INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 23, No. 3, p. 76-84, 2023
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Carrying capacity assessment of Looc pebble beach in Surigao City, Towards its sustainability

Roceller Y. Abis, Medielyn M. Odtojan*, Ralph Nicole L. Balutan, Jeah C. Caitum

College of Arts and Sciences, Surigao del Norte State University, Surigao City, Philippines

Article published on September 09, 2023

Key words: Tourism carrying capacity, Looc pebble beach, Recreational carrying capacity, Sustainable ecotourism

Abstract

Looc Pebble Beach is one of the most well-known beaches in Surigao City. As it is seen to attract more tourists, it is necessary to determine conservation measures unique to its characteristics. This study aimed to determine the Carrying Capacity of Looc Pebble Beach, in terms of Tourism and Recreational Carrying Capacity. With a beach area of 13,052 sq.m. and by employing Boullon's Mathematical Model, it was revealed that the Looc Pebble Beach's Tourism Carrying Capacity is 394 visitors/day. It was found out on one hand, that its recreational carrying capacity are 64, 194, 14, and 382 persons per day for snorkeling, swimming, diving, and beach walking/sightseeing, respectively. In terms of social indicators for recreational carrying capacity, analysis revealed that the minimum acceptable condition of encounters for the tourist is 312 people per 502 x 26 meters and 416 for the locals at a given time. Whereas, in terms of facility indicators, results showed that all characteristics provided at the beach are considered important for the users and the majority of the them are also satisfied with the condition of the characteristics as well. Finally, all local respondents agreed that the whole operation of Looc Pebble Beach has helped them in terms of income generation. It is recommended to the management to maintain informational signage of rules and regulations in strategic areas and to keep the cleanliness in its vicinity to ensure that tourists' dissatisfaction does not increase.

***Corresponding Author:** Medielyn M. Odtojan ✉ modtojan@ssct.edu.ph

Introduction

Carrying capacity (CC) is frequently regarded as one of the innate properties of environments that limits excessive anthropogenic actions, allowing people take cautious steps—with sustainability, when consuming resources. As a concept, carrying capacity was primarily created in the science of population and environment, suggesting the maximum number of inhabitant species that a specific environment can tolerate without encountering failures or challenges (Llausàsa *et al.*, 2019). Assessing the carrying capacity of ecotourism spots and placing a safe number of individual that an ecosystem can safely support may be a common approach in maintaining a cautious and sound utilization of naturally occurring goods to prevent the degradation of resources.

Over a long time now, the Philippine approach to tourism implementation has continuously centered within the travel industry where ecotourism is seen as a specific example owing to its importance in offsetting the adverse effects of tourism footprints as well as the intensive reshaping of the country's tourism spots. The aforementioned is often a reason the government has formulated national laws and policies that will help protect the country's ecotourism assets. These approaches are practical tools that have been serving their means, providing formal guidelines for the tourism development and sustainability in the Philippines (Ignacio, 2019).

Beaches are one of the most important tourist assets in the Philippines and are widely cited as one of the primary drivers of development in the coastal areas of the country. Deciding their carrying capacity is a basic factor for their sound use and management (Rajan *et al.*, 2013). Surigao City Looc Pebble Beach is one of the city's most well-known beaches. This study aimed to determine the tourism and recreational carrying capacity of this beach in terms of the number of tourists that can be accommodated over a certain period of time, which will aid in improved tourism management that will help bring balance between development and conservation in the beach area in effort to promote sustainability of its tourism resources.

Material and methods

Study Area

This study focused on assessing the tourism and recreational carrying capacity of Looc Pebble Beach, Barangay Punta Bilar, Surigao City, Surigao del Norte. Surigao City is geographically located in Mindanao's northern region. Surigao City is a home of recreation and adventure due to its 17 panoramic islands. Looc Pebble Beach, as the focus of this study is located in Brgy. Punta Bilar, Surigao City, Province of Surigao del Norte. It is situated at N9.48826 E125.26291 with a beach expanse of 502m (Surigao City Ecological Profile, 2019). Looc Pebble Beach is one of the most popular tourism sites in Surigao City owing to its amazing beach features. The tourism destination is about 20 minutes away from the city proper and may be reached by boat and/or local-land transport such as motorcycles, tricycles, private cars, etc. The 300-steps trail uphill enables the visitors to see even the view of Mabua Pebble Beach and Brgy. Ipil.

