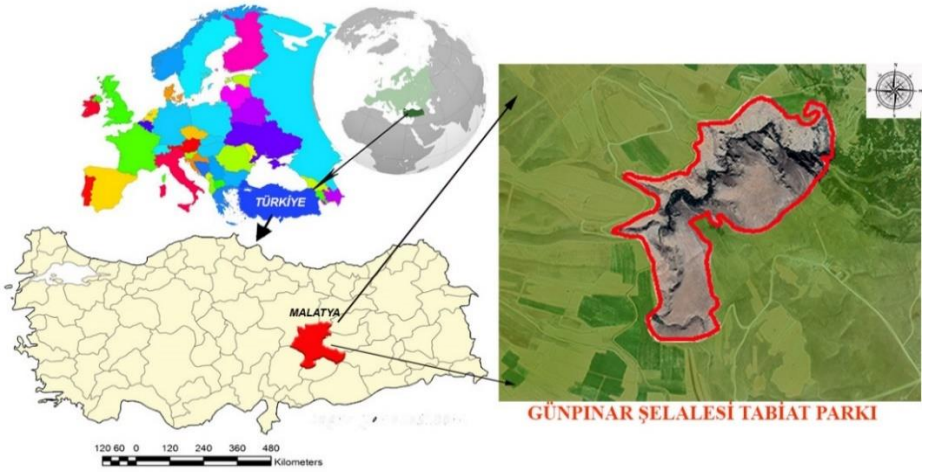


**Figure 1.** Günpınar Waterfall Nature Park Location Map (Original and created by the authors)

Günpınar Waterfall Nature Park covers an area of 135.20 hectares and was declared a Nature Park by the former Ministry of Forestry and Water Affairs due to its natural resource values and recreational potential, as per the Official Decree numbered 1312 on June 26, 2018 (DKMP, 2019).

The Nature Park does not contain any private property or pasture land; it is entirely state forest status and is under the responsibility of the Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks, XV. Regional Directorate, Malatya Branch Office. The Nature Park, located approximately 8 km west of Darende District, is situated on the right side of the 4th kilometer of the Elbistan-Darende road, which diverges westward from the D300 highway that passes through the district center (Türkoğlu & Demir, 2020; Koçak, 2023).

Günpınar Waterfall Nature Park, named after the waterfall within its boundaries, encompasses three distinct ecosystems: aquatic, rocky, and terrestrial. Due to the dynamic topography of the region, the highest point of the Nature Park reaches an elevation of 1,506 meters, while the lowest point is at 1,240 meters, with an average elevation of 1,408 meters (Karakaş, 2009; Şahin, Vural & Varol, 2012). To ensure the protection of its resource values, to allow the use of the area while maintaining a conservation-utilization balance, and to effectively transmit its natural values to future generations, a Development Plan (Table 1) has been prepared by the GDNCN.

**Table 1.** Spatial Distribution of Usage Zones According to the Development Plan (DKMP, 2019)

| Protection-Use Zone | Area (ha) | Percentage (%) |
|---|---|---|
| Sensitive Protection Zone | 5,48 | 4,05 |
| Sustainable Use Zone | 128,14 | 94,78 |
| Controlled Use Zone | 1,58 | 1,17 |
| **Total** | **135,20** | **100,00** |

In the Development Plan, the boundaries of the area have been determined by considering the conservation-utilization balance, the values of flora and fauna, and the structure of natural resources (Figure 2).

