

# The Effects of Cave Exploration Activity Towards Kilim Geoforest Park, Langkawi, Malaysia

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## Abstract

There are many natural geological heritage sites located in Kilim, as the total area of the geoforest consists of karst rock that was formed 500 million years ago. Bat Cave is among the favourite spot for tourists to appreciate and explore geological heritage sites. The Bat Cave is a 200 million years' minerals formation site and a habitat for thousands of bats in the geoforest area. However, excessive tourism activities have affected various natural resources and wildlife habitat of Kilim Karst Geoforest Park, Langkawi. The Bat Cave is one of the geological sites that is most probably affected by tourism activities. The aim of this paper is to identify local residents and tourists' opinion in the effects of cave exploration and tourism activities to the habitat of bats and geo-physical characters of the Bat Cave, Kilim Karst Geoforest Park, Langkawi. The methodology employed in this study is based on questionnaire survey with 93% response rate (n=299). Questionnaires were distributed to tourists (65), local residents in Kilim (145) and staff (89) who are in charge in the tourism operation of Kilim Karst Geoforest Park. Findings of this study suggest that tourism activities such as cave exploration and sight-seeing activities caused deterioration towards the physical characteristics of natural resources and habitat of bats in the Bat Cave, Kilim Karst Geoforest Park, Langkawi. This is due to tourists not adhering to a proper procedure (e.g. frequent use of torch light) while exploring the cave. Respondents agree that there is a decline in the numbers of bat population in the cave. The management agency of Kilim Karst Geoforest Park needs to take steps in controlling or reducing the number of tourist arrivals by using tourism carrying capacity approach in order to promote stability. Exceeded population could cause destructions towards the resources. Degradation of natural resources indirectly would distract the natural symbiosis of the ecosystem.

**Keywords:** Bat Cave, Cave Exploration, Tourism

## Abstrak

Terdapat banyak tapak warisan geologi semula jadi yang terletak di Kilim, kerana tapak geoforest di kawasan ini terdiri dari batu karst yang terbentuk 500 juta tahun yang lalu. Gua Kelawar (Bat Cave) merupakan antara tempat kegemaran para pelancong untuk menerokai dan menghargai tempat-tempat warisan geologi. Pembentukan mineral di Gua Kelawar dianggarkan berusia 200 juta tahun dan menjadi habitat bagi ribuan kelawar di kawasan geoforest. Namun, aktiviti pelancongan yang berlebihan telah mempengaruhi pelbagai sumber semula jadi dan habitat hidupan liar di kawasan Kilim Karst Geoforest Park, Langkawi. Gua Kelawar merupakan salah satu lokasi geologi yang berkemungkinan besar terkesan akibat daripada aktiviti pelancongan. Tujuan kajian ini dilaksanakan adalah untuk mendapat pandangan penduduk tempatan dan pelancong mengenai kesan aktiviti penerokaan gua dan aktiviti pelancongan terhadap habitat kelawar dan karekter geo-fizikal Gua Kelawar, Kilim Karst Geoforest Park, Langkawi. Metodologi yang digunakan dalam kajian ini adalah berdasarkan tinjauan soal selidik dengan kadar tindak respon 93% (n = 299). Borang soal selidik telah diedarkan kepada pelancong (65), penduduk setempat di Kilim (145) dan kakitangan (89) yang terlibat dengan aktiviti pelancongan di kawasan Kilim Karst Geoforest Park. Dapatan kajian menunjukkan bahawa aktiviti pelancongan seperti penerokaan gua dan aktiviti melihat-lihat menyebabkan kemerosotan terhadap ciri-ciri fizikal sumber semula jadi dan habitat kelawar di Gua Kelawar, Kilim Karst Geoforest Park, Langkawi. Ini berlaku disebabkan pelancong tidak mematuhi prosedur yang betul (sebagai contoh; penggunaan lampu suluh yang kerap) semasa menjelajahi gua. Responden juga bersetuju bahawa terdapat penurunan jumlah populasi kelawar di gua tersebut. Agensi pengurusan Kilim Karst Geoforest Park perlu mengambil langkah mengawal atau mengurangkan jumlah kedatangan pelancong dengan menggunakan pendekatan daya tampungan pelancongan untuk meningkatkan kestabilan kawasan. Jumlah pelancong yang berlebihan boleh menyebabkan kemusnahan terhadap sumber daya. Kemerosotan sumber semula jadi secara tidak langsung akan mengganggu simbiosis semula jadi ekosistem.

