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Crowding standards and willingness to pay at cenotes (sinkholes) of the Yucatan Peninsula: a comparative analysis of local, national and international visitors

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ABSTRACT

Most studies on crowding perception have focused on terrestrial natural areas and, to a lesser extent, on marine areas. The cenotes (sinkholes) of the Yucatán Peninsula are flooded caves that comprise one of the largest freshwater reserves in Mexico, and their use is rapidly changing from agricultural-livestock to tourism-recreational. Determining crowding indicators and standards has proven to be an effective tool in making the social dimension of carrying capacity in tourism-recreational sites operative and contributing to its sustainable management. This study used normative theory and the visual method to identify the crowding standards of visitors to two cenotes located in the community of San Antonio Mulix in Yucatán and to compare these standards in three types of visitors: local, national and international. Likewise, willingness to pay (WTP) for each type of visitor was identified and its correlation to perceived crowding was analyzed. The results found that visitor acceptability in both cenotes decreased as the number of people increased. In both cenotes international visitors have the most restricted crowding acceptability levels and are those who are willing to pay a higher entry fee. Finally, the results are discussed in the framework of better management of the cenotes.

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Introduction

The cenotes of the Yucatán Peninsula form the largest hydrological reserve in Mexico. The word 'cenote' derives from the Spanish adaptation of a Maya designation for a freshwater inundated cave, 'Ts'onot', and there are more than 3000 cenotes registered in the state of Yucatán (SEDUMA, 2018). Although most cenotes continue to be used for agricultural-livestock purposes, from 2014 to 2018 alone, thirty-two new cenotes were registered with some type of tourism-recreational use (SEDUMA, 2018; SEFOTUR, 2017). This

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rapid change in the use of cenotes is linked to the exponential economic and urban growth of cities such as Mérida and tourism regions such as Cancún-Riviera Maya and their inland areas (Jouault & Jiménez, 2015). However, as is the case with many tourist attractions, this growth is not uniform and there are cenotes that are rapidly gaining visitors while others are losing them (Enseñat-Soberanis, Frausto-Martínez, & Gándara-Vázquez, 2018; García de Fuentes, Jouault, & Romero, 2015; McKercher & Du Cros, 2002).

Of the total cenotes registered in the state of Yucatán, 56% are located on *ejidos* (SEDUMA, 2018), Mexican rural lands for collective use, and owned mostly by indigenous people. Hence, a large percentage of cenotes are found on communal lands and are administered by ecotourism cooperatives comprised in their entirety by Mayan peasants (García de Fuentes et al., 2015). Some of these cooperatives are faced with a dual challenge: on the one hand, they need to maintain or increase the already high number of visitors 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 prevailing environmental standards that require them to perform a carrying capacity study limiting the use of the cenote in order to protect it (SEDUMA, 2014). Although Article 4, Section VIII of the Regulations for the *Environmental Protection Act for the State of Yucatán in Matters of Cenotes, Caves and Grottoes* (SEDUMA, 2014) establishes that the Yucatán state government is the competent authority to develop the methodology to prepare studies of tourist carrying capacity, this methodology has yet to be defined. Therefore, our study has three objectives: (1) to contribute to the construction of a methodology to estimate the tourist carrying capacity in the cenotes of Yucatán through the identification of crowding standards; (2) to compare these standards in three types of visitors based on their local, national and international origin, and (3) to explore possible relations between visitor origin, crowding perception and the WTP.

Moreover, this study aims to contribute to the sparse literature about the influence of visitor origin in setting crowding standards and WTP in less-developed countries, where the cultural and economic characteristics of their inhabitants generate crowding standards and willingness to pay different from those generated by people from more developed countries (Santiago, Gonzalez-Caban, & Loomis, 2008; Sayan & Karagüzel, 2010; Sayan, Krymkowski, Manning, Valliere, & Rovelstad, 2013)

Crowding perception

Crowding is defined as the negative evaluation of the density of people in a single site (Alazaizeh, Hallo, Backman, Norman, & Vogel, 2015; Vaske & Shelby, 2008). It has its origin in the concept of carrying capacity, which began in the early 1960s considering only an environmental dimension, establishing connections between environmental damage and excessive visitors, to later include a psychosocial dimension that linked overcrowding with the deterioration of the quality of the visit (Manning & Anderson, 2012; Manning, Freimund, Lime, & Pitt, 1996; Rasoolimanesh, Jaafar, Marzuki, & Mohamad, 2016).

Although many studies have evaluated the impact of excessive visitors to natural areas (D'Antonio, Monz, Newman, Lawson, & Taff, 2013; Fennell, 2008; Hadwen, Hill, & Pickering, 2008; Leung & Marion, 2000; Weaver, 2013) and there is extensive literature on the environmental dimension of carrying capacity (Echamendi Lorente, 2001; Hammitt, Cole, & Monz, 2015; Leung & Marion, 2000; Manning, 2013; Manning & Anderson, 2012;

Newsome, Dowling, & Moore, 2005; Roman, Dearden, & Rollins, 2007; Segrado, Palafox, & Arroyo, 2008; Viñals et al., 2003), in practice academics have not come to an agreement in defining methods of setting the limits of ecological damage caused by an excess of visitors (Rasoolimanesh et al., 2016). In contrast, the psychosocial dimension of carrying capacity has proven to be useful in setting thresholds based on visitor expectations and experiences (Manning et al., 1996; Manning, Valliere, & Wang, 1999). Perception represents the most effective way to make the psychosocial dimension of carrying capacity operative and it does so through the formulation of quality indicators and standards of the visitor experience (Vaske & Shelby, 2008).

Crowding standards

A standard represents the minimum acceptable condition for each indicator (National Park Service, 1997) and an indicator 'is a sign summarizing key information on a specific phenomenon' (Frausto Martínez, Justo, & Santos, 2006, p. 175). Indicators make attributes of a social or natural phenomenon visible and standards are 'quantifiable value judgments reflecting what management is attempting to achieve' (Alazaizh et al., 2015, p. 2). Standards allow administrators to make decisions based on minimum quality limits that, once exceeded, require management actions (Manning, 2011; Vaske & Shelby, 2008).

The development of management frameworks for recreational sites involves three fundamental steps (Manning & Anderson, 2012): (1) formulate management objectives and associated indicators and standards of quality; (2) monitor indicators of quality, and (3) implement management actions when these standards are violated. In this way, the identification of crowding standards is a fundamental step in improving the management of a site. Crowding standards or norms are estimated in terms of the number and type of encounters a visitor experiences at a tourist or recreational site, encounters being understood as the number of people a visitor experiences at a site (Vaske & Shelby, 2008) that can vary not only in number but also in type: people on bicycles, motorbikes, boats, etc. Crowding standards reflect acceptable maximum numbers of visitors and their variability will depend, to a large extent, on the personal and social norms of each visitor or social group.

Normative theory

Initially developed in the fields of sociology and social psychology, norms have attracted considerable attention as a theoretical construction and empirical framework in the research and management of tourism-recreational activities. Norms refer to what is considered 'normal' or accepted by an individual (personal norms) or a social group (social norms) (Manning, 2013; Manning & Anderson, 2012). Unlike attitudes, which are positive or negative evaluations of behaviour, social norms have a punitive dimension that sanctions behaviour in a formal or informal manner (Manning, 2013). Many norms become public policy through rules, regulations or laws.