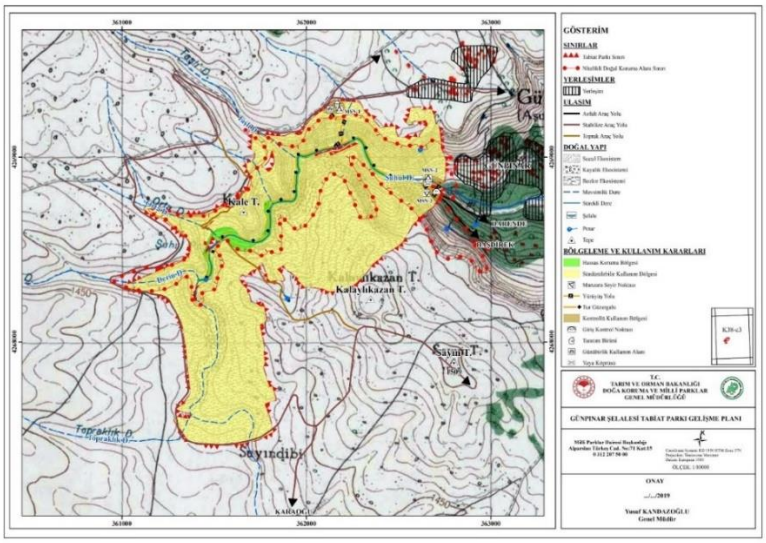


**Figure 2.** Günpınar Waterfall Nature Park Development Plan (DKMP, 2019)

In the establishment of the zoning system of the Nature Park; the resource values of the site, ecosystem integrity, threats, the level of intervention in the natural structure, traditional uses and socio-cultural values, land use status, and legal and administrative constraints have been considered (DKMP, 2019).

Sensitive Protection Areas are terrestrial, aquatic, and marine areas that are to be preserved with special measures for scientific research, education, or environmental monitoring purposes, where the use of the area and all impacts on it are restricted, and where human access may be prohibited when necessary. These are areas that must be absolutely protected, declared by the Council of Ministers' decision, and where construction is prohibited (Official Gazette, 2017).

Sustainable Use and Controlled Use Areas are regions that permit activities, tourism, and settlements which are compatible with nature and culture, contribute to conservation, and are in harmony with strictly protected sensitive areas or qualified natural conservation areas. These areas allow low-intensity activities that do not affect the integrity of the conservation zones (Official Gazette, 2017).

Considering the definitions and conditions of conservation and use, construction has been prohibited in areas declared as Sensitive Protection Zones, and human use of these areas has been restricted. Only in areas declared as Sustainable Use and Controlled Use Zones are construction, recreation, and tourism activities permitted. Observations in the field have concluded that within the boundaries of the Sustainable Use Zone defined by the Development Plan, there are no facilities that actively allow for recreational activities, and the area is closed to visitors. Taking all these developments into account, work has been conducted within the boundaries of Controlled Use Zone-1 (0.64 ha) and Controlled Use Zone-2 (0.94 ha) as shown in Figure 3 (Koçak, 2023).

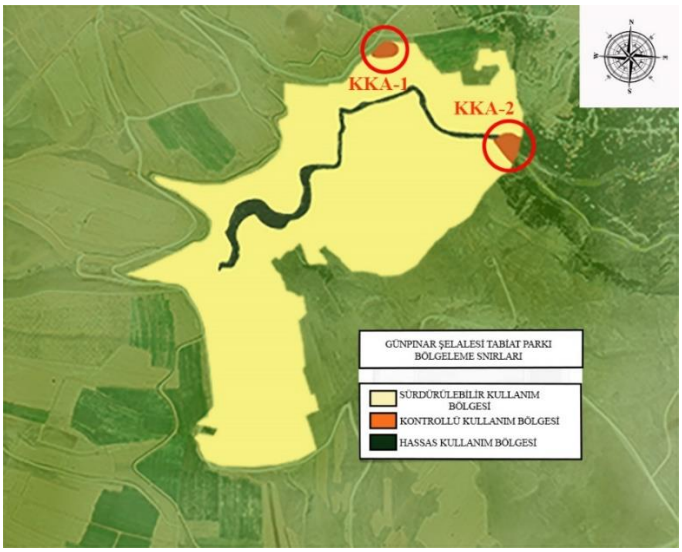


**Figure 3.** Working Area Boundaries (Original and created by the authors)

In the first step, a survey was conducted among the visitors of Günpınar Waterfall Nature Park. In the survey study, the value obtained by taking the average of the visitor numbers for the years 2019-2022, with the help of data provided by the GDNCN 15th Regional Directorate, was accepted as the Universe Size. The distribution of visitor numbers by months and years is given in Table 2.