**Katakunci:** Gua Kelawar, Penerokaan Gua, Pelancongan

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## ■1.0 INTRODUCTION

Natural resources are the earth resources. It consists of land, forests, minerals deposits etc. (Seaton, 2005). This earth biodiversity is important to be conserved as to balance the carrying capacity of the covered area. If any of those resources are gone, the natural symbiosis will be distracted. Various steps have been taken in conserving the natural resource from being extremely destructed by countless development comprising tourism. One of the efforts is the growth of sustainable tourism which is derived from sustainable development. The exertion is meant to sustain the environment for future generations. Natural resource conservation issues arose after public concern of environmental degradation began in the mid-nineteenth. However, this did not become a major concern for most people until in the late of twentieth century (Bowler, 2010). Consequently, there has been an explosion of awareness around the world in issues of sustainable development, ecological restoration, and resource management. All those issues were destined to reach the aim for natural resource conservation. Human is vigorously competing in emerging their nation for superiority purposes. Development for urbanization, industrialization and tourism earn revenues for the nation growth. According to Witbreuk (2000), the overall natural resources used in tourism activities are comprises of air and the atmosphere, water resources, oceans, ecosystems, fisheries, forest, wildlife, grazing, fields and irrigation systems. Developments are progressing without concern on the preservation of nature in order to seek more profits. This can be seen throughout the world where natural resources have been utilized to accommodate tourist needs for those who wanted to get closer to nature. In this modern era, since human are surrounded with massive development and urbanization, most people choose to escape themselves from hustle and bustle of the city by resting their mind and soul in nature area. Thus, Kilim has become one of the preferred destinations for nature lovers. Since Geopark Status has familiarized the site to the eyes of the world, Kilim has received countless of tourist arrivals. Nevertheless, this situation has also affected natural resources of the area. This research is carried out to ascertain the effect of cave exploration activities towards the natural resources and habitat in Bat Cave, Kilim in order to support the conservation effort that has been carried out at the site.

## ■2.0 LITERATURE REVIEW

### 2.1 Types Of Cave Exploration Activities

Cave exploration offers a range of exciting experience for tourists to explore the geological and natural features of the caves. The geological formations of the cave ceiling, wall and floor such as the straws, stalactites, curtains, stalagmites, flowstones and water deposit of rich minerals become a unique experience and knowledge to tourists. In addition, the natural features, especially the fauna ecosystem is unique and sensitive, in which most of them are very vulnerable to light and noise. Malaysian caves are home to fruit bats, swiftlets, and invertebrates beside having natural attractions of massive stalagmites and stalactites. The most significant habitat is the bats. The existence of millions of bats in a cave brings benefits to other fauna, in which other cave species depend on the bats for their survival. Bat sleeps on caves ceiling but fly at night in search of fruits and insects. They play a key role in sustaining other cave dwellers through their waste.