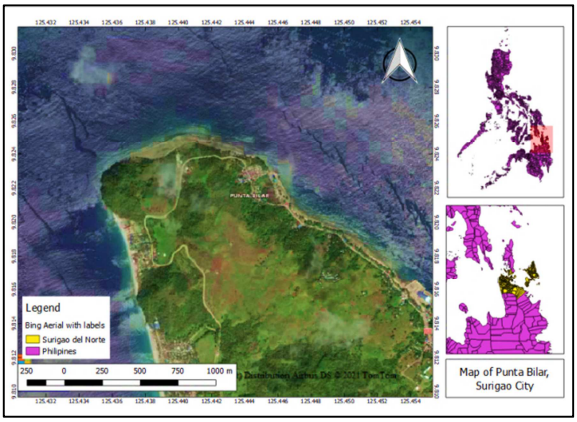

Fig. 1. Map of the Study Area.

Data Gathering

Random sampling was employed based on the households and their corresponding Serial Numbers situated within the geographic boundaries of Barangay Punta Bilar and Sitio Looc where the beach is located. The Household Serial Numbers (HSN) was used as means of picking respondents from the locals by randomly by lot.

Cochran formula was used in calculating the ideal sample size as this allows the calculation of sample size when the population to be sampled from is

unknown. The study's p-value is 0.5 with 95% confidence (yields 1.96 Z value) and at least 5 percent-plus or minus precision (0.05). Thus, there were 385 tourist respondents generated following the values mentioned. On the other hand, the sample size for local respondents at Sitio Looc was set at 148 individuals from its 239 households. This was determined by using the Raosoft online sample size calculator with a 95% confidence level, 5% margin of error, and 50% response distribution. The qualified respondents from the locals and tourists were those of ages 18 years old and above.

Carrying Capacity Calculation

This study used Boullon's formula in getting the Basic, Potential & Real Carrying Capacity of Looc Pebble Beach in terms of its Tourism and recreational activity carrying capacities. BCCMM is calculated at three levels: Basic Carrying Capacity (BCC), Potential Carrying Capacity (PCC), and Real Carrying Capacity (RCC).

1. First level: Basic Carrying Capacity (BCC)

$$BCC = \frac{Area\ used\ by\ visitors\ (sq.m.)}{Average\ visitor's\ standard\ (sq.m.)}$$

2. Second level: Potential Carrying Capacity (PCC)

$$PCC = BCC\ x\ RC$$

where:

$$RC = \frac{Total\ no.of\ hours\ a\ specific\ area\ is\ open\ for\ use}{Average\ no.of\ hours\ an\ area\ is\ used\ by\ visitors}$$

3. Third level: Real Carrying Capacity (RCC)

$$RCC = PCC\ x\ \frac{100 - Lf1}{100}\ x\ \frac{100 - Lf2}{100}\ x\ \frac{100 - Lf3}{100}\ x\ \frac{100 - Lfn}{100}$$

$$Limiting\ Factors\ (Lf\ 1,2,3\ \dots n) = \frac{M\ (a,b,c\ \dots n)}{MT}\ x\ 100$$

where:

M(a,b,c,...n)= limiting magnitude of the factor/variable

MT = total magnitude of the factor/variable

$$RCC = PCC\ x\ \frac{100 - Lf1}{100}\ x\ \frac{100 - Lf2}{100}\ x\ \frac{100 - Lf3}{100}\ x\ \frac{100 - Lfn}{100}$$

In determining the socio-demographic profile of the respondents; the perception of the local residents on the benefits they gained from the operation of Looc Pebble Beach and the recreational carrying capacity, the following statistical tools were used; to wit,

- Frequency count and percentage for the socio-demographic profile
- Cross tabulations, social norm/impact acceptability curve for recreational carrying capacity's social indicator
- Importance-performance matrix for recreational carrying capacity's facility indicator to determine the relationship between the importance and performance of facilities at the beach as perceived by the tourists (i.e., satisfaction).