**Table 2.** Spatial Distribution of Usage Zones According to the Development Plan (DKMP, 2019)

| Months | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| January | 0 | 788 | 642 | 286 |
| February | 0 | 1.344 | 632 | 343 |
| March | 0 | 205 | 5.589 | 5.398 |
| April | 0 | 1 | 11.780 | 20.495 |
| May | 0 | 1 | 14.912 | 24.425 |
| June | 30.196 | 32.518 | 17.217 | 25.646 |
| July | 31.911 | 40.925 | 26.307 | 55.143 |
| August | 40.688 | 95.605 | 20.213 | 19.194 |
| September | 25.971 | 37.438 | 2.015 | 15.200 |
| October | 8.477 | 12.116 | 1.537 | 4.559 |
| November | 4.104 | 4.033 | 1.115 | 1.117 |
| December | 834 | 1.450 | 951 | 1.037 |
| Total | 142.181 | 226.424 | 102.910 | 172.843 |
| Grand Total | 644.358 | | | |

According to the data obtained; in 2019, 142,181 people, in 2020, 226,424 people, in 2021, 102,910 people, and in 2022, 172,843 people visited the Nature Park. When the average of these four years is taken, the number obtained, 161,089, is accepted as the Universe Size for the method. The formula used for calculating the sample size is the one used by Esin et al. (2001). The formula is as follows:

$n=(N.P.Q.Z\_a^2)/((N-1).d^2 )$

According to the formula:

n: Sample Size

N: Population Size

P: Proportion of X observed in the Population

Q (1-P): Proportion of X not observed in the Population

Za: Z-value for a=0.05 is 1.96

d: Margin of Error

Based on this; the sample size n is calculated as follows:

n=161,088×0.052161,089×0.5×0.5×1.962=384.16

Considering the sample size and the result obtained from the formula; in this developed method, the minimum number of surveys to be applied with a 95% confidence interval and a ±5 margin of error is 384. Following discussions with users of the study area, a survey was conducted with 386 individuals, and the results have been analyzed in the findings section based on this number.

The physical carrying capacity of the areas suitable for visitor use within the study area (CUZ-1 and CUZ-2) has been calculated. Physical Carrying Capacity refers to the maximum number of people that can physically fit into an accepted area at the same time and is calculated using the following formula (Ceballos-Lascurain, 1996; Göktuğ, Bulut, Demir & Demircioğlu Yıldız, 2011):

PCC=A x Z/a x Rf

PCC: Physical Carrying Capacity

A: Area (Area or trail suitable for visitor use)

V/a: Visitor/Area (Area or trail length per visitor) (1 visitor/m², on the trail 1 visitor/m)

Rf: gs/zs (Rotation Factor: The duration of time an area is open daily / The average duration of a visit)

In calculating the physical carrying capacity of the Landscape Viewing Points within the Nature Park (CUZ-2 boundaries), the method developed by Itami (2002) for pedestrian flow in protected areas was used. According to this method, the physical carrying capacity of landscape viewing areas is defined as the maximum number of individuals that can fit without interfering with any individual's personal space. The personal circle area is defined as the circular space that allows an individual to turn a full circle without any obstruction while having their arms extended. A visual representation of the personal circle area is presented in Figure 4.

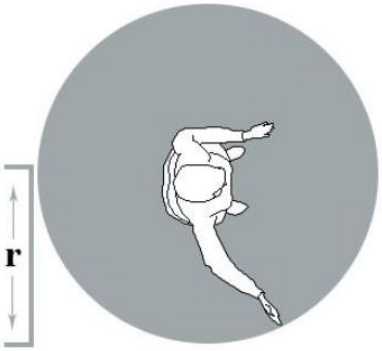


**Figure 4.** Minimum Personal Circle Area (Itami, 2002)

In the final step, the physical carrying capacity of the walking paths and stairs located within the Nature Park (CUZ-2 boundaries) has been calculated. The 'Highway Capacity Manual' published by the United States Federal Highway Administration in 1998 included 'Capacity Analyses for Pedestrian and Bicycle Pathways.' These analyses were later reinterpreted by Itami (2002) to be applicable to protected areas. In this phase of the study, the method revised by Itami (2002) was used. According to this method, a formula has been developed for calculating the basic pedestrian flow parameters (Rouphail et al. 1998; Chu &Baltes, 2003; Sisiopiku & Byrd, 2006; Hubbard et al. 2007):

a=H / M

a: Flow

H: Speed

M: Pedestrian Area (Area) = 1 / density

According to Itami (2002), the Level of Services (LOS) classes for relative value measurements of the variables in the formula are given in Table 3 for pedestrian pathways, and in Table 4 for stairs. These classes facilitate the transformation of factors such as speed, density, and type of pathway into a formula. The concept of 'Flow Intensity' in the tables refers to the number of visitors present at any time on a road with continuous flow. 'Unit Area,' on the other hand, represents the amount of space available for each visitor (Table 3), (Table 4).