Generally, there are two types of cave exploration activities: an adventure cave exploration and a show cave exploration. Nonetheless, there is no exact group to define the types of cave exploration. Adventure cave exploration is experiencing cave ecosystem in its natural state. It means that the caves and its landform have very minimum facilities such as pathways and lighting. It is meant for visitors to appreciate the natural state of the cave's ecosystem. Just like any other nature adventures, conservation of the geological features of stalagmites, stalactites and all cave wildlife are crucial for cave tourism activities. This type of cave activity requires explorers to be in good shape and stamina due to rigorous physical movement during the journey. To explore the architecture wonder of the natural cave, visitors have to crawl, squeeze and slide their way through networks of tunnel and landforms. Thus, they must be guided with trained and experienced travel guide. Another type of cave activity is the show cave exploration. Show cave is a cave that has been equipped with facilities such as walkway, boardwalk, minimum lighting to ensure safety, accessibility, and comfort of visitors (Hazebroek & Abang Kashim, 2006). For instance, in the case of Bat Cave, a wooden footbridge is the main facilities for visitors to experience the geological features and the fruit bats that reside in the cave. Some of the rock formations can resemble a certain shape of animal or creature, thus making the journey mysterious and exciting for visitors. For example, there is a living stalactite that resembles a snake with dripping water on its mouth in the Bat Cave.

### 2.2 Current Cave Tourism Activities In Malaysia And Around The World

Geological heritage sites were formed naturally by either tectonic plate movements or other biological effect. Caves exploration are among the favorite geological heritage sites visited by tourists. The enjoyment of outdoor and photography activities become the motivation for people to explore caves. At the same time, learning the physical and biological features of the site can be a valuable knowledge for tourists. There are many caves in the world, which are home to various minerals such as stalactite and stalagmite, as well as exotic fauna such as variety of bat species and many more. It is clear that, other than for tourist attractions, geological heritages are perfect for educational purposes. In Malaysia, there are several interesting caves with various characteristics to be explored by tourists. Among the most well-known caves are Gua Niah in Miri, Sarawak, Clearwater Cave, Wind Cave and Deer Cave in Gunung Mulu National Park, Sarawak, Dark Cave in Batu Caves, Perak Cave in Ipoh, Gua Payong in Kelantan, Gua Kelam in Perlis and Gua Tempurung in Gopeng, Perak (Lim, 2020). The types of adventure and show cave explorations in these caves vary. For example, tourists can explore the pre-historic humans traces in Gua Niah and they can scroll around inside the 8<sup>th</sup> longest cave in the world in Clearwater Cave of Gunung Mulu using its plank walks, paths and floating bridges. For tourists who yearn for a more adventure in the 'wild', they can explore the pitch black, bat-infested cave, and see forest and rivers of Wind Cave of Gunung Mulu. They can visit the rarest spider in the world in the Black Cave in Batu caves too. Overall, these cave activities can fulfill tourists' expectations by paying a small sum of money.

However, as the tourism activities take place, many nature depletions have been recorded such as unruly tourists who destroyed stalagmite in caves (Scroton et al., 2016) and excessive tourist visits that degraded the environment in Pindul Cave, Yogyakarta, Indonesia (Musadad, 2017). Cave tourism is suggested to have caused damage to stalactite and stalagmite from tourists touching. It is informed also that 75% of animals living in the cave such as fish and bats have eliminated. A study by Pulido et al. (1997) highlights the Cave of Marvel,

Aracena, Spain, was opened to the public since 1914 and the quality of air, water and rock conditions has been affected due to excessive human activities. The authors stated that, a large group of human interference and the lighting device can increase the temperature of the cave and reduce the humidity that is needed by mineral formation in the cave. The temperature of the cave can increase up to 17°C due to the said circumstances and this situation can affect the condition of stalactite and stalagmite because the heat dissolves minerals and reduces the biological condition of the rock. To make matter worse, a man-made water pump was installed at that area and distracted the underwater system and vanished the ornamental effect of the water level. Those are the example situations from tourism activities that affect nature, which need to be prevented and rectified.

