THE ESTIMATION OF PHYSICAL AND REAL CARRYING CAPACITY WITH APPLICATION ON EGYPT'S TOURIST SITES

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ABSTRACT

The concept of carrying capacity arose as an effective tool to avoid many negative impacts that occur as a result of excessive s' numbers. This paper aims at outlining the importance of carrying capacity application and estimating it for two of the main tourist sites in Egypt including the Egyptian Museum and Saint Katherine Protected Area, as a starting point to initiate its application on other tourist sites in Egypt.

The results indicated that the tourists visiting Saint Katherine Protected Area are less than its potentials, whereas the actual numbers of tourists visiting the Egyptian Museum are higher than the estimated values of its physical and real carrying capacity.

Keywords: Carrying capacity estimation, physical and real carrying capacity, Egypt's tourist sites, the Egyptian Museum, Saint Katherine Protected Area.

1 INTRODUCTION

Since tourism is dependent upon non-renewable resources and tourism flows are constantly growing, the rapid, as well as, the unplanned exploitation and utilization of these resources create the risk of their degradation and the probability of environmental hazards increases. Hence sustainable approaches need to be employed (Rajan et al., 2013). The aim of sustainable tourism development is the long-term and optimal use of tourism resources without causing negative impacts on the natural, social and economic environments (Jurincic, 2005). In terms of developing sustainable tourism, the concept of carrying capacity arose with the intention to avoid the saturation levels that both put natural and cultural systems at danger. It has received considerable attention and is often considered one of most effective ways to protect the destination physically, socially, culturally and ecologically by establishing the upper limits of visitor numbers allowed to enter a tourist site (Rajan et al., 2013), especially that ach tourist destination has a limited capacity to attract tourists, as well as, the related activities. Nevertheless, despite the growing concern for developing and utilizing tools that could facilitate planners and decision-makers in their efforts to control tourism development, there is limited experience not only in implementing tourism carrying capacity but also in measuring it (Coccossis and Mexa 2004).

Managing and redefining tourism development in the existing tourist destinations in Egypt is a key element in this research, which provides and attempt of estimating the tourism carrying capacity for tourist sites in Egypt. The major contribution of this research is to provide two examples of how the theoretical concept of carrying capacity can be practically applied and can serve the management of natural and historical sites in future planning. In addition, the results were compared with the actual tourists' numbers visiting both sites during the period from (2010-2013). This is the original finding of the current research that is not found in previous studies.

To meet these objectives, the following research questions were developed:

1- What is the maximum number of people that should be allowed to enter Saint Catherine Protected Area and the Egyptian Museum?

2- Has the carrying capacity of both sites been exceeded or is it still within its range?

2 LITERATURE REVIEW

2.1. Carrying capacity background, forms and definition

The term carrying capacity derives from wildlife ecology, as it was used to define the maximal population size of a certain species that an area can support without reducing its ability to maintain the same species in the future. It arouse from the perception that tourism cannot grow forever in a place without causing irreversible damage to the local system (Coccossis and Mexa, 2004). Since the 1970s, carrying capacity has been further developed as a precise technique and as a method of numerical calculation for determining land-use limits and development control for managing tourism in sensitive natural and cultural environments (Clark, 1996). Afterwards, a variety of more sophisticated planning and management frameworks have been developed, using qualitative methodologies. These frameworks set standards or ranges of acceptable change and describe a methodology for determining these standards, measuring impacts and identifying management strategies or controlling negative impacts. They include Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), Visitor Experience Resource Protection (VERP), Management Process for Visitor Activities (VAMP), Recreation Opportunity Spectrum (ROS), Tourism Optimization Management Model (TOMM). While each framework has a unique origin, they share common features and could be considered as different aspects of a specific monitoring and management strategy, i.e. making tourism sustainable in balance with other economic activities in the long-term. However, tourism carrying capacity remains an integral part of the management frameworks of most natural and cultural areas (Kostopoulou and Kyritsis, 2006).

The increased flow of either local or foreign tourists beyond the carrying capacity of any natural or cultural area may deteriorate its quality and destroy it. One way to deal with this problem is to identify the carrying capacity of the different areas and any tourism beyond the acceptable carrying capacity should be strictly prohibited (Rajan et al., 2013).

In 1994, the World Tourism Organization (WTO) proposed a definition of tourism carrying capacity as follows: "*The maximum number of* people *that may visit a tourist destination at the same time, without causing destruction of the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction"* (Nghi et al., 2007, pp. 80, 81). In addition, Hens (1998) defined the tourism carrying capacity as the maximum number of people that use a tourist site without causing negative effects on environmental resources while meeting the demands of tourists.

