

EXTENDED ABSTRACT

PERCEPTION OF CONGESTION AND SOCIAL DIMENSION OF THE CARRYING CAPACITY IN YUCATAN CENOTES

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The impacts that excess visitors are causing in natural areas can be divided into ecological and social. Ecological ones include soil compaction, loss of vegetation cover, air, water and hearing pollution (Manning and Anderson, 2012; Leung and Marion, 1999), as well as wildlife stress (Newsome, Dowling and Moore, 2005). Social includes perception of congestion and perception of environmental damage by visitors, satisfaction and inappropriate behaviour of the visitor, as well as conflicts between different types of visitors who use the same natural space (e.g. walkers and cyclists using the same path in a national park) (Tyler, Roberts and Nilsen, 1997).

In less developed countries, the visit of locals and foreign tourists in certain natural areas is considered an economic strategy that contributes to conservation and income generation for the rural communities that live around (Drumm and Moore, 2002). In the case of the Yucatan Peninsula, like many regions of Mexico and Latin America, rural people have subsisted by practicing various economic activities such as agriculture, livestock, hunting, fishing, the use of timber and non-timber products, among others. In addition to these activities, in recent decades, tourism began to be an important activity for some peasants of the peninsula who saw in this activity a significant complement to their precarious income (Blanco, Enseñat and Mondragón, 2019).

The cenotes of the Yucatan Peninsula are flooded caves of fresh water and form one of the largest hydrological reserves in Mexico. Although most of the cenotes are still used for agricultural-livestock purposes, from 2014 to 2018 thirty-two new cenotes were registered with some type of tourist-recreational use (SEDUMA, 2018; SEFOTUR,

2017). This rapid change in the use of the cenotes is linked to the exponential economic and urban growth of cities such as Mérida and tourist regions such as Cancun-Riviera Maya and their hinterlands (Jouault & Jiménez, 2015). However, as with many tourist attractions, this growth is not homogeneous and there are cenotes that are rapidly gaining visitors, while others are losing them (García de Fuentes, Jouault, & Romero, 2015; McKercher & Du Cros, 2002).

The Dzombakal and X'batún cenotes are located in the Ejido of San Antonio Mulix, in the Mexican state of Yucatán. Of the total cenotes registered in the State of Yucatán, 56% are in *ejidos* (SEDUMA, 2018). The *ejidos* are lands of common use, located mostly in rural areas and whose property falls, in many cases, on indigenous groups.

Thus, a large part of the cenotes are managed by ecotourism cooperatives of Mayan peasants who, as social economy organizations, have a double challenge: on the one hand they need to maintain or increase the already high number of visitors who arrive to their cenotes because it represents a complementary source of income for members and their families (Jouault, 2018); and on the other, they must comply with the current environmental regulations that require them to have a load capacity study that limits the use of the *cenote* in favour of its conservation (SEDUMA, 2014). Although in Article 4, section VIII of the Regulation of the Environmental Protection Law of the State of Yucatán in matters of cenotes, caves and caves (SEDUMA, 2014) it is established that it is the responsibility of the executive power of the Government of the State of Yucatán to establish the methodology for the development of the study of tourist load capacity, this methodology has not yet been determined. Thus, the present study has two objectives: 1) Contribute to the construction of a methodology to estimate the tourist load capacity in the cenotes of Yucatan, through the identification of congestion standards and 2) Compare these standards between three types of visitors according to their local, national and international origin.

Excessive use of a resource by visitors in a natural area has principal impacts on two elements: on nature and on the visitors' experience. Initially, the focus was only on the impacts on nature and trying to quantify how many visitors are too much, thus emerging, the first applications of cargo capacity in tourist-recreational sites.

It was in the national parks of the United States in the 1960s when the first studies of carrying capacity in recreational areas were given. These studies sought to establish the maximum number of visitors that a park could receive before the natural resource began to be damaged (Manning & Anderson, 2012). Over time it was understood that the reduction of ecological impacts can only be achieved by considering the social impacts.

Thus, the impacts on the visitor's experience are incorporated as a fundamental element to reduce ecological impacts since both elements are interrelated and are two sides of the same concept. In other words, there is no conservation without people and only by incorporating social indicators in the management of the sites can the impacts on nature be effectively attacked.