In terms of habitat condition, a study by Biswas (2009), Biswas & Shrotriya (2011) and Kunz & Fenton (2005) indicate that mammals usually alter their roosting sites in the cave as a result of human interference. This can be seen happening in the Kutumsar Cave located in Kanger Valley National Park, India. According to Biswas (2010), Kutumsar Cave is habituated by various wildlife such as leopards, bears, bats, fishes, frogs, cricket, insects, and more than 500 floral species. Various pools and magnificent limestone speleothem formations are among the nature attractions in Kutumsar Cave. During normal season, daily visitors coming to the cave is around 500 people and the number can increase up to 1500 people per day during public holiday. Although most visitors use artificial lights to torch bat habitat and see the enchanting speleothem formation, the bat population is reported unaffected by those anthropogenic activities because the number of bats varies according to seasons (Biswas & Shrotriya, 2011). On contrary, Donnell (2001) point out that tourist's activities such as bat watching, decline the number of bats in cave.

Clearly, tourism activities help in accelerating the local development and sustaining local economy. However, the execution of tourism activities was mostly influenced by human reaction towards the area. Massive tourism activities would affect nature in many ways. Therefore, Byers (2005) in his writing emphasizes that human behavior may affect the ecosystem as it is a connection between the ecosystem and social system. For instance, behaviors of some group of unconcern people in certain community towards nature would deplete the natural resources. Thus, the frequency and density of tourist arrivals need to be controlled in order to conserve the natural resources for future needs. Besides, degradation of resources could make the area from being a favorite tourist destination in years to come. Consequently, tourism activities need to be planned in more sustainable manner but at the same time providing various attractive tourists destinations.

### 2.3 Tourism Carrying Capacity

Tourism carrying capacity is a calculation method used to measure the number of tourist arrivals in tourism area without causing depletion towards the natural environment. A study conducted by Mohamad et al. (2014), described Tourism Carrying Capacity as capacities that were reached when visitors perceived the location as crowded. Thus, Attallah (2015) listed four forms of tourism carrying capacity which are:

- i. Physical Carrying Capacity  
It is the maximum number of tourist arrivals that can be accommodated by a tourism area. Besides, tourists also will be able to stay at the site at any given time as well as they can move comfortably within the area.
- ii. Economic Carrying Capacity  
It is a level of acceptable change within the local economy and tourist arrival, whereby, local economy can cater the tourist needs without the loss of local economic activities.
- iii. Social Carrying Capacity  
It is the level when both visitor enjoyment and crime rate are equal. For instance, if the visitor enjoyment is reduced and the crime rate is increased, this indicates the social carrying capacity has been exceeded.
- iv. Biophysical Carrying Capacity  
It is when the natural environment is capable to endure from tourist interference. This carrying capacity is defined as exceeding the limit when the natural destruction destroyed natural habitats for living things to survive.

Kostopoulou and Kyritsis (2006), Lagmoj et al. (2013), Kurhade (2013) and Rajan et al. (2013) agreed all of the above mentioned are different forms of carrying capacity that have been referred to in tourism. According to Marzuki et al. (2014), tourist arrivals in Kilim is considered as high and should be planned accordingly to avoid congestion. In addition, they also suggested responsible body to create tourists' awareness to overcome tourist overflowed issue. Therefore, it can be said that the numbers of tourist to the Kilim Geoforest Park have high carrying capacity and should be controlled to a considerable amount if measures to be taken for its conservation.