Moreover, Munar (2002) outlined that the carrying capacity provides the optimum level upon which resources can deteriorate or damage, by using a mathematical formula that determines the adequate tourists' numbers, and according to McNeely and Thorsell (1987) carrying capacity is the

maximum level of visitor use that an area can accommodate with high levels of visitors' satisfaction and few negative impacts on resources.

2.2. The various forms of carrying capacity

According to Kostopoulou and Kyritsis (2006); Lagmoj et al. (2012) and Kurhade (2013) and Rajan et al. (2013), there are a number of different forms of carrying capacity referred to in tourism; however this paper will focus on the most commonly used:

The physical carrying capacity is the maximum number that a tourist attraction is able to support. This carrying capacity is often used as a managerial tool that defines a threshold beyond which environmental changes, disturbance and problems occur.

The economic carrying capacity relates to a level of unacceptable change within the local economy of a tourist destination. It is the extent to which a tourist destination is able to accommodate tourist functions without the loss of local activities.

The social carrying capacity concerns the negative socio-cultural effects related to tourism development. It defines the amount of effects resulting from tourists on the host societies, as well as, the density tolerance rate of tourists.

The *biophysical carrying capacity* deals with the extent to which the natural environment is able to tolerate interference from tourists. In other words, it is the limit where the damage exceeds the habitat's ability to regenerate.

The environmental carrying capacity refers to ecological and physical parameters, capacity of resources, ecosystems and infrastructure.

The psychological (conceptual) carrying capacity refers to the maximum number of visitors for whom an area is able to provide a quality experience at any one time (Ceballos-Lascuráin, 1996).

The tourism carrying capacity is a specific type of environmental carrying capacity and refers to the (biophysical and social) environment with respect to tourist activity and development (Wolters, 1991).

2.3. Carrying capacity importance and estimation

Carrying capacity is a complex and variable concept in the field of tourism due to its multiple dimensions that have different thresholds and implications for tourism development (Kostopoulou and Kyritsis, 2006), even though it has significant contribution to sustainable tourism growth (Ceballos-Luscaráin, 1996). Experiences have shown that tourism carrying capacity has proved to be an efficient planning tool applicable in both less developed and highly developed areas (Academia, 2015).

Furthermore, Mexa and Coccossis (2004) indicated that despite several criticisms, carrying capacity assessment remains a powerful concept that can be used for planning and management of sustainable tourism. Besides, it is helpful in policy formation, planning of infrastructural facilities, natural resource allocation etc., as it permits managers of an area or tourist attraction to make decisions about the maximum intensity of visitation to be allowed in a given interval of time.

Additionally, Segrado et al. (2008) reported that apart from outlining all factors that limit tourism growth, the concept of carrying capacity also indicates compensatory tools to manage tourism flows to a destination. Mondal (2012) agrees with Ceballos-Luscaráin's viewpoint by arguing that while there are different kinds of adverse factors that reduce the carrying capacity of any destination, its assessment remains one of the most effective tools to detect the degree of negative impacts and intensity of use in tourist sites. Nevertheless, it is difficult to quantify the accurate carrying capacity value, since it is dynamic in nature in terms of space and time.

That's why, it is commonly recognized that there are no fixed or standard tourism carrying capacity values. Rather, carrying capacity varies, depending upon place, season and time, user behavior, facility design, patterns and levels of management, and the dynamic character of the environments themselves. In addition, it is not always possible in practice to separate the tourist activity from other human activities. However, tourism planning can benefit from attempts to define tourism carrying capacity for a specific site or sites since these will offer an indication of the limits and limitations to tourism development (Ceballos-Luscaráin, 1996).

There are various techniques available for the assessment of carrying capacity, the most and widely used one is the method proposed by Cifuente's (1992), which was further explained and applied by several other authors including Ceballos-Lascuráin, (1996); Munar (2002); Nghi et al. (2007); Segrado et al. (2008); Zacarias et al. (2011) and Lagmoj et al. (2013). This framework attempts to establish the maximum number of tourists that an area can tolerate, based on its physical, biological and management conditions of the area. This is accomplished by determining the site specific factors, representing the limitations of the area, which reduce the level and quality of visitation, by considering three main levels:

The physical carrying capacity (PCC): is the maximum number of visitors who can attend physically in a given place and time, To apply this method, it is important to consider tourist flows, the size of the area, the optimum space available for each tourist to move freely and the visiting time (Cifuentes, 1992).