Result and discussion

Tourism Carrying Capacity

Looc Pebble Beach has an area of 13,052m² (502 m long and 26 m wide) as determined through distance measurement in Google maps (beach length) and average management responses (beach wide). Table 1 shows the summary of data used for TCC calculation.

Table 1. Summary of data used for TCC calculation.

Data for BCC Calculation	Quantity
Total area requirement of Looc Pebble Beach for beach activity derived from Google maps and management responses.	13,052 m²
Standard area requirement for the activity per person in tropics	30 m²
Data for PCC Calculation	Quantity
Basic Carrying Capacity	435 tourist/day
The total no. of hours beach is open and safe for activities per day	12 hrs
Average tourist time	5.4 hrs
Rotation Coefficient (RC)	2
Limiting Factors	Quantity
1. Bad weather condition (typhoon, strong waves and current) in a year	30 days/year
2. Available time for activity (hr)	4 hours/day
3. Intense sunlight in a day (hr)	4 hours/day
Data for PCC Calculation	Quantity
Potential Carrying Capacity	
Limiting Factor (1)	8.22
Limiting Factor (2)	33.33
Limiting Factor (3)	33.33

Analysis showed that the Basic Carrying Capacity (BCC) of Looc Pebble Beach, in respect of the number of tourists is 435 per day considering its area which is 13,052 m². This is the number of tourists that the beach area can basically accommodate daily irrespective of other factors like the limiting factors.

Basic Carrying Capacity

Looc Pebble Beach has an area of 13,052m² (502m long and 26m wide) as determined through distance measurement in Google maps (beach length) and average management responses (beach wide). Analysis showed that the Basic Carrying Capacity (BCC) of Looc Pebble Beach, in respect of the number of tourists is 435 per day considering its area which is 13,052 m². This is the number of tourists that the beach area can basically accommodate daily irrespective of other factors like the limiting factors.

Potential Carrying Capacity

Sequentially, with the resulting BCC, the Potential Carrying Capacity (PCC) of Looc Pebble Beach is 967 tourists per day considering the basic carrying capacity, the time (in hrs) that the beach is available for tourists' use, and the average tourist time of use. This value entails the maximum number of tourists that will potentially fit into the area of Looc Pebble Beach daily, and therefore it should never exceed this range. According to the study of Zacarias (2011), the rotational coefficient is also an important variable to consider in determining the PCC as this is an indicator of a beach's overall tourism management development strategies. As PCC is one of the needed variables to determine the real carrying capacity value, which in turn is the ultimate basis for the determination of Looc Pebble Beach sustainable tourism management.

Real Carrying Capacity

The three limiting factors which are the environmental considerations that may limit the visit to Looc Pebble Beach or the use of a particular space/activity in the said beach are reflected in Table 6. It has been known to every resident and the management of Looc Pebble Beach that bad weather conditions such as typhoon, strong waves, and current is always experienced in a year in the place and is estimated for 30 days in a year. Moreover, the available time for activity on the beach is estimated to be 4 hours a day. The intense sunlight in a day also affects the activity on the beach and this happens from 11 AM to 3 PM. All these are the three limiting factors used in this study and are adapted on from a manual on computing carrying capacities in ecotourism sites by Calanog (2015) in the Philippine context.