There are three approaches to the study and application of normative theory (Vaske & Whittaker, 2004): one that focuses on the variables that activate norms, another that studies the influence of attitudes and norms on the behaviour of individuals, and a

third that is related to structural characteristics models that seek to determine social standards. These models have been widely applied in natural areas through the *return potential model* (RPM) by Jackson (1966), which evaluates the acceptance of a social group towards a given behaviour. Applied to the psychosocial carrying capacity or perceived crowding of a site, the RPM allows social standards of acceptance of visitor behaviour in a tourism-recreational space to be established. The RPM is comprised of two main components that are graphed as lines on two axes: the x -axis representing the behaviour of the individual or social group and the y -axis representing the evaluation of that behaviour by means such as, for example, acceptability scales. The line that results from aggregating the data is called a *social norm curve*.

The social norm curve is plotted to describe the feelings of acceptance or rejection of group members about a specific dimension of behaviour in a concrete situation (Alazaizeh et al., 2015). The ratings by individual members of the group are averaged and serve as a basis for the curve. The curve describes different features of the norm, such as the range of acceptable condition, optimal or preferred condition, minimum acceptable condition and crystallization of the norm (Jackson, 1966).

Two approaches have been used to determine crowding standards in tourism-recreational sites: the first, narrative and numerical (Shelby & Heberlein, 1986), and the second, a decade later, fundamentally visual (Manning et al., 1996). Both approaches are based on asking visitors to evaluate the level of crowding at a site using an acceptability scale of the number of people, groups of people, vehicles or vessels they can tolerate seeing at the same time in a given place. However, it has been demonstrated that the visual approach is more appropriate than the narrative approach for sites with high visitor capacity, because it uses computer-manipulated photographs that make it easier to understand the concept of crowding (Manning et al., 1999).

Most applications of normative theory in tourism-recreational spaces have been in terrestrial settings of national parks in developed countries (Manning & Anderson, 2012). Some of these studies estimated crowding standards in inland water environments such as the Colorado River in the Grand Canyon National Park and the Virgin River in Zion National Park, both in the United States. In the Colorado River, the maximum number of encounters were determined for vessels and people visitors should come across during their journey along the river (Manning & Anderson, 2012). At the Virgin River, which runs at the foot of a narrow canyon and is attractive for many hikers for its landscape, it was found that the level of visitor acceptability began to decline after 22 hikers in the river at the same time (Manning, 2013). In a study on crowding and satisfaction in two rivers in Puerto Rico, 150 was the number of people per day yielding the highest level of visitor-reported satisfaction generated by the use of the rivers (Santiago et al., 2008). In marine settings, studies that apply normative theory to determine crowding standards are even more scant due to, among other factors, the absence on the open sea of physical and biological references that allow visitors to identify the presence of other people or vessels from the shoreline or as a passenger on another boat (Inglis, Johnson, & Ponte, 1999). In a study conducted in Koh Chang National Marine Park in Thailand on ecological and social standards of snorkelers in a coral reef area, it was found that visitor satisfaction begins to decrease when there are more than 35 snorkelers at the same time in the water (Roman et al., 2007). At the Great Barrier Reef in Australia the crowding acceptability standard was estimated as 22 snorkelers in an above-water view

and less than six snorkelers in the underwater scenes (Inglis et al., 1999). Other studies in marine environments have determined the tourist carrying capacity for divers on underwater trails (Ríos-Jara, Galván-Villa, Rodríguez-Zaragoza, López-Uriarte, & Muñoz-Fernández, 2013), but no research has been identified defining normative standards for crowding in confined inland waters such as flooded caves.

Origin of visitors and crowding

The factors that influence perceived crowding by visitors may be divided into two large groups: (1) factors intrinsic to the visitor such as sociodemographic profile (Rasoolimanesh et al., 2016), previous experience (Inglis et al., 1999), income (Sayan & Karagüzel, 2010), motivations (Jin, Hu, & Kavan, 2016), values (León, de León, Araña, & González, 2015), or culture/nationality (Jin et al., 2016; Juutinen et al., 2011; Rasoolimanesh et al., 2016; Santiago et al., 2008; Sayan & Karagüzel, 2010; Sayan et al., 2013) and (2) factors extrinsic to the visitor such as the physical and environmental characteristics of the site (Inglis et al., 1999; Juutinen et al., 2011; Roman et al., 2007) and the type of encounter (e.g. with groups of people, with people on bicycles, snorkelling, diving, etc.) (Inglis et al., 1999; Popp, 2012).

Among the intrinsic factors, visitor origin (nationality/culture) has been found to be associated with the determination of crowding standards, although empirically the results have not always been consistent. Neuts and Nijkamp (2012) found that Asian visitors to the city of Bruges, Belgium, have higher levels of tolerance to crowding than western visitors, while the opposite was found in the tourist city of Xi'an in China (Jin et al., 2016). Both studies found a significant correlation between the variables of visitor origin and crowding perception, but with different results. In a comparative study of national parks in Turkey and the United States, it was reported that U.S. and British visitors had less tolerance for crowding than Turkish visitors, which was attributed to the fact that the Turkish culture privileges closer contact, in contrast to the search for solitude in natural spaces that traditionally has characterized United States history and environmental policy (Sayan et al., 2013). These results are consistent with those found by Santiago et al. (2008) where local Puerto Rican visitors reported higher crowding acceptability standards than those expressed by foreign visitors.

Origin of visitors, crowding and WTP

One of the objectives of this study is to explore the relationships between the origin of visitors, crowding standards and the WTP. WTP (willingness to pay) is defined as the maximum amount of money a person is willing to pay for consuming a certain good or service (Frey, 2004) and its use plays a crucial role in the designation of entrance fees to tourism-recreational sites (Weaver, 2013). Setting appropriate entrance fees can be useful to: recover operating costs; improve the quality of services; contribute to the conservation of the environment and reduce or redistribute visitor demand (More, 1999). In less-developed countries that receive visitors from developed countries, the implementation of *differentiated entrance fees* where foreign visitors are charged more than local visitors, has proven to be an appropriate pricing strategy that contributes to providing a balance between gentrification and overcrowding at natural sites (Halpenny,

2002; Menkhous & Lober, 1996; Mowforth & Munt, 2009). Gentrification, on the one hand, because setting only high rates would mainly attract international visitors with greater purchasing power and more willingness to pay for less congested sites and on the other, overcrowding, because setting only very low rates could attract large numbers of local visitors with low willingness to pay, often to the detriment of the natural resource.

The origin of the visitor influences crowding perception, and this perceived crowding influences the WTP and the average spending of the visitor (Cicchetti & Smith, 1973; Jones, Wood, Catlin, & Norman, 2009; Juutinen et al., 2011; McConnell, 1977; Rasoolimanesh et al., 2016). In a study conducted at several beaches in Rhode Island in the United States, it was found that the more beachgoers were in the water, the less the visitor was willing to pay (McConnell, 1977). Similarly, in the Spanish Peaks Primitive Area in the United States, a significant decrease in WTP was found as the congestion of people in a space increased (Cicchetti & Smith, 1973). On the other hand, Juutinen et al. (2011) found that foreign visitors were willing to pay more than local visitors to visit a national park in Finland, and Jones et al. (2009) reports that U.S. and Southeast Asian visitors participating in a whale shark tour off the Ningaloo Coast of Western Australia on average spent more money than their German, British and Irish counterparts.