## 3.0 METHODOLOGY

### Bat Cave, Kilim Karst Geoforest Park, Langkawi, Malaysia

Kilim Karst Geoforest Park is situated at the Northeast of Langkawi Island in Malaysia. It covers an area of 500 acres which consists of Kampung Lubuk Mata Kuching, Kampung Pinang Karung, Kampung Tanah Rincik/Longgok, Kampung Bukit Sabar and Kampung Batu Gajah (Langkawi Development Authority (LADA), 2012). There are a lot of natural geological heritage sites available in Kilim, as the overall area consist of Karst Rock that were formed 500 million years ago. In fact, the name of Kilim Karst Geoforest Park was given after the name of the local rock. Among well-known geological heritage cave destinations in Kilim Karst Geoforest Park are 'Gua Kelawar' (Bat Cave), Gua Cherita, Gua Buaya and Gua Langsir. Every package of boating tour that available at Kilim Jetty offers a trip to various fascinating destinations especially the Bat Cave. Bat Cave is situated only about 1 nautical mile from Kilim Jetty and around 24 miles nautical from Tanjung Rhu Jetty. The size of Bat Cave is quite spacious. It covers an area of 1000m<sup>2</sup> and became the habitat for thousands of bats. There are two types of bats found inhabiting Bat Cave which are Fruit Bat and Long-tonged Nectar Bat. The mineral formations were believed to form since 200 million years ago into various unique shapes. With rapid development of facilities and amenities, Kilim receives more tourist arrivals yearly since after its' endorsement as Geopark Status. As per data gained from *Koperasi Kampung Kilim Langkawi Berhad* (KKKLB) and *Komuniti Pengurusan Sumber Perikanan* (KPSP) on tourist arrivals and boat trip in Kilim waterways, it can be concluded that there is an increment in both activities after Langkawi received an international endorsement from UNESCO as Langkawi

Geopark in Jun 2007. Table 1 indicated that number of boat trip was less than 5000 and tourist arrivals at Bat Cave was less than 50 000 people per year. However, the number was dramatically increased after it was recognized as Langkawi Geopark. Total of tourist arrivals in Kilim waterways can be equalized with the number of tourist arrivals at Bat Cave as the cave is the main tourist destinations in Kilim.

**Table 1** Types and total of human activities before & after recognition by UNESCO

Before endorsement by UNESCO (June 2007)		After endorsement by UNESCO (June 2007)	
Types of human activities	Total human activities	Types of human activities	Total human activities
• Boating tour	>5000 per year	• Boating tour	>10,000 per year
• Bat Cave visit	>50,000 per year	• Bat Cave visit	>100,000 per year

According to the record retrieved by (KKKLB), from 2006 until 2016, total numbers of tourist's arrivals at Kilim Karst Geoforest Park recorded were 1,873,345 people. Thus, the study believes that approximately similar numbers of tourists might visit the Bat Cave. Table 2 shows tourist's arrival records retrieved from the Langkawi Development Authority (LADA, 2016). The only average daily visitor arrivals at Bat Cave for year 2006 was below the estimation limit. It was recorded that from 2007 until 2016, Bat Cave received more than 180 visitors daily. Therefore, this huge number shows that physical carrying capacity in Bat Cave has exceeded the estimation limit. The excessive numbers of tourist arrivals in long term period should be taken seriously. The effect of tourism to the Cave of Marvel, Aracena, Spain, affected the natural speleothem and bat habitat inside the cave (Pulido et al., 1997).

**Table 2** Average daily visitor arrivals at Bat Cave

Year	Number of tourists Koperasi Kampung Kilim Langkawi Berhad (KKKLB)	Number of tourists Komuniti Pengurusan Sumber Perikanan (KPSP)	Total average visitors per day
2006	36 460	4000	40,460/365 = 111
2007	78 145	8 400	86,545/365 = 237
2008	114 665	13 520	128,185/365 = 351
2009	102 060	13 600	115,660/365 = 317
2010	117 931	13 840	131,771/365 = 361
2011	321 325	22 240	343,565/365 = 942
2012	273 449	18 768	292,217/365 = 801
2013	295 615	19 656	315,271/365 = 864
2014	274 629	18 000	292,629/365 = 802
2015	259 066	18 800	277,866/365 = 761
2016	212 552	20 160	232,712/365 = 638

Source: LADA (2016)

According to Mohamad et.al (2014), tourist arrivals in Kilim is high and should be planned accordingly to avoid congestion. The study believes that the additional criteria Bat Cave possessed which is far significant from other types of ecotourism is its richness in terms of the geological heritage value. With the international endorsement, Kilim Karst Geoforest Park, Langkawi has successfully attracted tourists and visitors. The pristine environments as well as geological heritage area with historical values make the areas as favorite destinations among nature lovers. Similarly, like most ecotourism areas, Kilim Karst Geoforest Park are also facing problems of excessive tourism activities that cause destruction to its natural resources like the Bat Cave. If income were positioned as the main purpose in tourism activities, natural resources will eventually loss by the hands of human. Thus, it is substantial to monitor the carrying capacity to sustain both local income and natural resources for future generations. In addition, Mohamad et.al (2014) suggested that, a responsible body needs to control and create more tourists' awareness to overcome tourist overflowed issue.

