

Assessment of Visitor Management Methods at the Caparaó National Park

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Abstract

In Brazil, the planning and development of visitor impact management actions still occur incipiently, in contrast to a significant greater number of visitors observed in Brazilian protected areas. The aim of the present study is to determine the Tourism Carrying Capacity (TCC) and the Benchmark Number of Visitors (BNV) for the trail to Pico da Bandeira, at the Caparaó National Park, in order to carry out a comparative analysis between these two visitor impact control management tools. The park's current visitation intensity does not surpass the estimated TCC for this study (1,695 visitors per day), albeit exceeds the BNV (250 visitors per day). Even though the BNV methodology conceptually originates from the TCC, expressive improvements have not been observed, just a timid change in approach. In both cases, estimating the maximum number of visitors is a dynamic process that requires periodic review in order to adjust visitor impact management decisions.

Key words: protected areas; public use; tourism carrying capacity; benchmark number of visitors.

INTRODUCTION

In Brazil, there is a growing concern regarding the preservation and conservation of the environment, which can be attested by observing the amount of conservation units (UC) created in the last two decades (Peccatiello, 2011). The establishing of protected natural areas is an important mechanism for maintaining the enormous biological diversity that exists in the national territory as a whole (Vianna, 2008). In this regard, the country has international highlight, since it shelters 10 to 18 percent of all indexed species in the whole planet (Lewinsohn and Prado, 2005).

Over the last few years, the search for natural environments for the development of recreational and leisure activities has been growing expressively in Brazil. The conservation units, especially parks, have been the most frequent destination of such visitors, in search of the opportunity to be in touch with nature (Lobo and Simões, 2010; Instituto Chico Mendes de Conservação da Biodiversidade – ICMBIO, 2017).

Among the activities realized in conservation units, Ikemoto et al. (2009), highlights trekking, since while walking the trails the visitor has the opportunity of directly interacting with the natural environment. According to Oliveira and Nishida (2011), the observing and direct contact with the different natural resources on the trail stimulate each individual's reflection on the importance of preserving nature.

Since the 1970's, different initiatives have been pursued with the purpose of promoting proper visitation management of the protected natural areas spread out around the world (ICMBIO, 2011). Some of the employed methodologies throughout the years were: *Recreation opportunity spectrum* – ROS; *Limits of Acceptable Change* – LAC; *Visitor Activity Management Process* – VAMP; *Visitor Impact Management* – VIM; *Capacidade de Carga Turística en Areas Protegidas* – CC; *Visitor Experience and Resource Protection* – VERP; *Tourism Optimization Management Model* – TOMM; *Sustainable Recreation and Tourism* – SRT (Limberger and Pires, 2014). In Brazil, however, the planning and development of visitor impact management actions still occur incipiently, in contrast to a significant greater number of visitors observed in Brazilian conservation units (ICMBIO, 2011).

According to Limberger and Pires (2014), in Brazil, the most utilized methodology over the course of the last few decades has been Tourism Carrying Capacity (TCC), proposed by Cifuentes in 1992. On the other hand, the Visitor Impact Management methodology proposed by ICMBIO in 2011 establishes the Benchmark Number of Visitors, which most likely consists of the most recent devised tool within the scope of visitation management in conservation units in the country.

The aim of the present study is to determine the Tourism Carrying Capacity (TCC) and the Benchmark Number of Visitors (BNV) for the trail to Pico da Bandeira from Tronqueira, in order to carry out a comparative analysis between both methodologies and point out their similarities and specificities.