The management of Looc Pebble Beach required only an area of 13,052m² for the beach activity. As perceived by the tourists, the average area they occupied when having activity in the beach is 310m² with the average time of activity is 5.46 hrs this is so because tourists are engaged in activities such as beach walking and sightseeing which requires a wider area of coverage for them to fully enjoy being at the beach. Moreover, as derived from secondary literature such as from publications of the World Tourism Organization as cited in the paper of Calanog (2015), the standard space requirements in beach areas is 30.0m²/person in the tropics like the Philippines. Although the potential carrying capacity showed a relatively higher no. of tourist visits that Looc Pebble Beach can accommodate in a day, reality showed as unveiled by the calculated value of the real carrying capacity that considering the factors that could limit the extent of activities in Looc Pebble beach such as, bad weather conditions, overall daily available time for beach activities, and intense sunlight in a day, Looc Pebble Beach can only cater a relatively lower no. of tourists visit per day which is at the maximum of 394 persons so that the quality of the beach may attain sustainability.

Conversely, as the number of tourists on the beach increases, tourists may feel that the beach is losing quality. The increasing number of tourists can also result in a gradual deterioration of the existing condition of the beach. As a result, natural properties and measures to recover their quality can be costly (Zacarias *et al.*, 2011; Odtojan & Amarille, 2023). Thus, the management should consider limiting the tourist visit to 394 individuals per day maximum as this value suggests the Real carrying capacity of the area to safeguard the quality of Looc Pebble Beach while simultaneously promoting enjoyment at the facet of the tourists. The summary of Tourism Carrying Capacity results as per the steps mentioned above; namely, BCC, PCC and RCC are shown in the table below.

Table 2. Summary of results for Tourism Carrying Capacity.

Looc Pebble Beach Tourism Carrying Capacity	Permissible No. of Tourists per TCC step
Basic Carrying Capacity (BCC)	435 visitors/day
Potential Carrying Capacity (PCC)	967 visitors/day
Real Carrying Capacity (RCC)	394 Visitors/day

Based on the overall analysis, it can be seen that PCC is greater than BCC, and BCC is greater than RCC. Among the three values, RCC is more applicable; values, however, can be improved. The determination of the tourism carrying capacity of Looc pebble Beach is relevant to the development of a strategy in improving the beach management since it reveals the maximum number of visitors that should be permitted given the current state and management capacity (Bera *et al.*, 2015). If the Real Carrying Capacity of the beach exceeded the BCC and PCC, then it could mean that the beach has already encountered a detrimental state since the maximum tolerable threshold has already been reached (Odtojan & Amarille, 2023). If it is the case, management is therefore advised to consider measures relevant to the area.

Carrying Capacity per activities at Looc Pebble Beach

The 385 tourists of Looc Pebble Beach were surveyed concerning the activities they love and enjoyed at the beach and results are displayed in Table 3.

Table 3. Activities the tourists enjoyed at Looc Pebble Beach

Activity	Frequency	Percent
Snorkeling	351	91
Swimming	385	100
Diving	271	70
Beach walking/sightseeing	385	100

Results showed that 100 tourists go to beach for swimming and beach walking/sightseeing. Generally, the majority of visitors at the beach liked to spend their time mostly for swimming and beach walking (Zacarias *et al.*, 2011). Furthermore, about 90% of them visit the beach also for snorkeling while 70% visit to simultaneously do the diving activity. A beach visit will always imply activities like swimming and sightseeing. In Looc Pebble Beach, not all of the tourists are into diving since they prefer taking photographs on the rock formation rather than doing the diving activities. On the ocular observation during the survey, it can be seen that the younger ones are more inclined to do diving from the rock formation while taking photographs at the same time in comparison to the older ones.

Table 4 presents the summary of data used and results of the computation on the Carrying Capacity of the beach on the specific recreational activities namely: swimming, snorkeling, diving, and beach walking.

Table 4. Looc Pebble Beach Recreational Activities' Carrying Capacity.