The population size for this research is 1300. Based on the standard formulae to determine sample size according to Krejcie and Morgan (1970), the study needs to obtain 297 sample of respondents. Respondents were selected using convenient sampling by stopping random individuals at the study area and asked them to participate in answering the questionnaire survey. Briefings were given before questionnaires were distributed to all respondents. The questionnaires then were returned to the researcher after the respondents have completed with their answers. Initially, 320 questionnaires were distributed to respondents. However, only 299 samples were valid to be proceeded for the data analysis process using ANOVA. Other than that, descriptive statistics were used to describe basic features of data to provide simple summaries about the samples of the study. Structured questionnaires were distributed to tourists and local residents in Kilim as well as staff who involved in tourism activities in Kilim Karst Geoforest Park, Langkawi. The highest sample were taken from the local residents (n=145). Whereas, staff of Langkawi Development Authority (LADA), Koperasi Kampung Kilim Langkawi Berhad (KKKLB) and Komuniti Pengurusan Sumber Perikanan (KPSP) were the second highest group of respondents (n=89) as they have knowledge about Kilim and witnessed the tourism activities in Kilim. Tourists (n=65) was the least sample taken as they may infrequently spent time and witnessed the changes of natural environment in Kilim. The survey data were then analysed using Statistical Packages for the Social Sciences (SPSS version 21.0) software. The questionnaires comprised of three sections consisting closed-ended questions. For Section 1- Respondents' demographic information, in the form of Nominal type that offers more than two unordered questions. Whereas, for Section 2- To identify whether tourism activities such as cave exploration affected bat habitat, and Section 3- To identify whether tourism activities affect the natural heritage in Kilim Karst Geoforest Park, using a Likert scale which is a scale attitude measurement that can be compromised based on social desirability. Polit and Hungler (2013) describe reliability as the amount of consistency and capability of an instrument to measure

the expected element. Therefore, to enhance the reliability of the questionnaire for this study, questions were constructed based on selected reference, briefing were given to the respondents and conducive places were chosen as to make them feel comfortable while answering those questions. The study also conducted a pilot test on 30 respondents. The validity of the standard questionnaire is validated using eigenvalue equal to or greater than 1 (eigenvalue  $\geq 1$ ) and confirmatory factor analysis (CFA) with the value of each variance is greater than 51% (CFA  $> 51\%$ ) for each question item. The reliability of the questionnaire was tested, and the result obtained was Cronbach's alpha coefficient ( $\alpha > 0.72$ ) and according to Pallant (2005), 0.70 or higher reliability coefficient is considered acceptable in most social science researches. Among the deleted items that was removed from the original questionnaire was 'tourists' arrivals increase vandalism in Bat Cave'. Deleting this question would increase Cronbach's alpha score to  $\alpha = 0.74$ , thus deletion should be considered.