Study area: X'batún and Dzombakal cenotes on the Yucatan Peninsula

The Yucatán Peninsula karst aquifer is considered one of Mexico's most important water reservoirs and is the only source of water in Yucatán, where surface water is virtually absent (Bauer-Gottwein et al., 2011). This immense groundwater resource maintains highly diverse socio-ecosystems and the only window into this complex hydraulic system are the cenotes. There are different types of cenotes, according to their geological age, structure, and location. The cenotes at San Antonio Mulix represent two distinct types: Dzombakal is a relatively small cave cenote, where the water table is completely covered by rock, whereas X'batún, perhaps one of the best-known cenotes in the region, is a small open water table cenote at the bottom of a micro funnel drain basin without a cave ceiling. The distance between these two cenotes is however only hundreds of metres apart. Both are very stable environments with minimal fluctuations of variables such as temperature, salinity, pH and dissolved oxygen. The water is very transparent due to a continuous and imperceptible water flow, which enhances their potential for tourism. Cenotes are home to a number of small crustacean species, many of which are endemic (Alvarez, 2015).

Anthropogenic pollution of the Yucatan peninsula aquifer has increased over the last couple of decades, due to a burgeoning economic development and population growth on the Peninsula (Bauer-Gottwein et al., 2011). A component of that pollution comes from the relatively recent massive-tourism activity in the cenotes. Visitors can have several direct types of impact on the cenotes' ecosystems. The most immediate and visible is human derived discarded litter of all sorts, both above and under the water. Less visible but equally important are the emerging chemical contaminants (pharmaceuticals and personal care products – PPCPs), that include, among others, substances such as antibiotics, anti-perspirants, sunblock and insect repellent (Fink, Moelzner, Berghahn, & von Elert, 2017; Harada, Komori, Nakada, Kitamura, & Suzuki, 2008). These chemicals

may accumulate either at the water surface altering the water-gas exchange processes, or in the sediment. The effects of these PPCPs on the biota are still being debated.

The cenotes of Dzombakal and X'batún are located within the San Antonio Mulix Ejido, 49 km (30 miles) from the city of Mérida, capital of the state of Yucatán (Figure 1).

According to official data, the population of the San Antonio Mulix Ejido went from 44 to 33 inhabitants between 1990 and 2009 (INEGI, 1991; SEDESOL, 2013). 64% of the population is dedicated to ecotourism organized into two cooperatives: Xuux Ek and Tumben Zazil Kin Dzonot. The primary attraction offered by both cooperatives is the use of cenotes, in addition to providing lodging services in rustic cabins and meals in two restaurants. They also offer bicycle, snorkelling and camping equipment rentals. The Tumben Zazil Kin Dzonot cooperative, in addition to offering the aforementioned tourist services, is responsible for administering the use of the Dzombakal and X'batún cenotes for tourism. Ecotourism represents the main source of income for the population, as they charge an entrance fee for the use and enjoyment of the cenotes. In recent years, the number of visitors to both cenotes has increased significantly, registering a 12% increase between 2015 and 2016 alone, especially in weekend visitors from the city of Mérida and, to a lesser extent, visitors from other states in Mexico and other countries.

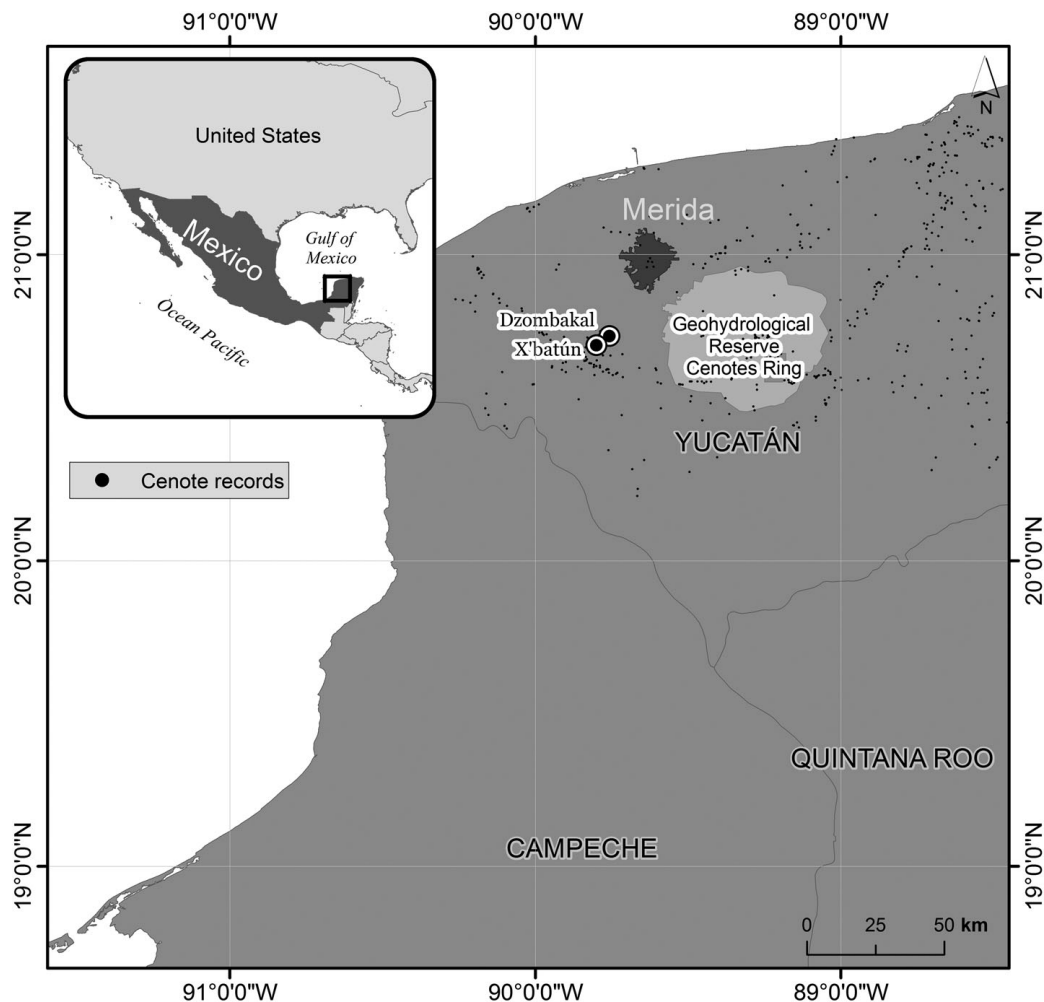


Figure 1. Map of the Ring of Cenotes hydrological reserve and the Dzombakal and X'batún cenotes.

Methods

To gather the data for this study, a quantitative questionnaire was designed based on normative theory and a question to estimate the WTP. The questionnaires were administered face-to-face to a representative sample of visitors of the Dzombakal and X'batún cenotes during the peak holiday season of April 2017. Samples were mutually exclusive (visitors surveyed in one cenote were different from those surveyed in the other.) The percentage of visitors who agreed to answer the questionnaire was recorded and the data were processed using SPSS Statistics Version 24.