**Table 3.** LOS Values for Walking Paths (Rouphail et al., 1998; Itami, 2002)

| LOS | Unit Area (m2/visitor) | Current Density (Visitor/min/m) | Average Speed (m/min) (m/s) | (m/min) (m/s) |
|---|---|---|---|---|
| A | >5.6 | <14 | >78 | >1 |
| B | 3.7-5.6 | 14-21 | 76.2-78 | 1.27-1.30 |
| C | 2.2-3.7 | 21-33 | 73.2-76.2 | 1.22-1.27 |
| D | 1.4-2.2 | 33-49 | 68.4-73.2 | 1.14-1.22 |
| E | 0.75-1.4 | 49-60 | 45-68.4 | 0.75-1.14 |
| F | <0.75 | >60 | <45 | <0.75 |

**Table 4.** LOS Values for Stairs (Rouphail et al., 1998; Itami, 2002)

| LOS | Unit Area (m2/visitor) | Current Density (Visitor/min/m) | Average Speed (m/min) (m/s) | (m/min) (m/s) |
|---|---|---|---|---|
| A | 1.9 | 16 | 32 | 0.53 |
| B | 1.6-1.9 | 16-20 | 32 | 0.53 |
| C | 1.1-1.6 | 20-26 | 29-32 | 0.48 |
| D | 0.7-1.1 | 26-36 | 25-29 | 0.42 |
| E | 0.5-0.7 | 36-49 | 24-25 | 0.42 |
| F | <0.5 | >49 | <24 | <0.40 |

In pedestrian usage, as in vehicle traffic, the following distance increases with speed. The quality of service is directly proportional to this situation. Visitors make less contact with each other as the unit area increases, allowing them to observe the natural and cultural landscape more extensively. Consequently, an increase in service quality is observed. However, an increase in unit area leads to a decrease in flow intensity. In the LOS classification, A represents the best, while F represents the worst. LOS standards are actively used in many countries, including America, Europe, the United Kingdom, and Australia, due to their proven reliability (Itami, 2002; Muraleetharan et al. 2004; Göktuğ et al., 2013; Caner, 2018).

## 3. Findings and Discussion

In the conducted survey, participants were asked, "How much time do you spend at Günpınar Waterfall Nature Park?" The responses were as follows: 13.7% spent 1 hour (53 individuals), 34.7% spent 2 hours (134 individuals), 32.6% spent 3 hours (126 individuals), 12.7% spent 4 hours (49 individuals), 3.6% spent 5 hours (14 individuals), 1.6% spent 6 hours (6 individuals), 0.8% spent 7 hours, and 0.3% spent 8 hours (1 individual) (Table 5). When calculating the average of all these values, a result of 2.67 is obtained. This figure is significant for the calculation of the area's physical carrying capacity.

**Table 5.** Stay Duration of Günpınar Waterfall Nature Park Visitors (According to the survey results)

| How much time do you spend at Günpınar Waterfall Nature Park? | Number of People | Percentage (%) |
|---|---|---|
| 1 Hour | 53 | 13,7 |
| 2 Hours | 134 | 34,7 |
| 3 Hours | 126 | 32,6 |
| 4 Hours | 49 | 12,7 |
| 5 Hours | 14 | 3,6 |
| 6 Hours | 6 | 1,6 |
| 7 Hours | 1 | 0,8 |
| 8 Hours | 1 | 0,8 |

Günpınar Waterfall Nature Park, Physical Carrying Capacity is calculated separately for Controlled Use Area-1 and Controlled Use Area-2. Accordingly (Table 6);

**Table 6.** Physical Carrying Capacity for Controlled Use Areas (Koçak, 2023)

| Physical Properties | CUZ-1 | CUZ-2 |
|---|---|---|
| zs: Average Visit Time of the Area (Hours) | 2,67 | 2,67 |
| A: Recreation Area ($m^2$) | 6.400 m2 | 9.400 $m^2$ |
| gs: Daily time the area is open to visitors (Hours) | 8 | 8 |
| Z/a: Optimum Picnic Area per Person (person/m2) | 1/60 Person/$m^2$ | |

In this context;

z: Represents the average value of responses to the survey question “How much time do you spend within the Nature Park?”