2. MATERIALS AND METHODS

2.1. Study Area

The Caparaó National Park (CNP) was established by the Federal Act number 50.646 of May 24th, 1961, and belongs to the group of conservation units under full protection. The park is totally inserted in the Atlantic Rainforest biome and has a total territorial extension of 78,485 acres (Ministério do Meio Ambiente – MMA, 2017). The Pico da Bandeira sits at an altitude of 2,892 meters, is the third highest peak in Brazil and is the most visited attraction at the CNP. The peak can be reached by two trails, the first starting at Tronqueira (which can be accessed through the entrance in Minas Gerais) with approximately 6,000

meters in length, and the second starting at Casa Queimada (which can be accessed through the entrance in Espírito Santo) which is approximately 4,200 meters long (ICMBIO, 2015).

2.2. Visitation Aspects at the Caparaó National Park

The visitation data was obtained from monitoring spreadsheets made available by the administration of the conservation unit. After compiling and analyzing the data, the graphs were drawn up with Microsoft Excel.

2.3. Benchmark Number of Visitors

The concept for the Benchmark Number of Visitors (BNV) proposes a quantitative assessment of visitors, that is, an estimate for the number of visitors that a specific location has the capacity of supporting per day for the realization of a specific activity, taking in consideration the natural and operating conditions of the conservation unit.

Therefore, the existing conditions of the attraction and its access trail were analyzed, especially those conditions that represent restrictions as for the use of the location, consequently referred to as limiting factors. The quantification of the limiting factors is indispensable for determining the BNV, which was calculated separately for each activity previously mentioned.

The procedure for calculating the Benchmark Number of Visitors follows the logic presented in Equations 1 and 2, adapted from ICMBIO (2011).

$$BNV = \left(\frac{AS}{N}\right) \times NT \quad (1)$$

$$NT = \left(\frac{TO}{TN}\right) \quad (2)$$

In which: AS = available space (in area, linear meters or quantity); N = necessity per person or group (in area, linear meters or quantity); NT = number of times that a certain location can be visited by the same person or group in the course of a day; TO = time offered by the conservation unit for the completion of the activity; TN = time needed for a person or group to complete the activity.

2.4. Tourism Carrying Capacity

The determination of the Tourism Carrying Capacity was based on the methodology proposed by Cifuentes (1992) and adapted to the physical and biological conditions and infrastructure present at the Caparaó National Park, and it is composed of three quantities:

- Physical Carrying Capacity (PCC)
- Real Carrying Capacity (RCC)
- Effective Carrying Capacity (ECC)

The following correlation can be observed among them: $PCC \geq RCC \geq ECC$.

2.4.1. Physical Carrying Capacity (PCC)

The Physical Carrying Capacity is influenced by the space available, the space required per visitor during the trail and by the aspects of the visitation, as its duration and the time that it occurs. Equation 3 was used for calculating this amount.

$$PCC = \frac{A}{A_u} \times \frac{O_p}{T_v} \quad (3)$$

In which: A = available area for use, in linear meters; A_u = area required per user, in linear meters; O_p = open period of the trail to the public; and T_v = time required by the visitor to conclude the trail.

2.4.2. Real Carrying Capacity (RCC)

The Real Carrying Capacity is obtained from the PCC, after it is submitted to a series of correction factors, previously defined according to the qualities of the assessed location. Equation 4 was used for calculating this amount.

$$CF = 1 - \frac{LM}{TM} \quad (4)$$

In which: CF = correction factor of the variable; LM = Limiting magnitude of the variable; and TM = total magnitude of the variable.

After obtaining the correction factors, the Real Carrying Capacity was determined through Equation 5.

$$RCC = PCC \times (CF_1 \times CF_2 \times \dots \times CF_n) \quad (5)$$

In which: PCC = physical carrying capacity; CF_1 = correction factor for variable 1; CF_2 = correction factor for variable 2; and CF_n = correction factor for variable "n".

2.4.3. Effective Carrying Capacity (ECC)

The Effective Carrying Capacity considers, in addition to the correction factors, the management capacity presented by the administration of the conservation unit. Equation 6 was used for calculating this amount.

$$ECC = RCC \times MC \quad (6)$$

In which: RCC = real carrying capacity; and MC = management capacity.