The original questionnaire was written in Spanish and then translated into English and is divided into three parts. The first includes general sociodemographic data including the place of residence to allow us to classify ecotourists as local, national or international. The second part includes a set of questions to understand the crowding acceptability of the visitors using a 9-point scale developed by Heberlein and Vaske (1977). The visual method was used due to the elevated levels of use at both cenotes. The third part of the questionnaire inquired into the willingness of the visitor to pay to use the cenotes with different numbers of people at the same time, through direct questions.

Visitors from each cenote were asked to evaluate the level of crowding acceptability on a 9-point scale (from +4 to -4) using a series of six photographs, each with different numbers of people (Figures 2 and 3).

Photographs were manipulated with the Photoshop PS6 programme to obtain 12 different images, the first with no visitors and the last with a number equivalent to the maximum density of use of the cenote. That is to say, the maximum number of persons each cenote could accommodate based on its water surface (Figures 4 and 5) and rest area in square metres. The maximum density of use for each cenote was considered the limit of people that a tourist should be able to find in these spaces.

To estimate the maximum density of use (MDU), the total public use area 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) (Formula 1 and Table 1).

Formula 1

$$MDU = \frac{WM + RA}{VA}$$

where, MDU (Maximum density of use); WM (Water mirror); RA (Rest area); VA (Vital area).

Thus, the MDU was 80 people for X'batún and 55 for Dzombakal. These numbers were used in photograph number 6 for each cenote. Social norm curves were then constructed with the averages of the responses on the level of acceptability 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 indicates the number of people that the ecotourism cooperative should allow to enter each cenote at the same time (*Management Action*). In addition, they were asked to state the highest amount they would be willing to pay to access the cenotes with a different number of people at the same time. For this, each respondent was shown the series of six photos and was asked to allocate a maximum amount that they would be willing to pay as an entrance fee for each photo. To assist respondents with a point of reference, they were reminded that they had paid according to their origin (25 Mexican Pesos for local and national

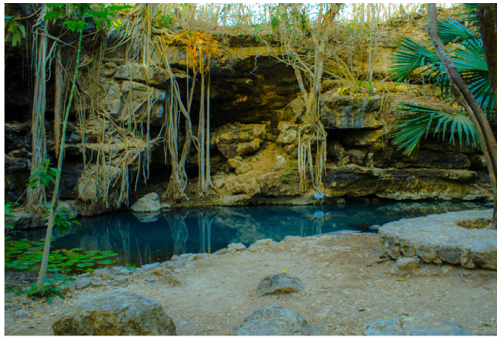


Photo 1: 0 visitors



Photo 2: 16 visitors



Photo 3: 32 visitors



Photo 4: 48 visitors



Photo 5: 64 visitors



Photo 6: 80 visitors

Figure 2. Photographs of the X'batún cenote used for the study. (Colour online)

and 50 Pesos for international visitors). The intention of this question was to explore the possible relationship between visitor origin, crowding perception and WTP.

Results

300 questionnaires were administered in each cenote with a response rate of 63% (189) in X'batún and 64% (192) in Dzombakal. Lost data and atypical cases (outliers) were identified and removed. Five outliers were eliminated in X'batún and seven in Dzombakal.

Visitor profile. X'batún cenote

Of the 184 questionnaires from X'batún, 56% were local visitors, i.e. from the state of Yucatán, mainly from the city of Mérida and towns near the cenote; 35% were national



Photo 1: 0 visitors



Photo 2: 11 visitors



Photo 3: 22 visitors



Photo 4: 33 visitors



Photo 5: 44 visitors



Photo 6: 55 visitors

Figure 3. Photographs of the Dzombakal cenote used for the study. (Colour online)

visitors, considered as all residents of Mexican states other than Yucatán; and 9% were international visitors. The largest proportion of respondents in X'batún were between 18 and 29 years of age (40%) followed by those between 30 and 44 (31%). The least numerous group was that aged 60 or above (4%). 42% had completed undergraduate studies and 11% had a graduate degree.

Visitor profile. Dzombakal cenote

Of the 185 final questionnaires, 58% were local visitors, 30% national visitors and 12% international visitors. The largest proportion of respondents were between 18 and 29 years of age (34%) followed by those between 30 and 44 (31%). The smallest group was that aged 60 or above (6%). 34% had completed undergraduate studies and 8% had a graduate degree.

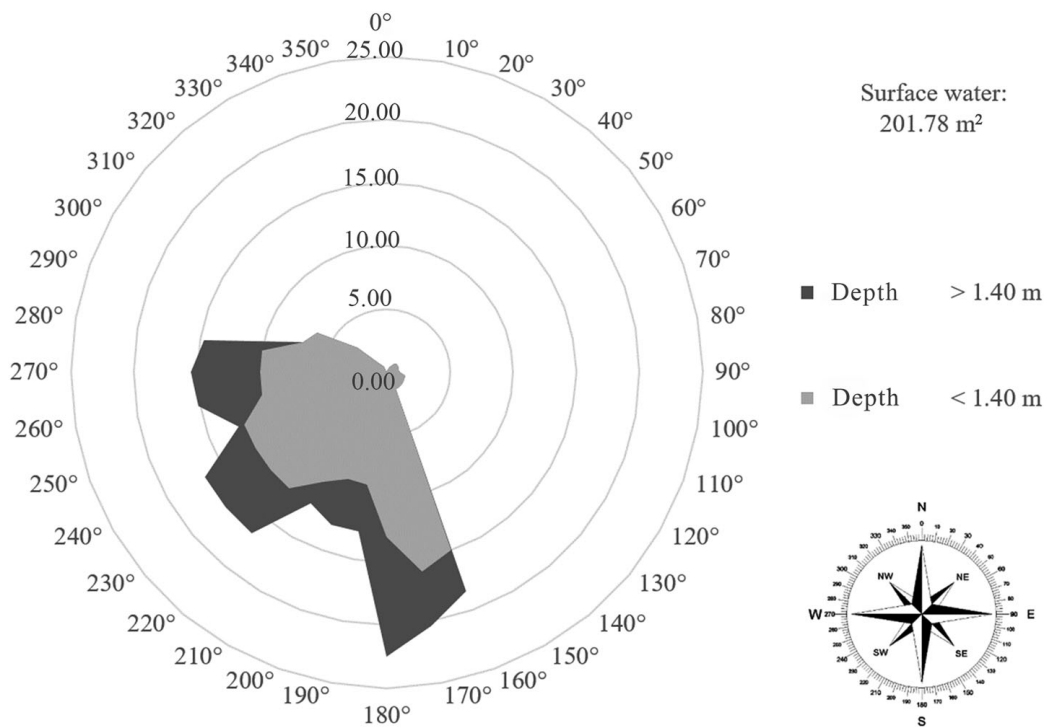


Figure 4. X'batún Water Mirror.