A: Denotes the area allocated for the Controlled Use Zone as determined within the Development Plan obtained through the Directorate of Conservation of Natural Heritage (GDNCN) 15th Regional Directorate.

g: Indicates the duration for which the Nature Park is open to daily visitors.

Z/a: This value is accepted according to the Forest Parks Regulation.

Rf: Recreation Factor = gs/zs

When the collected data is converted into numerical values according to the formula;

PCC=A×aZ×Rf

For CUZ-1:

6,400×(601)×(2.678)=319visitors

9,400×(601)×(2.678)=469visitors

When the results are combined, a total of 788 individuals can perform recreational activities within the boundaries of the Günpınar Waterfall Nature Park Controlled Use Zone in a single day.

At this stage, the physical carrying capacity of the Landscape Observation Terrace, located within the borders of CUZ-2, which actively enables recreational activities, was calculated.

Based on anthropometric characteristics, the distance between the tip of the right hand and the tip of the left hand when a person stretches their arms out to both sides corresponds to their height. Half of this length represents the radius of the circle that denotes the personal space of individuals at scenic viewing points. To calculate this circle, the average heights of female and male individuals are required.

According to statistical data, the average height for women living in Turkey is 164 cm, and for men, it is 176 cm (Caner, 2018; Rüzgar, 2022).

164/2=82 cm personal space radius of female individuals

176/2=88 cm personal space radius of male individuals

When averaged, the calculation is as follows:

282+88=85 cm(0.85 m)

According to the Turkish average, the circumference of the personal space circle for individuals has been determined to be 0.85 m. According to the formula for the area of a circle;

$A=\pi r^2(\pi=3)$

$3\times(0.85)2=2.17\ m^2$. (The average area accepted for an individual at a scenic viewing point is 2.17 m²).

According to the studies conducted in Günpınar Waterfall Nature Park, the area of the scenic viewing terrace within the park has been determined to be 57 m². Consequently,

Carrying Capacity Calculation=Personal Area Size

$57\ m^2/2{,}17\ m^2=26$ individuals.

This value represents the maximum number of people that the scenic viewing terrace can accommodate (Figure 5).

**Figure 5.** Landscape Observation Terrace in the Nature Park (Original and created by the authors)

In the method, the quality levels of the walking paths are expressed using Service Level (LOS) grades. These levels are denoted as A-B-C-D-E-F (Unobstructed-Semi Obstructed-Restricted-Crowded-Very Crowded-Congested), where A represents the best conditions and F represents the worst conditions (Table 7).

**Table 7.** LOS Values for Walking Paths (Rouphail et al., 1998; Itami, 2002)

| LOS | Unit Area (m2/visitor) | Current Density (Visitor/min/m) | Average Speed (m/min) (m/s) | (m/min) (m/s) |
|---|---|---|---|---|
| A | >5.6 | <14 | >78 | >1 |
| B | 3.7-5.6 | 14-21 | 76.2-78 | 1.27-1.30 |
| C | 2.2-3.7 | 21-33 | 73.2-76.2 | 1.22-1.27 |
| D | 1.4-2.2 | 33-49 | 68.4-73.2 | 1.14-1.22 |
| E | 0.75-1.4 | 49-60 | 45-68.4 | 0.75-1.14 |
| F | <0.75 | >60 | <45 | <0.75 |

Itami (2002), based on his literature research, surveys, and field measurements, concluded that standards C and D are more suitable for protected areas. In the study area, the C Standards have been adopted for the physical carrying capacity calculations of walking paths and stairs.