#### 4.0 RESULTS AND DISCUSSION

Various kinds of human activities had interfered and affected wildlife habitat as well as the natural heritage area in Kilim. Tourism activities such as sight-seeing in Bat Cave had interfered wildlife habitat and unique natural heritage of the stalactite and stalagmite that has been formulated thousand years ago. The increment of tourist arrivals in Kilim ranging from 114% up to 780% since 2007 until 2016 (KKKLB, 2017) indirectly interfered the habitat and physical environment of the cave. The study found that the main tourism activity at the Bat Cave is sightseeing where visitors watch the bats habitat and speleothems closely while experiencing the cave environment. In order to view the bat population, lights need to be torch towards the mammals around the cave (refer Figure 1 and 2). As indicated earlier, the temperature of the cave can increase up to 17°C from lighting effect and this situation would affect the condition of stalactite and stalagmite. In the case of the Bat Cave in Kilim, normal temperature with less tourist recorded by researcher was 21°C and during peak hours was 30°C. This shows that the temperature increment was 9°C. The study believes that if the management of Bat Cave, did not control the number of tourists coming in, the quality of stalactite and stalagmite will be affected due to the increase of temperature by body heat and torch lights.

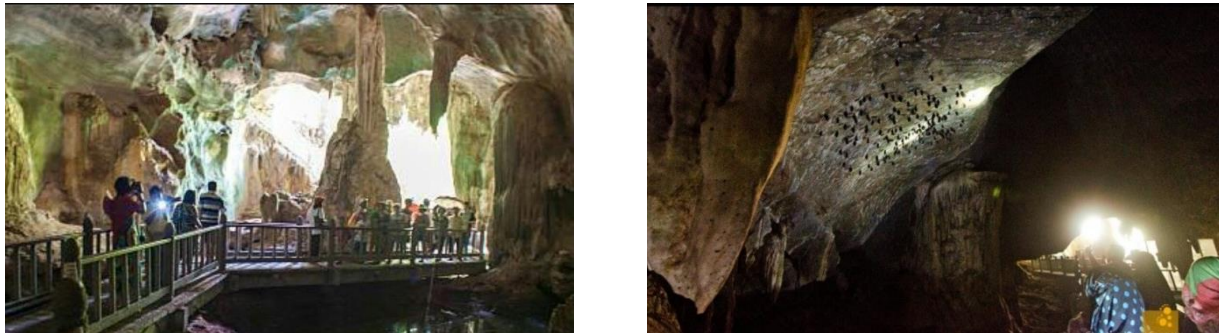


Figure 1 and 2 Tourists and guides using torch lights to torch bats in Bat Cave, Kilim, Langkawi  
Source: Researchers

Table 3 Post hoc comparisons using the Tukey HSD test to identify whether tourism activities affected bat habitat by category of respondents

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
local residents	145	3.97	1.808	.150	3.67	4.26	1	6
tourist	65	4.40	1.730	.215	3.97	4.83	1	6
staff	89	5.39	.961	.102	5.19	5.60	3	6
Total	299	4.48	1.696	.098	4.29	4.68	1	6

Based on the descriptive analysis obtained from the questionnaires, the study found that 92% of the visitors in Bat Cave lit up the lights to torch bats and speleothems while they were in the cave. Table 3 shows the lowest mean scores are local resident with 3.97, while tourist scores 4.40, and staff scores 5.39. This shows that majority of the respondents under the staff category agreed that tourists turn on their torch light during their visit at the Bat Cave. This means that they know more about the tourism activities inside the cave as some of the respondents under this category are boatmen and tourist guides who have been involved in tourism activities. A majority of respondents from the tourist's category also agreed to this statement. Hence, they are aware of the effects of tourism to the habitats in the cave. The result shows that there is a need of a mechanism to control and manage the micro-climatic conditions within the cave. This maybe carried out in terms of managing the quantity of tourists who can enter the cave within a certain period of time. Scientific research on the ideal temperature in relation to the number of light interferences can help to understand more on this situation. Other scientific information such as on effects of touching and handling stalactites and stalagmites in the cave by humans need also be recorded so that more information is known on the sensitive conditions of the site. Through this data, a proper carrying capacity way can be implemented.