Factors	Snorkeling	Swimming	Diving	Beach walking/ sightseeing
Standard area requirement for activity	2510 m²	2510 m²	400 m²	10542 m²
Ave. area visitors covered	80.84 m²	35.43 m²	25.17 m²	294.94 m²
Available time for activity per day	11 hrs	12 hrs	12 hrs	12 hrs
Average tourist time	1.06 hrs	2.11 hrs	0.94 hrs	1.35 hrs
Standard area requirement for the activity per person	150.00 m²	30.00 m²	150.00 m²	50.00 m²
Limiting factor 1 (Bad weather condition (typhoon, strong waves and current)	8.22	8.22	8.22	8.22
Limiting factor 2 (Available time for activity)	36.36	33.33	33.33	66.66
Limiting factor 3 (Intense sunlight in a day)	36.37	33.33	33.33	33.33
Rotational Coefficient	10	6	12.77	9
Basic Carrying Capacity	17	84	3	211
Potential Carrying Capacity	173	477	34	1874
Real Carrying Capacity	64	194	14	382

With regards to the three (3) given limiting factors, the computed carrying capacity of the area for the 4 indicated activities was different even if they are situated in the same location. The reason for this is that the area sizes vary from one recreational activity to the other. Areas are only 10,542m² for beach walking, 2,510m² for swimming and snorkeling, and 400m² for diving. Findings revealed that the real carrying capacity of Looc Pebble Beach for snorkeling is 64 persons per day; swimming, is only 194 swimmers per day; for diving and beach walking/ sightseeing, the estimated and required numbers of persons per day are 14 and 382, respectively. Management is advised to limit their daily

tourists/beach users based on the computed values for the carrying capacities on each recreational activity. And therefore, it must not exceed in these values.

Recreational Carrying Capacity

Social Indicator

Social norms and the tourist perceived crowding are two factors used in this study since these are measures to: (a) estimate standards of quality for social indicators and (2) if standards are met or exceeded at a specific beach area. Fig. 2 showed the photographs utilized to assess the respondents' perceived crowding at Looc Pebble Beach.

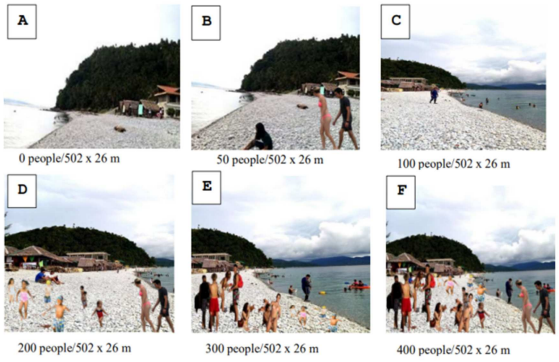

Fig. 2. Photographs for Assessing Use Level Norms at Looc Beach.

Social norms are used as standards for measuring the quality of a particular characteristic provided by a certain area, its activities and their corresponding management approach of whether it is good or bad. The respondents' perceived crowding was used as means to measure norms particularly their acceptance of the differing density of people in each of the six photographs through a 5-point likert scale of 1 "very unacceptable" to 5 "very acceptable" if it was to occur at Looc Pebble Beach. The averages on acceptability of each photograph were plotted on a social norm curve (Fig. 3).

Based on Fig. 2, both tourist and local respondents rated acceptable images B, C, D and E containing 50, 100, 200 and 300 people per 502 x 26 meters respectively. Conversely, images containing 0 and 400 people per 502 x 26 meters were both rated unacceptable by the respondents if it was to occur at Looc Pebble Beach. It can be seen on the graph that image A, a deserted setting received an "unacceptable" response from the respondents as compared to an image showing some level of use like image B. It can also be seen that for the the respondents, both deserted and overcrowded beach would not be ideal for their enjoyment and experience. As shown in Fig. 3, the minimum acceptable conditions were at approximately 10 people per 502 x 26 meters and no more than 312 people per 502 x 26 meters for the tourist and 416 people per 502 x 26 meters for the locals; these are the points where the curve passes the neutral line and thus can be used as points to illustrate the standard of quality for Looc pebble Beach for its 502 x 26 meters area before tourists satisfaction decreases and site characteristics degrade (Needham *et al.*, 2008).