2.4.3.1. Management Capacity (MC)

Management capacity is the condition the administrators of a conservation unit have to develop its activities and meet its objectives, and is influenced by variables such as; legal support, policies, equipment, infrastructure, and availability of human and financial resources (Cifuentes, 1992).

Considering the official data available and measurement feasibility, the most adequate variables for evaluating the management capacity at the Caparaó National Park are: equipment, infrastructure, and human resources.

Each variable consists of a series of components that were jointly selected, discussed and assessed by the head of the unit, the research sector coordinator, and the author of this paper, hereafter referred as the multidisciplinary team. The aforementioned variables and their respective components are listed below:

- **EQUIPMENT:** Automobile; Motorcycle; Walkie-talkie; Handie-talkie; Repeater; Computer; Projector; Fire extinguisher; Chainsaw; First aid kit.
- **INFRASTRUCTURE:** Entrance; Visitors Center; Scale Model; Auditorium; Parking; Public Telephone; Lodging; Researcher's Cabin; Employee's Cabin; Office; Kitchen; Storage Room; Recreational Area; Grill; Water Fountain; Table; Kiosk; Bench; Restroom; Toilet; Urinal; Shower; Sink; Waste Bin; Campsite; Trail; Attraction; Observation Deck.
- **HUMAN RESOURCES:** Manager; Public Use Coordinator; Research Coordinator; Environmental Education Coordinator; Protection and Inspection Coordinator; Financial Coordinator; Firefighter; Gatekeeper/Access Controller; Secretary/Receptionist; Security Guard; Janitor.

The criteria used by the multidisciplinary team for evaluating the aforementioned components are specified as follows:

- **Quantity:** relation between the actual quantity and the ideal quantity for each evaluated component.
- **Conservation status:** conservation status of the evaluated component, considering its maintenance, cleaning, and security status that allow the proper use of the component.
- **Location:** where the component is situated inside the conservation unit, as well as its ease of access.
- **Functionality:** practical use of each component for both employees and visitors.

The procedure for calculating the management capacity includes filling in a spreadsheet similar to the one presented on Table 1. In the specific case of the variable human resources, only the quantity criterion will be evaluated, disregarding the criteria referring to the conservation status, location, and functionality.

Table 1. Model worksheet for calculating factors regarding infrastructure, equipment, and human resources variables.

VARIABLE	Current quantity	Optimum quantity	Quantity (A/B)	Conservation Status	Location	Functionality	Sum (S)	Factor (S/16)
Component ₁	A ₁	B ₁	0 - 4	0 - 4	0 - 4	0 - 4	S ₁	F ₁
Component ₂	A ₂	B ₂	0 - 4	0 - 4	0 - 4	0 - 4	S ₂	F ₂
Component _n	A _n	B _n	0 - 4	0 - 4	0 - 4	0 - 4	S _n	F _n
								F_{VARIABLE}

From the percentage obtained by dividing the current quantity (A) and the optimum quantity (B), a score from 0 to 4 is assigned to the quantity criterion using the aforementioned rating scale established on Table 2. For the other three criteria (conservation status, location, and functionality), a score from 0 to 4 is assigned according to Table 2, based on field observations and the previous knowledge of the multidisciplinary team. The sum of the attained scores in the four assessed criteria divided by the maximum score possible (16 in case of the variables "equipment" and "infrastructure"; 4 in case of the variable "human resources") determines the factor of the component, and the average of all components factors consists of the factor of the variable (Table 1).

Table 2. Assessed criteria rating scale.

PERCENTAGE (%)	VALUE	RATING
≤ 35	0	Very unsatisfactory
36 – 50	1	Unsatisfactory
51 – 75	2	Averagely satisfactory
76 – 89	3	Satisfactory
≥ 90	4	Highly satisfactory

Source: Cifuentes et al. (1999).