**Table 4** Post hoc comparisons using the Tukey HSD test to identify whether cave exploration reduce bat population by category of respondents

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
local residents	145	3.21	1.783	.148	2.91	3.50	1	6
tourist	65	4.18	1.740	.216	3.75	4.62	1	6
staff	89	4.27	1.769	.188	3.90	4.64	1	6
Total	299	3.74	1.837	.106	3.53	3.94	1	6

Furthermore, the study would like to find out whether the population of bats in the Bat Cave are reducing due to the effect of cave exploration activity like sightseeing. Based on the descriptive analysis obtained from the questionnaires, the study found that 88% of the respondents agreed that high number of visitors at a time can increased the heat in Bat Cave and can affect bat habitat, as well as speleothem condition in the cave. Findings in Table 4 show that local residents score the lowest means with 3.21, followed by tourist with 4.18 and staff 4.27. The result shows that majority of the staff are aware and concern on the declining number of bats populations in the Bat Cave. However, it should be noted that as indicated earlier, a study by Biswas & Shrotriya (2011) highlights that tourism activities do not affect the bat population in the cave because the quantity of bats changes according to seasons.

Natural resources are important in stabilizing the ecosystem of an area. As for Kilim Karst Geoforest Park, the existing natural resources like the Kilim river and its' aquatic life, mangrove forest and wildlife as well as bats and speleothem in the cave possess multiple values and purposes to the ecosystem. One of the key criteria to sustain the endorsement of Langkawi Geopark from Global Geopark Network is to conserve the natural resources of the area (UNESCO, 2014). Thus, the research would like to know whether tourism activities affect the natural heritage in Kilim Karst Geoforest Park.

**Table 5** Post hoc comparisons using the Tukey HSD test to identify whether tourism activities affect the natural heritage in Kilim Karst Geoforest Park by category of respondents

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.339	2	9.170	3.150	.044
Within Groups	861.707	296	2.911		
Total	880.047	298			

Findings in Table 5 shows there was significant effect at the  $p < .05$  level for the three conditions [ $F(2, 296) = 3.150, p = 0.044$ ]. The above analysis was carried out to examine whether tourism activities affect the natural heritage of Bat Cave in Kilim Karst Geoforest Park. There was significant effect at the  $p < .05$  level for the three conditions [ $F(2, 296) = 3.150, p = 0.044$ ]. Post hoc comparisons using the Tukey HSD test indicated that the mean scores for local residents of Kilim opinion ( $M = 3.39, SD = 1.757$ ), tourist opinion ( $M = 3.68, SD = 1.552$ ), and staff opinion ( $M = 3.97, SD = 1.728$ ) were significant. The mean scores for the three categories group answers were slightly similar which are 3.97 for staff, 3.39 for local resident and 3.68 for tourist. Those scores show that all categories were strongly agreed that tourism activities affected the natural heritage in Kilim Karst Geoforest Park. In addition, all categories also possessed significant values which are less than 0.05, indicate that the data gained are very significant.

## 6.0 CONCLUSION

The management agency of the Bat Cave Kilim should take early initiatives in conserving the natural resources by controlling or reducing the number of tourist arrivals. Both sight-seeing and cave exploration activities to some extent may interfere both wildlife habitat and natural heritage at the pristine area. For that reason, tourist arrivals shall be controlled according to the carrying capacity that the area can accommodate without destruction. High capacity of anthropogenic activities in natural heritage area such as Bat Cave also might affect the natural resources in long term. Responsible body should be aware of the slight effect that might have been overlooked in order to retain the Geopark Status in future as well as to protect the nature for future generations. The study believes that before the quality of natural heritage in Bat Cave decline or become worsen as what had happened to the Cave of Marvel in Aracena, Spain, tourism activities in Bat Cave should be controlled i.e. to limit number of daily tourist arrivals to the cave. Therefore, Tourism Carrying Capacity approach needs to be monitored in Kilim in order to retain the Geopark Status by conserving the natural resources of the area. For that reason, tourist arrivals in Kilim need to be controlled, which simultaneously will control the cause of nature depletion in Kilim Karst Geoforest Park, Langkawi.

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