To collect the data from this study, a quantitative questionnaire was designed based on normative theory. The questionnaires were administered, face to face, to a representative sample of visitors from the Dzombakal and X'batún cenotes in the high holiday season of April 2017. The samples are mutually exclusive (visitors surveyed in a cenote

are different from those surveyed in the other). The percentage of visitors who agreed to answer the questionnaire was recorded and the data was processed using the SPSS Statistics version 24 program.

The questionnaire is divided into two parts. The first includes general sociodemographic data, among which the place of residence that allowed classifying ecotourists into local, national and international. The second part includes a set of questions in order to understand the acceptance of visitors to the crowd (crowding acceptability) using a 9-point scale developed by Heberlein and Vaske (1977). The visual method was used due to the high levels of use that both cenotes present.

Visitors to each cenote were asked to assess the level of acceptance of the crowd on a 9-point scale (from +4 to -4) for a series of 6 photographs with different numbers of people each.

The photographs were manipulated with the Photoshop Ps6 program, so that 12 different images were obtained, 6 from each cenote. The first image of every 6 had zero visitors and the last one had the number equivalent to the maximum density of cenote use. That is, the maximum number of people at the same time that each cenote can accommodate according to its water surface (Figure 6 and Figure 7) and rest area, in square meters that each has. The maximum density of use of each cenote was considered as the limit of people that a tourist should be able to find in these spaces.

To estimate the maximum density of use (DMU), the total area of public use of each cenote was divided by 4 m², which is the estimated vital area necessary for a visitor to feel comfortable in recreational spaces (García Hernández, 2001).

Thus, the DMU was 80 people for X'Batún and 55 for Dzombakal. These numbers were those that were used in photograph number 6 of each cenote. The social norm curves were constructed with the averages of the responses on the level of acceptance that each visitor assigned to the photos. Visitors were also asked to indicate the photo that best reflects the number of people they prefer to see (Preference) and the photo that best shows the number of people that the ecotourism cooperative should allow to enter at the same time in each cenote (Management action).

The great challenge for cooperatives and other social economy organizations, in terms of setting limits on the use of the natural resource without undermining their income, is to find the balance between low rates and high demand or high rates and low demand. The former exerts more pressure on the resource but favours access to local people - mostly low and very low income - and discourages national and foreign visitors looking for natural sites with few people. The second helps to conserve the resource, favors the visit of national and foreign ecotourists but discourages access to premises due to their high rates.

This research proposes a methodology to measure the social dimension of the load capacity in cenotes of the Yucatan Peninsula and thus evaluate the negative impacts that the massification has on the visitor's experience. This methodology, which has already been applied in more than 181 natural and cultural sites, uses normative theory and visual method to determine visitor congestion standards according to their origin, since many cooperatives charge differentiated entrance fees, according to visitors are local (those who live in towns near the cenote, including the city of Mérida); nationals

(those who reside in other states of Mexico other than Yucatan) or foreigners (those who come from other countries).

The origin of visitors is one of the sociodemographic factors that can affect crowd standards (Neuts and Nijkamp, 2012; Rasoolimanesh, Jaafar, Marzuki and Mohamad, 2016). The results of this study show similarities and differences between the three types of visitors. International visitors are the ones with the lowest level of acceptance among the three types and the locals have the highest levels of acceptance. These results coincide with those found by Santiago, Gonzalez-Caban and Loomis (2008) and Sayan and Karagüzel (2010), which show that the standards of many Puerto Rican and Turkish local visitors are wider than those shown by foreign tourists from developed countries. In the cenotes, this could be due to cultural factors typical of the Mexican from rural areas or from small and medium-sized cities that perform recreational activities in a more collectivist way, in large groups and incorporating extended family members, while urban citizens from developed countries they practice recreation in natural spaces, especially as a couple, small groups or with members of the nuclear family (Manning, 2011; Santiago et al., 2008; Sayan, Krymkowski, Manning, Valliere and Rovelstad, 2013). However, these results do not coincide with those expressed by Jin, Hu and Kavan (2016) where visitors from Europe and North America feel less congestion at the Xi'an cultural destination in China, than Chinese and Japanese visitors.