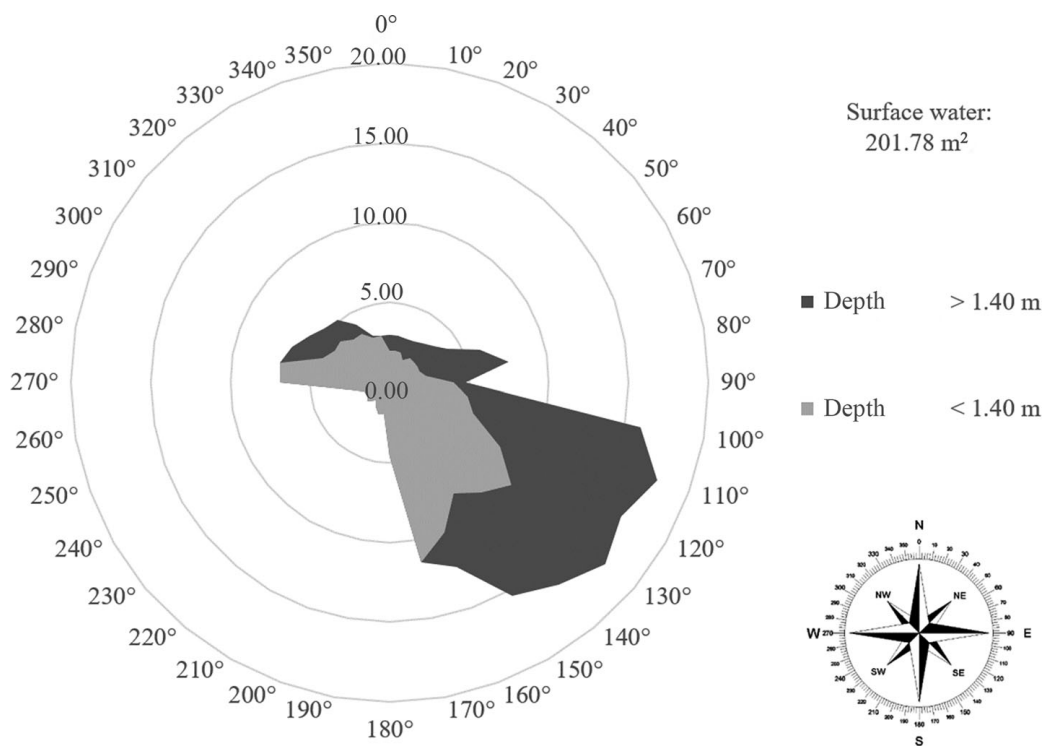


Figure 5. Dzombakal Water Mirror.

Table 1. Maximum density of use for both cenotes.

	Surface water mirror (m ²)	Rest Area (m ²)	Vital Area (m ²)	MDU (m ²)
X'batún	283.33	36.6	4	80
Dzombakal	201.78	18	4	55

Source: Prepared by the authors. (MDU was rounded to be able to designate the maximum number of people in the final photo).

In both cenotes, 70% of the respondents reported that it was their first visit there.

Crowding standards for all visitors to the cenotes

These findings allowed us to establish crowding standards for both cenotes and confirm that found in similar studies where the level of acceptability experienced by visitors decreases as the number of people in a given space at the same time increases. Using a 9-point scale (from +4 to -4) developed by Heberlein and Vaske (1977) where 1 equals 'not at all crowded' and 9 'extremely crowded', visitors rated a series of six photos for each cenote. Social norm curves were generated with the data obtained and the norm was crystallized through the second generation of the Potential for Conflict Index (PCI₂), which ranges from 0 to 1, where 0 indicates a low level of conflict and high consensus and 1 indicates a high level of conflict and low consensus (Vaske, Beaman, Barreto, & Shelby, 2010) (Figures 6 and 7).

In general terms, the averages of acceptability of crowding standards for all visitors to the X'batún cenote ranged from 3.10 to -3.14 as the number of people in the photos increased from 0 to 80. In Dzombakal the average acceptability ranged from 2.93 to -2.39 as the number of visitors increased from 0 to 55. X'batún registered a slightly higher range of acceptability than Dzombakal in terms of combined visitors, ranging from 0 to 37 visitors at the same time in X'batún and from 0 to 33 in Dzombakal. In other words, the accepted maximum number of people a visitor is willing to see at the same time in X'batún was 37 and in Dzombakal 33. In both cenotes, the highest level of acceptability is when the cenotes are empty. On average, all visitors combined preferred to see up to 15.7 people in X'batún and 15.3 in Dzombakal 15.3 (*Preference*). As for the average number of people the cooperative should allow to enter the cenotes, visitors indicated 32 for X'batún and 27.8 for Dzombakal (*Management Action*).

Potential for Conflict Index (PCI₂)

The results of applying the PCI₂ to crystallize the norm show a low level of conflict in both cenotes with slight variations from one cenote to another. The larger the circle, the greater the level of conflict. In the case of X'batún, the highest levels of conflict were recorded with 32 and 48 visitors at the same time in the cenote. In Dzombakal, this level was manifested in the low ranges of unacceptability, i.e. with 33, 44 and 55 visitors at the same time.

Crowding standards of local, national and international visitors of the cenotes

As may be observed in Figures 8 and 9 the level of acceptability for the three types of visitors (local, national and international) in both cenotes decreases as the number of people

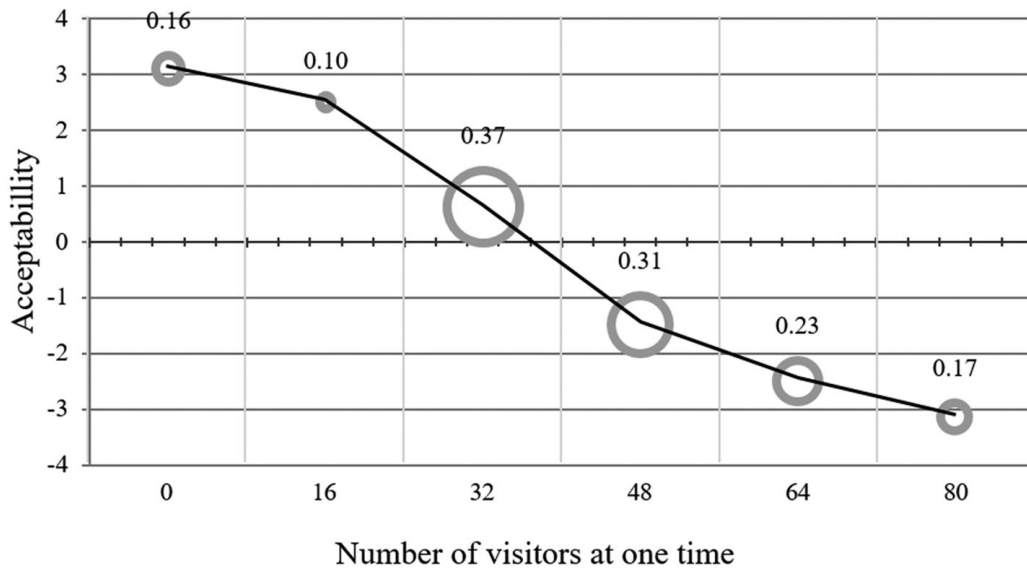


Figure 6. Social norm curve for the X'batún cenote.

increase. In both the X'batún and Dzombakal cenotes, the lowest acceptability level was found among international visitors, with 27 and 25 people at the same time, respectively. National visitors followed with 35 and 32 visitors at the same time and, finally, local visitors with the highest acceptability level: 40 visitors in X'batún and 35.5 in Dzombakal.

For all three types of visitors of both cenotes the number they prefer to see (*Preference*) is approximately twofold what they accept seeing, and the maximum number reported by respondents from which the ecotourism cooperative should implement management actions (*Management Action*) is close to the acceptability number (*Acceptability*) (Table 2).