Finally, the management capacity was determined through Equation 7, expressed in percentage:

$$MC = \left(\frac{EQ + IS + HR}{3} \right) \times 100 \quad (7)$$

In which: EQ = factor of the variable "equipment"; IS = factor of the variable "infrastructure"; e HR = factor of the variable "human resources".

3. RESULTS AND DISCUSSION

3.1. Visitation Aspects at the Caparaó National Park

With regards to the increase of visitors observed in national parks in the last few years, the Caparaó National Park in particular does not present a very clear growth trend, although it registered in 2014 a record number of visitors, which corresponded to an increase of 41% in relation to the previous year (Figure 1).

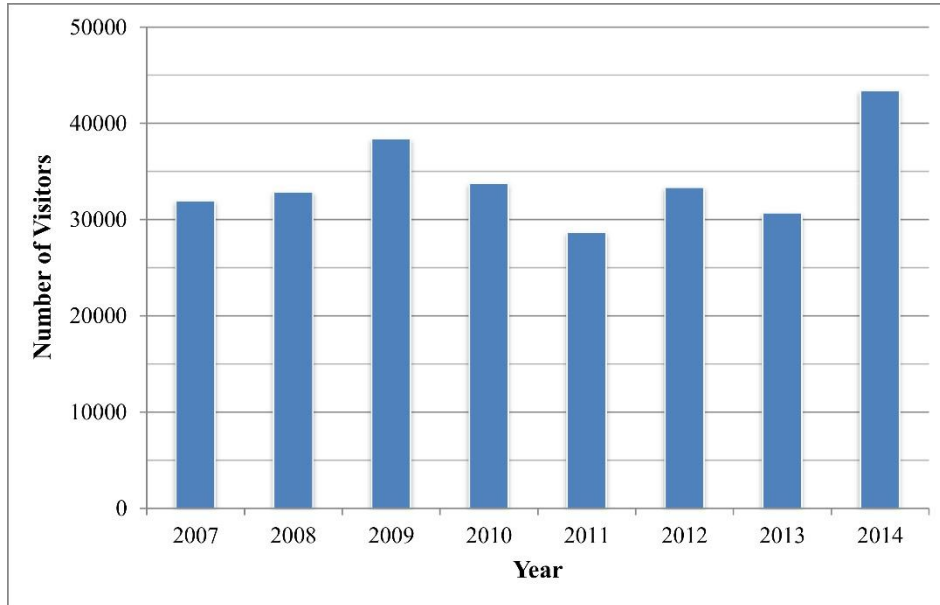


Fig. 1. Number of visitors at the Caparaó National Park from 2007 to 2014.
Source: made by author (2015).

The distribution of visitors between the two entrances at the CNP occurs distinctively since, in 2014, 82.5% of the visitors entered the park through the entrance located at Alto Caparaó, Minas Gerais (Figure 2). The inferior flow of visitors entering through the capixaba side of the park is related to the tardy implementation of the Pedra Menina (ES) entrance that according to Massini et al. (2015) occurred between the years of 1997 and 1998.