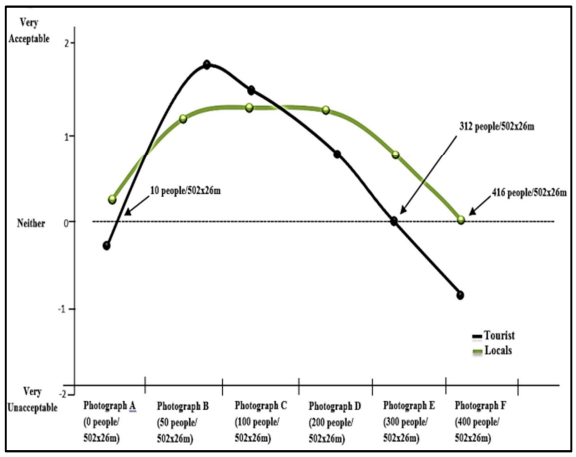

Fig. 3. Social Norm/Impact acceptability curve of the Tourist and Local Respondents.

Shown in Table 5 were amounts of how the respondents agreed or disagreed (i.e., agreement) on the acceptable conditions at Looc Pebble Beach.

These are the average standard deviations of the norm curve which are set at 0.80 and 0.88 for the tourists and 0.87 for the locals. A high standard deviation implies to a lower degree of consensus on the respondents' responses (Needham *et al.*, 2008 and Zacarias *et al.*, 2011; Ando *et al.*, 2022), in which the data shows that there is a moderate agreement between both the tourist and local responses on the acceptability of the conditions experienced at the beach.

Table 5. Characteristics of the Social Norm/Impact Acceptability.

Norm Characteristics	Norm Curve	Characteristics
	Tourist Respondents	Locals Respondents
Minimum acceptable conditions	10 people/502x26 meters and 312 people/502x26 meters	416 people/ 502 x 26 meters
Norm crystallization (range = 0 to 2)	0.80 and 0.88	0.87

Facility Indicators

As shown in Fig. 4, the majority of the users rated all the characteristics provide at Looc Pebble Beach as important for their overall experience and enjoyment. As to the users' satisfaction (Fig. 5), almost all of the them were satisfied with all characteristics especially with the clean ocean water, showers/rinse stations, comfort rooms, presence of life guards and parking availability for vehicles. However, two of the characteristics provided such as the absence of litter and informational assigns about guidelines and regulations need to be looked through by the beach owners. As described from Fig. 5, 94 users on "the absence of litter" were unsatisfied and 2 were very unsatisfied. Whereas, with informational assigns about guidelines and regulations, 29 users were unsatisfied. These two beach characteristics is recommended to be closely monitored by the management to ensure that dissatisfaction does not increase.

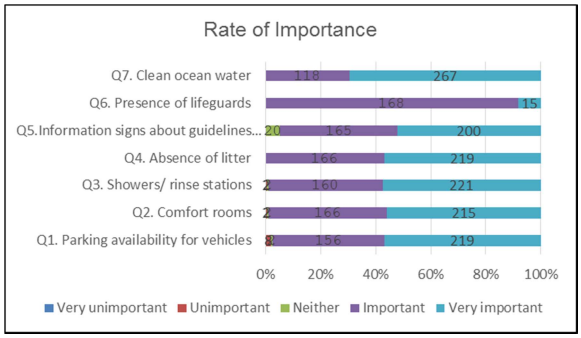

Fig. 4. Rate of Importance of the characteristics provided at Looc Pebble Beach Resort.

While some respondents were satisfied with the characteristics provided at Looc Pebble Beach, some may feel that these characteristics are not important to be actually established in the area. Thus, it is important to understand the relationship between the rate of importance and satisfaction of the respondents for each characteristic provided at Looc Pebble Beach. A visual representation of the relationship between the two measures was plotted through the Importance Performance (IP) matrix (Fig. 6). IPM is good method that could be used determining the relationship between beach visitors' satisfaction with the particular beach characteristics found at the beach and the level of importance beach visitors associate to those characteristics. This approach will determine which beach characteristics may demand for management attention (Needham *et al.*, 2008 and Zacarias *et al.*, 2011).