To assess whether there are significant differences across the three types of visitors in terms of their standards of crowd acceptability, preference for number of visitors and maximum number at which the cooperative should implement management actions, a

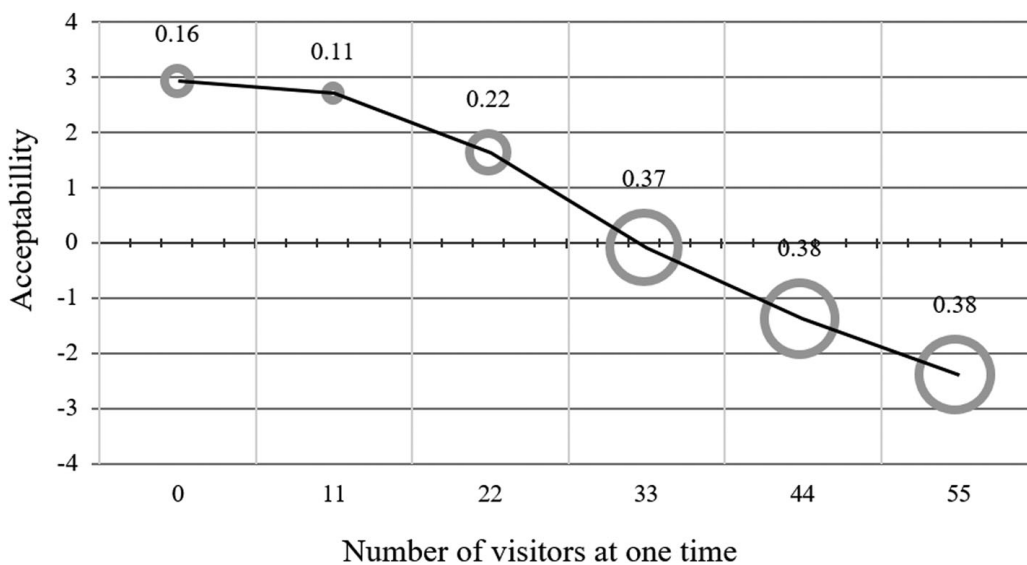


Figure 7. Social norm curve for the Dzombakal cenote.

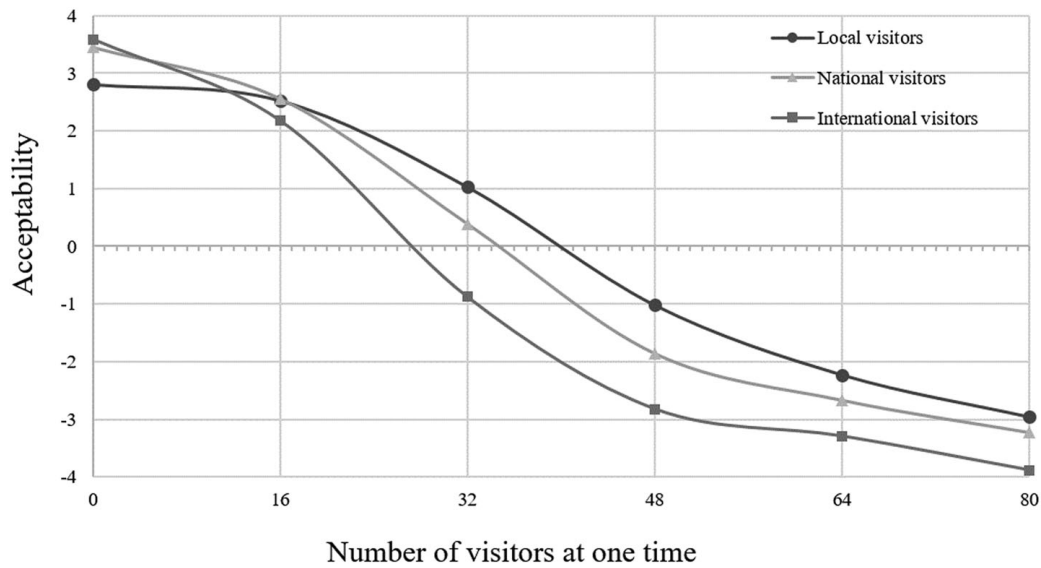


Figure 8. Social norm curve for type of visitor at the X'batún cenote.

one-way ANOVA was performed with Tukey's post hoc test using SPSS Statistics Version 24. Significant differences were found in both cenotes under the heading of *Acceptability* ($F = 3,191$, $p < 0.05$ for X'batún and $F = 5,417$, $p < 0.05$ for Dzombakal) but only between local and international visitors ($p < 0.05$). This confirms that the local visitors are those with the highest level of acceptability and the international visitors are the most restricted. National and local visitors as well as national and international visitors have statistically similar levels of acceptability.

As for the number of visitors they prefer to see, there were significant differences between local and national visitors ($p < 0.05$) at the Dzombakal cenote, with locals having a higher level of preference than nationals; comparisons between local and

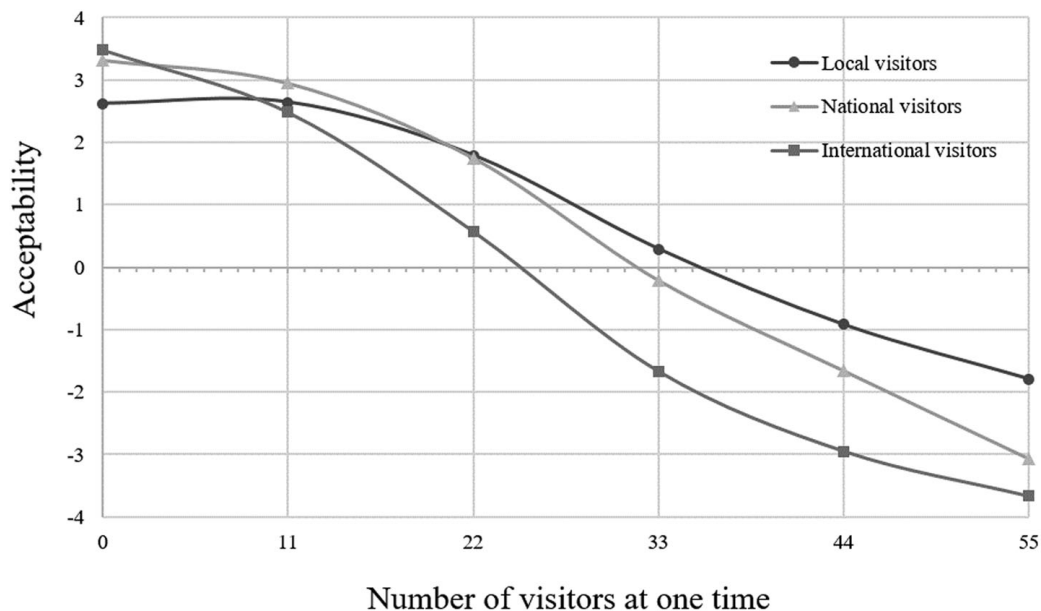


Figure 9. Social norm curve for type of visitor at the Dzombakal cenote.

Table 2. Comparison of Mean (SD) ratings of different evaluative dimensions and WTP.