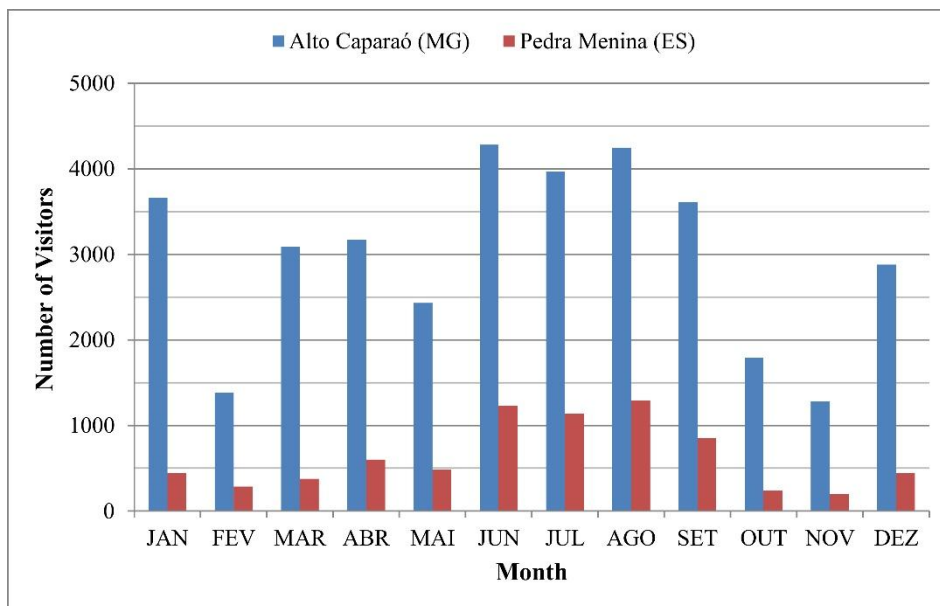


Fig. 2. Number of visitors comparative between both entrances at the Caparaó National Park in 2014.
Source: made by author (2015).

The high number of visitors seen in June, July, August, and September corresponds to the period with better weather conditions for walking the trail to Pico da Bandeira, especially due to the absence of rain and good visibility at the summit; whereas the months of January, March, and April, which also had a considerable flow of visitors, attract mainly those who are interested in visiting the park's waterfalls, due to higher temperatures.

When considering specifically the three months with the most visitors (June, July, August), it can be observed that these high numbers occur preferably during the weekends; in the 13 occasions in which the number of visitors exceeded 300 people, 11 of them were Saturdays. When added, the numbers from those 13 occasions represent about 15% of the annual visitation of 2014 (Figure 3). During the rest of the year, the number of visitors remains lower, with an average of 120 visitors per day in the year of 2014.

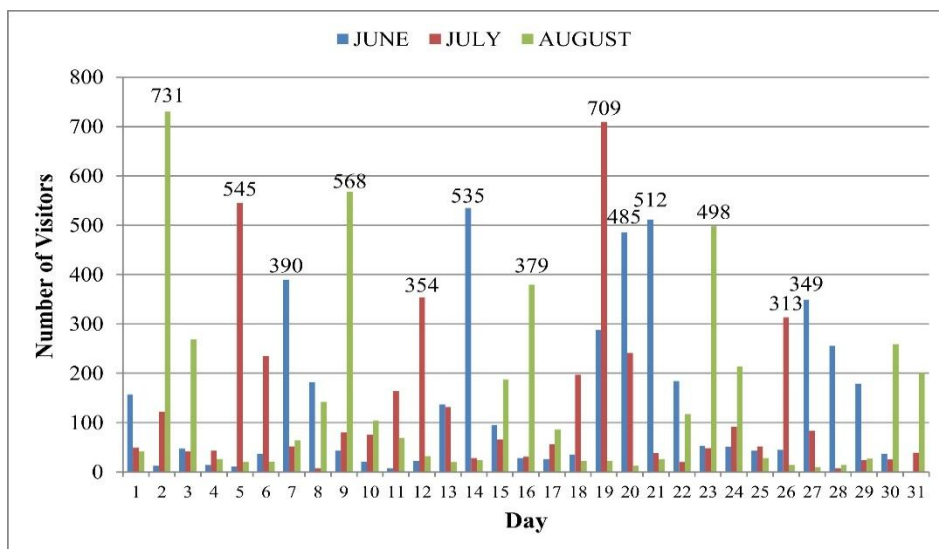


Fig. 3. Number of visitors registered daily in the months with the highest number of visitors at the Caparaó National Park in 2014. Source: made by author (2015).