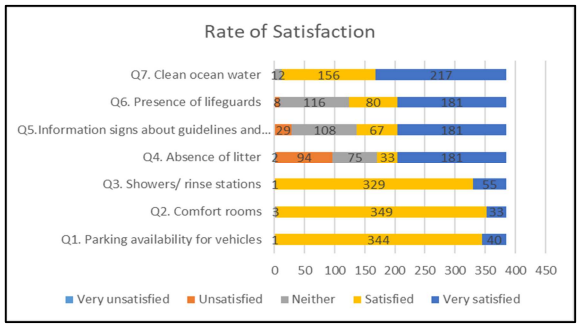

Fig. 5. Rate of satisfaction of the characteristics provided at Looc Pebble Beach Resort.

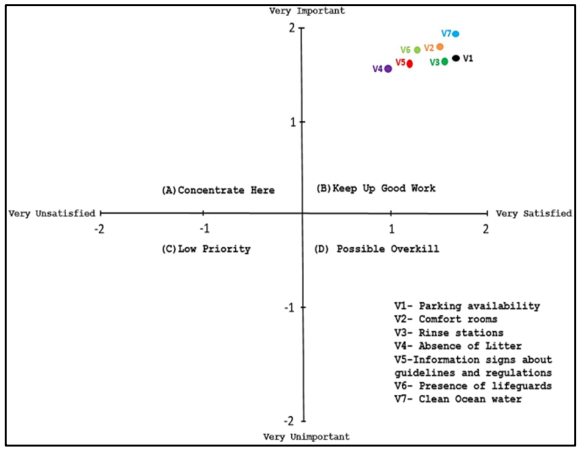

Fig. 6. Importance-Performance Analysis Visual of the Characteristics provided at Looc Pebble Beach.

Although the concept of tourist satisfaction is not well-defined, one of the factors that affect the aforementioned is a destination's characteristics that could also mean return of visit (Shahrivar, 2012 as

cited by Nabirye, 2018). Data presented in Fig. 6 showed a considerably large number of tourist respondents perceived the characteristics provided at Looc Pebble Beach as vital and important for their experience and enjoyment. Majority of the respondents were also satisfied with these characteristics. With these, beach managers and staff at Looc Pebble Beach are advised to maintain the status of management in the area in relation to the above characteristics. Although, few of the respondents (beach users) considered both beach litter and the informational signage as characteristics in need of management attention as reflected in Fig. 5 that these characteristics received "unsatisfied" responses by the beach users. This can be explained primarily by the fact that there are portions of the beach wherein particular beach owners could not, sometimes, attend to clean up garbage accumulated on the beach brought to shore mainly by tides and waves. Other beach owners do not have informational signage on proper solid waste disposal which could result in unwanted and irresponsible littering at the site. According to the study of Nabirye in 2018, plastic pollution caused by beach litter could result to reduced tourism activities, beach degradation, decreased social well-being and loss of aesthetic value. since beach cleanliness is said to be one of the most sought-after beach characteristics that affects tourist satisfaction.

Nevertheless, the rate of satisfaction at Looc Pebble Beach is high since all the characteristics fall on Quadrant B of the IPM visual (Fig. 6), suggesting that beach owners should keep up their current management strategies at Looc Pebble Beach.

Conclusions

This study revealed that tourist and local residents' perception vary in terms of preferences in usage and experience at Looc Pebble Beach in Surigao City. It is important to determine two varying sources of information (as from the tourists and local residents) in choosing best practices for beach tourism resources management. Both tourists and locals are factors for proper and optimal management of these resources. The tourism and recreational carrying capacity assessment of Looc Pebble Beach suggest the maximum permissible number of people that the beach can support taking into account the total beach area. The tourism real carrying capacity of Looc pebble beach is 394 tourists per day taking into account several factors and the total area of the beach. On one hand, the characteristics provided by the beach managers at Looc Pebble Beach are all relevant and important for the ultimate experience and preference of the tourists/users. Finally, majority of the respondents were satisfied with the characteristics provided at the beach but few of them were unsatisfied on beach litter and informational sign about guidelines and regulations. It is therefore recommended to the management to consider enhancing and strengthening some characteristics that influence the overall tourist enjoyment and the area's surrounding condition.