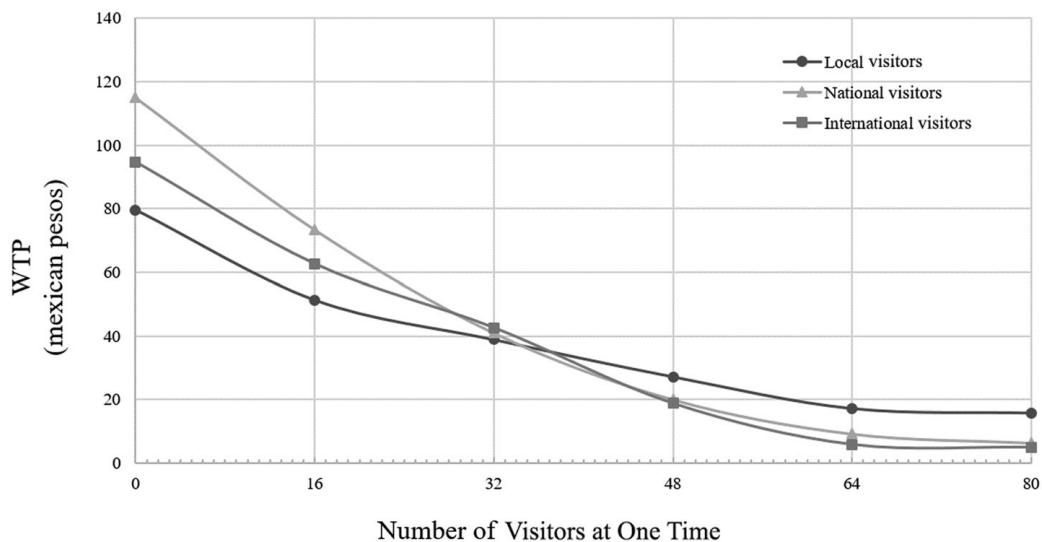
X'batún	All visitors N = 184	Local visitors N = 103	National visitors N = 64	International visitors N = 17	ANOVA	
					F	p
Acceptability	37 (1.4)	40 (1.5)	35 (1.3)	27 (0.6)	3.191	0.043
Preferences	15.7 (16.6)	18.2 (18.2)	13 (11.7)	11.3 (20.2)	2.636	0.074
Management action	32 (14.8)	34.3 (14.6)	29.8 (14.5)	27.3 (15.8)	2.925	0.056
WTP (mexican pesos)	31.7 (17.9)	27.4 (13.6)	36.9 (21.2)	38.3 (21.5)	7.242	0.001
Dzombakal	All visitors N = 185	Local visitors N = 107	National visitors N = 56	International visitors N = 22	ANOVA	
					F	p
Acceptability	33 (1.4)	35.5 (1.4)	32 (1.4)	25 (0.8)	5.417	0.005
Preferences	15.3 (15.7)	19.3 (17.1)	11.2 (11.9)	5.7 (8.9)	10.780	0.000
Management action	27.8 (11.9)	30.1 (12.0)	25.5 (10.9)	22.5 (11.3)	5.365	0.005
WTP	33.6 (18.8)	28.3 (13.6)	37.6 (17.3)	49.7 (31.3)	15.128	0.000

international visitors ($p < 0.05$) also found locals with a higher level of preference. Visitors to the X'batún cenote had statistically similar levels of preference.

Differences among visitors regarding the standards at which point they thought the cooperative should intervene (*Management Actions*) were also compared. In X'batún no difference was found between any type of visitor. In Dzombakal, differences were found between local and national visitors ($p < 0.05$) and between local and international visitors ($p < 0.05$), the locals being in both cases the group with the highest standard level and the internationals the group with the lowest.

WTP of local, national and international visitors of the cenotes

In both cenotes international visitors were those who said they were willing to pay more for a cenote with no or few people (Figures 10 and 11), followed by nationals and lastly locals.

**Figure 10.** WTP at X'batún cenote.

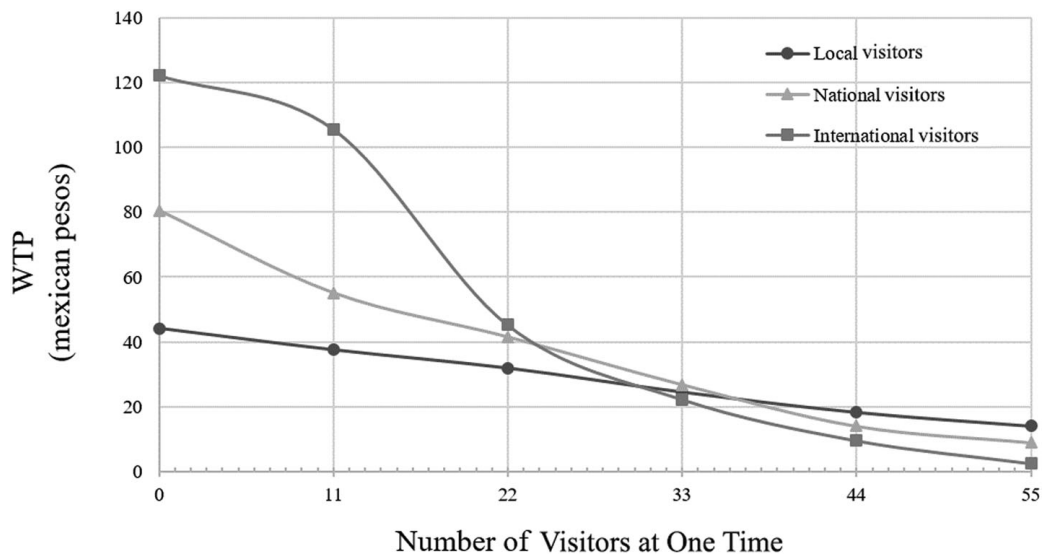


Figure 11. WTP at Dzombakal cenote.

A one-way ANOVA was also performed to compare differences across visitor types regarding their WTP at different levels of crowding. In X'batún, significant differences were found between local and national ($p < 0.05$) and between local and international visitors ($p < 0.05$), with the lowest average WTP (27.4) found among locals and the highest with international visitors (38.3). In Dzombakal significant differences ($p < 0.05$) were found across the three types of visitors, locals again being those with the lowest willingness to pay (28.3), followed by nationals (37.6) and finally international visitors with the highest willingness to pay (49.7). These quantities should be regarded cautiously as they are in comparison to the entrance fee to the cenotes in their present state and should not be used to allocate an economic value to these bodies of water (Juutinen et al., 2011). Economic valuation implies considering other components such as the cost of the trip to get to the site (Menkhaus & Lober, 1996).

Correlations of crowding and WTP at the cenotes

To determine whether there is a correlation between the crowding perception and WTP, Spearman rho bivariate correlations (Neuts & Nijkamp, 2012) were performed on the means of both variables with SPSS software version 24. The results may be observed in Table 3.

The only groups in which a significant correlation was observed were the international visitors of X'batún and the locals of Dzombakal. International visitors of X'batún

Table 3. Mean correlations between crowding perception and WTP.

	All visitors	Local visitors	National visitors	International visitors
<i>X'batún</i>				
ρ	-0.012	0.028	0.119	-0.623**
<i>Dzombakal</i>				
ρ	-0.035	0.212*	-0.198	-0.372

*significance $p < 0.05$, rho Spearman.