The pedestrian paths within the study area have been classified according to their slope grades, and area calculations have been performed. Accordingly, the paths with a slope of 0-5% cover an area of 284.9 m², those with a slope of 10-20% cover 130.6 m², paths with a slope of 20-40% cover 145.2 m², and paths with a slope of over 40% cover 277.4 m². The total area of pedestrian paths is 838.1 m² (Figure 6).

Since the evaluation is conducted according to C Standards.

838.1/2.2=380 individuals

The maximum number of individuals that can simultaneously use the pedestrian paths within the area is 380. Considering the visitors' round-trip movements, this number will be considered as 760 individuals.

**Figure 6.** Pedestrian Paths in the Nature Park (Original and created by the authors)

According to the method, the quality levels of the stairs are expressed using Service Level (LOS) grades. These levels are denoted as A-B-C-D-E-F (Unobstructed-Semi Obstructed-Restricted-Crowded-Very Crowded-Congested), where A represents the best conditions and F represents the worst conditions (Table 8). In the study area, the C Standards have been adopted for calculating the physical carrying capacities of the stairs.

**Table 8.** LOS Values for Stairs (Rouphail et al., 1998; Itami, 2002)

| LOS | Unit Area (m2/visitor) | Current Density (Visitor/min/m) | Average Speed (m/min) (m/s) | (m/min) (m/s) |
|---|---|---|---|---|
| A | 1.9 | 16 | 32 | 0.53 |
| B | 1.6-1.9 | 16-20 | 32 | 0.53 |
| C | 1.1-1.6 | 20-26 | 29-32 | 0.48 |
| D | 0.7-1.1 | 26-36 | 25-29 | 0.42 |
| E | 0.5-0.7 | 36-49 | 24-25 | 0.42 |
| F | <0.5 | >49 | <24 | <0.40 |

According to the examinations conducted in the study area, it has been determined that there are three sets of stairs within the area (Figure 7). The area of each step has been measured, and by multiplying these values by the number of steps, it has been found that they have a total area of 36.4 m². Based on the C Standards, this translates to: 36.4/1.1=33 individuals.

This figure represents the number of people who can use the stairs simultaneously. Since there will be a round-trip circulation like the pedestrian paths, this number will be considered as 2 x 33 = 66 individuals.