References

Abernethy VD. 2001. Carrying capacity: the tradition and policy implications of limits. Ethics in Science and Environmental Politics, **2001(1),** 9-18.

Ando SMY, Benlot GAC, Siva MGA, Tresiana EC, Odtojan MM. 2022. Tourism and Recreational Carrying Capacity of Octopus Islet Adventure in Bacuag, Surigao del Norte: An Essential Instrument for Sustainable Tourism. Journal of Social Responsibility, Tourism and Hospitality (JSRTH) ISSN 2799-1016, **2(03),** 1-15.

Brandolini SMDA, Mosetti R. 2004. Sustainable tourism development and social carrying capacity: a case-study on the North-Western Adriatic Sea. WIT Transactions on Ecology and the Environment 76.

Butler R. 2002. The development of tourism in frontier regions: Issues and approaches, 213-229.

Butler RW. 2020. Tourism carrying capacity research: A perspective article. Tourism Review **75(1),** 207-211.

Calanog LA. 2015. A Manual on Computing Carrying Capacity of Ecotourism Sites in Protected Areas. Department of Environment and Natural Resources, Ecosystems Research and Development Bureau. ISBN 978971-8831-48-9.

De Vera M. 2019. July. Localized Effective Tourism Carrying Capacity using Tourist Proxemics and Corrective Factors, The Case of Sabang Beach in Baler, Aurora, Philippines. In IOP Conference Series: Earth and Environmental Science **294(1),** 012016). IOP Publishing.

Declerck M, Verheul M, Daly D, Sanders R. 2016. Benefits and enjoyment of a swimming intervention for Youth with Cerebral Palsy: an RCT Study. Pediatric physical therapy **28(2),** 162-169.

Faiz SA, Komalasari RI. 2020. November. The assessment of tourism carrying capacity in Lombok Island. In IOP Conference Series: Earth and Environmental Science **592(1),** 012002). IOP Publishing.

Hobbs PR, Sayre K, Gupta R. 2008. The role of conservation agriculture in sustainable agriculture. Philosophical Transactions of the Royal Society B: Biological Sciences **363(1491),** 543-555.

Hunter C. 1997. Sustainable tourism as an adaptive paradigm. Annals of tourism research **24(4),** 850-867.

International Ecotourism Society. 2020. Ecotourism-A Path Towards Better Conservation. https://ecotourism.org/news/ecotourism-a-path-towards-better-conservation

Odtojan MM, Amarille MC. 2023. Carrying capacity assessment of the ecotourism site of day-asan, Surigao City towards sustainable ecotourism. International Journal of Biosciences **22(6),** 22-29.

Okech RN, Bob U. 2009. Sustainable ecotourism management in Kenya. Ethiopian Journal of Environmental Studies and Management **2(1).**

Pangemanan PA. 2012. (Similarity Check) Economic Analysis of Bunaken Nasional Park Ecotourism Area Based on the Carrying Capacity and Visitation Level.

Patil DY, Patil LS. 2008. Environmental Carrying Capacity and Tourism Development in Maharastra.

Quicoy AR, Briones ND. 2010. Beach carrying capacity assessment of coastal ecotourism in Calatagan, Batangas, Phlippines. Journal of Environmental Science and Management **12(2).**

Sadikin PN, Arifin HS, Pramudya B, Mulatsih SRI. 2017. Carrying capacity to preserve biodiversity on ecotourism in Mount Rinjani National Park, Indonesia. Biodiversitas Journal of Biological Diversity **18(3),** 978-989.

Saveriades A. 2000. Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. Tourism Management **21(2),** 147-156.