**significance $p < 0.001$, rho Spearman.

presented a moderately high negative correlation ($\rho = -0.623$; $p < 0.001$) between crowding perception and WTP indicating that the less visitors there are at the same time in the cenote, the greater the amount these visitors are willing to pay. Surprisingly, local visitors to the Dzombakal cenote are willing to pay more as the number of people in the cenote increase, presenting a low positive correlation ($\rho = 0.212$; $p < 0.05$).

Discussion and conclusion

Cenotes are localized flooded caves in the Yucatán Peninsula that form one of the largest hydrological reserve in Mexico. Their increasing tourism-recreational use, as well as environmental regulatory frameworks, require their owners and administrators, including several peasant ecotourism cooperatives, to perform carrying capacity studies even though there is no clear methodology proposed by government authorities. On the other hand, overly restricting the number of visitors to the cenotes would represent a decrease in the income of members of cooperatives and a negative impact on their families for whom ecotourism is a complementary activity.

This research is the first time that normative theory through the visual method has been applied to cenotes to determine crowding standards and explore the influence that this perceived crowding may have on the WTP of visitors based on their origin, as many cooperatives charge differentiated entrance fees depending on whether the visitors are local, i.e. those who live in communities near the cenote including the city of Merida; national, who reside in Mexican states other than Yucatán, or international, visiting from other countries.

Crowding standards were thus determined for two cenotes located in the San Antonio Mulix Ejido on the Yucatán peninsula: X'batún and Dzombakal. In both cenotes it was found that acceptability decreases as the number of visitors increases. In X'batún the total number visitors accept to see is no more 37 people at the same time, while in Dzombakal this number is 33, due, in part, to the fact that the public use surface in Dzombakal is more reduced than in X'batún.

The origin of the visitors is among the sociodemographic factors that can affect crowding standards (Neuts & Nijkamp, 2012; Rasoolimanesh et al., 2016). The results of this study show similarities and differences across the three types of visitors. International visitors are those with the lowest level of acceptability of the three types and locals are those with the highest levels of acceptability. In addition, local and international visitors were the only two groups with statistically significant differences in their levels of acceptability in both cenotes. These results coincide with those found by Santiago et al. (2008) and Sayan and Karagüzel (2010), which demonstrated that the crowding standards of many local Puerto Rican and Turkish visitors are broader than those found in international tourists of developed countries. In the cenotes, this could be due to cultural factors typical of Mexicans from rural areas or small and medium-sized cities who engage in recreational activities in a more collectivist manner, in large groups and incorporating members of their extended families, while urban citizens of developed countries tend to practice recreation in natural spaces as a couple, small groups or with members of their nuclear family (Manning, 2011; Santiago et al., 2008; Sayan et al., 2013). However, these results do not coincide with those reported by Jin et al. (2016) where visitors from Europe and North America perceived less crowding in the cultural destination of Xi'an, China, than Chinese and Japanese visitors.

Of the three types of visitors, international visitors are those with the lowest standard levels in terms of the number of people they prefer to see and the maximum number of people they think the cooperative should allow to enter the cenotes, followed by national and finally local visitors. These differences between types of visitors could also be rooted in cultural factors.

The statistical similarity of crowding standards (*Acceptability, Preference and Management Actions*) between national and international visitors in both cenotes may be explained because most national respondents came from large cosmopolitan cities (e.g. Guadalajara, Mexico City, Monterrey) with tourism and recreational practices more akin to those of urban international visitors than Mexicans from rural areas or small and medium-sized cities.

Crowding perception influences the WTP and average expenditure that visitors make at a tourist destination (Cicchetti & Smith, 1973; McConnell, 1977) and this WTP and average expenditure, in turn, are conditioned by the origin of the visitors (Jones et al., 2009; Juutinen et al., 2011). In X'batún, the fewer people there are in the cenote, the more international visitors are willing to pay. The foregoing coincides with Juutinen et al. (2011), which demonstrated that foreign visitors are willing to pay more than domestic visitors to enjoy a national park with few people, besides being the visitors with the highest incomes. In Dzombakal, the results of the locals show the opposite. Locals are willing to pay more as the number of people in the cenote increases. Although this result was surprising, it makes sense when considering the qualitative comments given by local respondents to interviewers during field work. Some local visitors state that an empty cenote fills them with fear and that they prefer to see it with large numbers of people. Once again, these results can be explained based on cultural features of the local Maya people for whom cenotes represent not only an economic resource but also places with symbolic value. Many locals believe that each cenote has a 'master' who guards it and can harm people (Valdez-Tah, 2006). For a complete description of Mayan myths and beliefs see Evia (2006, 2007).

Furthermore, many local visitors do not know how to swim, and an empty cenote increases their anxiety. Although they use them to cool off during holiday seasons in the warmer months, cenotes are not conducive to learning to swim because of their substantial depth and the presence of rocks and trees. While local visitors, mostly from medium-sized cities and rural areas, have used the cenotes as recreation spaces since their childhood, historically their socioeconomic characteristics have limited their access to swimming pools to learn to swim. Public swimming pools are non-existent in this region and private pools are only accessible to high-income families.

The crowding standards found in this study should contribute to an improvement in the management of cenotes of San Antonio Mulix since they make the social dimension of visitor carrying capacity operative and apply it to recreational spaces with confined waters. Crowding standards are an effective and simpler alternative for ecotourism cooperatives than the tourist carrying capacity developed by Cifuentes (1992) that has been widely used in natural protected areas of Latin America but that has limitations when adapting it to cenotes. The standards presented here should be taken into account by the cooperative and, when exceeded, necessary management strategies should be applied. Such strategies may range from limiting the number of visitors to distributing them in time and space through the establishment of entrance timeslots that allow the cenote to have a suitable visitor flow without crowding (Enseñat-Soberanis et al., 2018).

The results also help cooperatives set differentiated entrance fees that charge international visitors more and local visitors less but pose significant challenges to administrators. On the one hand, local visitors, who are the majority, pay little but are willing to pay more to see more people in the cenotes; on the other, a small group of international visitors who pay higher entrance fees and are willing to pay more to see fewer people in the cenotes. In other words, administrators should try to achieve a balance between the potential gentrification of the site reserved for foreign tourists paying a higher rate for a cenote that is exclusive or with few people but would exclude local visitors unable to afford it; and the mass influx of visitors of the cenote caused by the arrival of locals paying low entrance fees, in which case the resource could be compromised and no longer attract international visitors.

Thus, ecotourist cooperatives should avoid the massification of the cenotes even if this represents a reduction in local visitors. The low entrance fees paid by locals can be compensated by charging higher fees to nationals and internationals. It is important to acknowledge that a polluted resource would compromise the long-term viability of tourist activity, which in turn would affect the economic sustenance of the families who depend on cenotes.

Future studies should consider estimating crowding standards in other cenotes with physical characteristics that are different from those of San Antonio Mulix and compare results. Another pending research topic would be to determine the economic value of the cenotes using the travel cost model that takes in account not only the willingness to pay the entrance fee, but also the expenses related to the visitor's travel to the site (Menkhaus & Lober, 1996). The influence of crowding on the WTP in cenotes and other recreational sites with confined waters is another element in the literature of crowding that merits further research.

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