3.2. Benchmark Number of Visitors

Conquering the Pico da Bandeira can be accomplished in two ways: i) daytime hike; ii) nighttime hike; the latter has the objective of contemplating the sunrise from the summit of the peak. Therefore, results regarding the Benchmark Number of Visitors will be presented for both trekking options (Table 3), since each has its own specificities.

Table 3. Benchmark Number of Visitors calculation for the trail to Pico da Bandeira from Tronqueira (daytime hike and nighttime hike).

DAYTIME HIKE						
LIMITING FACTORS	TO	TN	NT	A	N	BNV
Trail length	660 min.	420 min.	1	6,645 m	1.5 m	4,430 people
Area at the summit with panoramic views	180 min.	45 min.	4	900 m ²	2 m ²	1,800 people
Parking	660 min.	420 min.	1	45 parking spaces	1 parking space	45 vehicles
Transfer	660 min.	45 min.	14	30 jeeps	1 jeep	420 trips
NIGHTTIME HIKE						
LIMITING FACTORS	TO	TN	NT	A	N	BNV
Trail length	465 min.	465 min.	1	6,645 m	1.5 m	4,430 people
Area at the summit with panoramic views	45 min.	45 min.	1	900 m ²	2 m ²	450 people
Tronqueira Campsite	675 min.	675 min.	1	1,000 m ²	8 m ²	125 tents

For the daytime hike, it was considered that the visitor does not make use of the campsite at the park, staying at the park's surroundings. Traveling from the entrance of the park to Tronqueira, the starting point of the trail, can be accomplished in private vehicles, abiding to parking limits, or by means of hiring a transfer service. For calculating the BNV, it was assumed that private vehicles carry 3 people in average, whereas transfer vehicles carry 4 people in average. The BNV amounts found for the limiting factors of parking and transfer were added, providing a BNV value of 1,815 visitors (135 for parking; 1,680 for transfers), which considers both forms of transportation available.

With respect to the nighttime hike, the trek has its own relevant specificities, especially in regards to the starting time of the hike and sunrise, which allows performing the activity only once a day (NT equals 1). The length of stay at the campsite (675 minutes) consists of the time between arrival and returning to the entrance, including car travel (45 minutes), the time of accommodation at the campsite (60 minutes), the time to complete the trail (510 minutes, considering the time spent in average at the summit), and the time for arranging the return to the entrance (60 minutes).

Taking the precautionary principle into account, the BNV value assumed for the trail to Pico da Bandeira from Tronqueira represents the lowest BNV value among the limiting factors, i.e. 250 people (campsite limiting factor, considering two people per tent in average). It is worth noting that the BNV values for the daytime hike and nighttime hike cannot be added, since the time in which these activities occur partially overlap with each other, making visitors share the same space on the trail and, eventually, at the summit.

3.3. Tourism Carrying Capacity

The results obtained for the carrying capacity components, including all necessary factors for this calculation, can be found summarized on Table 4.

Table 4. Carrying Capacity Components and associated correction factors.

CARRYING CAPACITY	VALUE	UNIT
Physical (PCC)	6,961	visitors/day
Real (RCC)	3,533	visitors/day
Corrections Factors		
Accessibility (CF _{acc})	0.60	-
Waterlogging (CF _{wat})	0.94	-
Erosion (CF _{ero})	0.90	-
Effective (ECC)	1,695	visitors/day
Management Capacity		
Infrastructure	0.48	-
Equipment	0.34	-
Human Resources	0.53	-
	0.57	-

3.3.1. Physical Carrying Capacity (PCC)

For calculating the Physical Carrying Capacity, it was assumed that each person needs 1.5 meters to move adequately on the trail (A_n), and that the extension of the trail is of 6,645 meters (A). The open period of the trail consisted of the park's opening hours (7:00 a.m. to 6 p.m.), i.e. 11 hours (O_p), whereas the time required for concluding the trail (round trip) is of 7 hours (T_v).