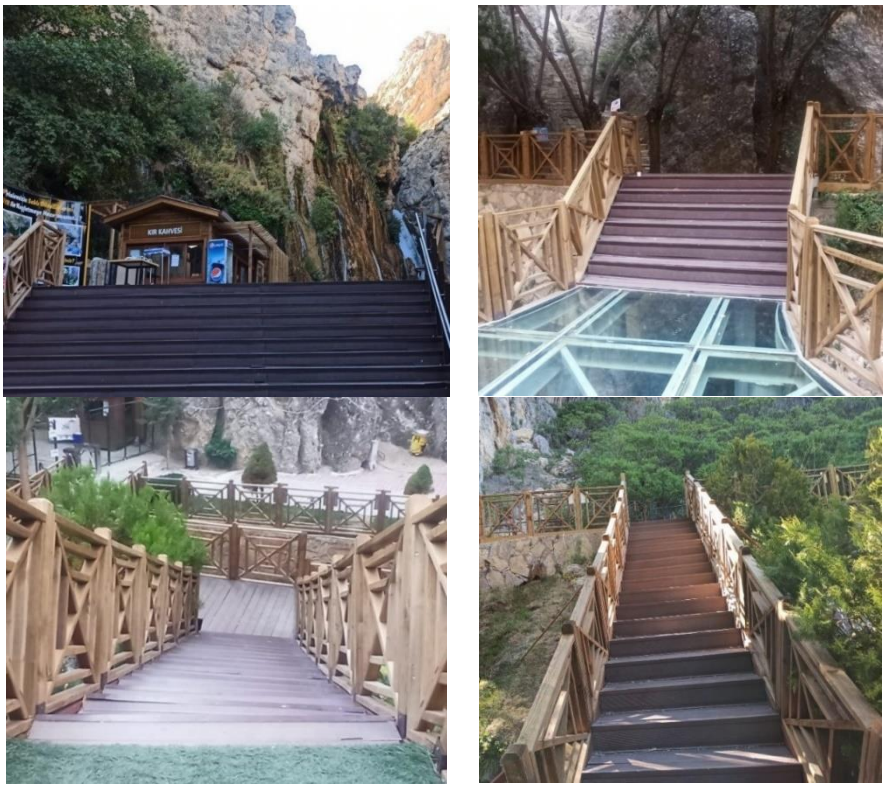

**Figure 7.** Stairs in the Nature Park (Original and created by the authors)

## 4. Conclusion and Suggestions

In the planning process of recreational areas, determining the behaviors and tendencies individuals exhibit during their leisure time is of great importance. These determinations provide planners with the necessary data, enabling them to understand the preferences and likes of the users. Consequently, this contributes to the development of physical plans and programs that achieve the most suitable balance between natural resources and the recreational needs of individuals. This process is crucial for ensuring the effective and efficient use of recreational areas (Demircan, Aytatlı & Yıldız, 2018).

Recreational areas serve not only to enhance environmental quality and provide aesthetically pleasing spaces but also offer a range of benefits to urban ecology. These areas contribute to the mental and

physical health development of the urban community, as well as carry significant value by offering opportunities for rest, entertainment, and socialization. In this context, recreational areas are an integral part of urban life and play a vital role in the sustainability of city ecosystems and human well-being. The sustainability of recreational areas can be achieved through controlled visitor acceptance based on the results of carrying capacity calculations (Göktuğ et al., 2011).

The Controlled Use Zones of the Nature Park have undergone a physical carrying capacity assessment. According to the calculations, the physical carrying capacity for CUZ-1 is determined to be 319 visitors/day, and for CUZ-2, it is 469 visitors/day. In the second step, the physical carrying capacity of the scenic viewing terrace located within the Nature Park has been calculated. Measurements conducted in the Nature Park have revealed that the scenic viewing terrace occupies an area of 57 m². Consequently, when utilized considering a personal circular space for everyone, the terrace can simultaneously serve 26 people. In the final step, the carrying capacity for the walking paths and stairs within the area has been calculated. The area sizes for the walking paths, based on their slope categories, have been computed, and the number of people they can accommodate has been determined according to the total area. The calculations indicate that the carrying capacity for the walking paths is 760 individuals. Similarly, for the stairs, the method applied involved calculating the total area of the stairs in the field, and the carrying capacity has been determined based on this value. According to the data obtained, the carrying capacity for the stairs is concluded to be 66 individuals.

When all these numerical data are compared with the monthly visitor numbers for Günpınar Waterfall Nature Park, obtained from the Directorate of Nature Conservation and National Parks 15th Regional Directorate, it has been determined that, especially during the summer months, the area is subjected to usage far exceeding its carrying capacity.

Although Günpınar Waterfall Nature Park spans an area of 135 hectares, active recreational activities are permitted only within a portion measuring 0.94 hectares. In consideration of the Development Plan prepared by the Directorate of Nature Conservation and National Parks (GDNCN) for the Nature Park, new recreational facilities should be created within the Controlled Use and Sustainable Use zones of the area. Within these zones, amenities such as trail walking paths, bicycle lanes, new picnic areas, camping sites, parking facilities, and the like could be offered. Considering that Darende District is situated at a junction point of the Eastern Anatolia, Central Anatolia, and Mediterranean Regions, the diversity of recreational activities could be enhanced. In planning these new recreational spaces, the carrying capacity calculations conducted for CUZ-1 and CUZ-2 in this study can be referenced.

The four-year visitor numbers for the Nature Park (2019-2020-2021-2022), obtained from the Directorate of Nature Conservation and National Parks 15th Regional Directorate, have been compared with the calculated physical carrying capacity of the area. When comparing the annual user average with the carrying capacity, it can be said that the park has an ideal number of visitors. However, when the monthly values are compared, it has been observed that, particularly during the heavily frequented spring and summer months, the area is exposed to a number of visitors far exceeding its carrying capacity. For this reason, particularly during the summer months, an appointment system for entry to the area could be implemented, or the duration of the area's availability for visitation could be extended.

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**Author Contribution and Conflict of Interest Declaration Information**

All authors contributed equally to the article. There is no conflict of interest.

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