3.3.2. Real Carrying Capacity (RCC)

3.3.2.1. Accessibility Factor

The accessibility correction factor considered the level of difficulty that visitors might find to move adequately due to parts of the trail with significant declivity.

Considering the average declivity calculated for the trail (15%) as a limiting value, only the sections of the trail with declivity equal to or higher than 15% were accounted for. When added, these sections correspond to 2,645 meters (limiting magnitude); whereas the entire trail stretches for 6,645 meters (total magnitude).

3.3.2.2. Waterlogging Factor

The waterlogging correction factor considered the parts of the trail that remain soaked, even in the dry season, that coincides with the period of higher visitation at the park. The extension of these parts adds up to 431 meters (limiting magnitude), and the full extension of the trail is again considered as the total magnitude.

3.3.2.3. Erosion Factor

The erosion factor considers parts of the trail in which established erosive processes can be observed (visually) as a limiting magnitude. These parts correspond to 635 meters of the full trail (or total magnitude).

3.3.3. Effective Carrying Capacity (ECC)

The management capacity presented by the administration of the Caparaó National Park was considered for calculating the Effective Carrying Capacity. Table 4 presents a summary of the obtained results for the three management capacity variables.

3.4. Benchmark Number of Visitors versus Tourism Carrying Capacity

Notable similarities were observed when analyzing the formulas used for calculating the Benchmark Number of Visitors and the Physical Carrying Capacity. Conceptually, it is noted that the BNV was developed from the TCC, although it proposes a shift in its approach, which explains the inconsistent results found for the methodologies here analyzed.

Whereas the PCC for a given trail is usually estimated exclusively from its own attributes, the BNV is estimated separately for each limiting factor from their respective attributes. Limiting factors are support structures provided to visitors, including services, that influence the development of the activity, such as parking, campsite area, trail length, attraction area and transfer services.

When analyzing several studies published on Tourism Carrying Capacity, Delgado (2007) considered the choice of correction factors used for obtaining the Real Carrying Capacity one of the methodology's main flaws. The author explains that the correction factors recurrently used "did not present a direct correlation with the possible impacts caused by visitation".

The management capacity used for obtaining the Effective Carrying Capacity reflects the conservation area's situation as a whole, since it represents the conditions displayed by the administration of the conservation unit to develop its activities. However, this stage does not take into consideration that the sectors within a conservation unit can present distinct qualities, especially in relation to their equipment and support infrastructure to visitors. In practice, the concept of management capacity proposed by Cifuentes is more adequate to smaller areas, where the conditions offered to visitors on the park's different trails are equivalent.

In summary, the Benchmark Number of Visitors methodology can be considered to be more objective than the Tourism Carrying Capacity, as by not utilizing correction factors (including management capacity) it eliminates the subjectivity in the calculation, focusing the analysis on unquestionable qualities, such as the space of visitor support structures, operational aspects of the services available, trail length and attraction dimensions. Such qualities, when pertaining to the structures and support services offered to visitors, are easily adjustable in case the BNV needs revision by reducing, for example, spots on the campsite or parking space, or regulating transfer services.

4. CONCLUSION

Although the Caparaó National Park offers several attractions open for visitation, the Pico da Bandeira stands out as the most visited place at the park as a whole. Considering that the conservation unit had a record in visitation in 2014, and that in the same year the highest number of visitors that the park welcomed in a single day was of 731 people, the current traffic of visitors at the park does not exceed its Tourism Carrying Capacity (1,695 people per day), however, it does exceed the Benchmark Number of Visitors (250 people per day) established in the present study.

Conceptually, the Benchmark Number of Visitors when compared to the Tourism Carrying Capacity does not represent a paradigm shift. On the contrary, the BNV consists of a timid methodological evolution from the TCC. In both cases, the estimate of a maximum number of visitors should not be conceived as a definite solution for the management of visitor impacts, but as a simple tool capable of assisting the planning and monitoring of public use and that requires periodic review for adjusting management decisions.

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