The real carrying capacity (RCC): is the maximum permissible number of visits to a specific site, which is calculated according to the limiting factors resulting from specific conditions of that place and influence of these factors on the physical carrying capacity. It is worth noting that these limiting or corrective factors are not necessarily the same for each site; and only the negative factors which hinder or affect tourism activities are considered, among which the environmental factors are usually the most important. These factors are then translated into quantitative values (Nghi et al., 2007).

The effective or permissible carrying capacity (ECC): is the maximum number of visits that a site can sustain considering the RCC and the management capacity (Nghi et al., 2007; Zacarias et al., 2011; Lagmoj et al., 2013).

Each subsequent level constitutes a corrected or reduced level of the previous one, i.e. PCC is always greater than RCC and RCC is greater or equal to ECC.

The PCC can be expressed according to following formula:

$PCC = A \times V/a \times Rf$

Where: A = available area for public use

V/a = area required per user

Rf = Open period / Average time of one visit

The RCC is determined by the following equation

$RCC = PCC \times 100- Cf_1/ 100 \times 100- Cf_2/100 \times \ldots 100 - Cf_n/100$, where

$Cf = (M_1 / M_t) \times 100$

$Cf_1- Cf_n$ are the corrective factors, they are expressed as a percentage

M_1 = limiting magnitude of variable

M_t = total magnitude of variable

ECC = RCC x MC, where: MC = management capacity. Measuring MC is not easy, as it involves many variables, including policy measures, legislation, infrastructure, facilities, amenities and equipment, staff (both number and competency), funding, available budget, etc. (Cifuente, 1992; Ceballos-Lascuráin, 1996). Therefore, this is beyond the research focus.

3 METHODOLOGY

This research is quantitative, applied research. It relied on the most widely framework proposed by Cifuente's (1992), which was further explained, adapted and applied on the different tourist sites in the various countries, such as beaches (Zacarias et al., 2011; Rajan et al., 2013); eco-sensitive areas or protected areas (Kostopoulou and Kyritsis, 2006; Sayan and Ortaçeşme, 2006; Kurhade, 2013); forests (Lagmoj et al., 2013); museums (Mondal, 2012); caves (Nghi et al.,2007) and lagoons (Fadaee et al. 2013). Therefore, the research adopted this methodology for the estimation of the physical and real carrying capacity of Saint Katherine Protected Area and the Egyptian Museum.

This paper focused on Saint Katherine Protected Area and the Egyptian Museum, as study areas. Saint Katherine is acknowledged as World Cultural and Natural Heritage Site and is one of the largest and most important protected areas in Egypt. It is of unique history and includes enormous religious and culturally significant sites, as well as, the country's highest mountains that support a surprising biodiversity and endemic species (Mallarah, 2008; Ministry of Environment, 2015). As regards the Egyptian Museum, it is the largest and the most famous museum in Egypt.

The researcher attempted to estimate the maximum number of tourists that should be allowed to visit both sites without endangering the surrounding ecological, social and cultural environments. As an initial attempt and the difficulty to obtain information in Egypt, the related data for this particular purpose was not available. Therefore, the estimation included only the physical and real carrying capacity for both sites and excluded the effective carrying capacity due to the complexity of its calculation.

The researcher depended mainly on secondary data including various published and unpublished reports, case studies, as well as, assessment methods conducted by different nations, in addition to field visits and interviews held with the managers and tour guides of Saint Catherine Protected Area and the Egyptian Museum and questionnaires distributed among 300 tourists in the Museum. Furthermore, because studies on the area required per user are not available for both sites, the value of $1m^2$ was adopted from (Ceballos-Lascurain, 1996; Mowforth and Munt, 2003; Sayan and Ortaçeseme, 2006; Nghi et al., 2007; Sayan and Atik, 2011; Mondal, 2012).

4 STUDY AREAS

4.1. Saint Katherine Protected Area (Protectorate)

Description. In 1988, St. Katherine area was declared as a Nature Protectorate, under Law 102/1983, by Prime Minister's Decree no. 613. It occupies much of the central part of South Sinai with an area of about 4300km^2. The Protectorate is a complex system of mountains and valleys at the meeting of Wadi Asbaaiya with Wadi El-Arbain. Furthermore, it includes oases around water springs and wells that are unique attractions worldwide.

Besides, the area is characterized by the highest mountain tops in Egypt, among which the Monastery of St. Katherine and Mount Sinai are only two of its numerous outstanding cultural and religious heritage sites. Saint Katherine Monastery, founded in the 6th century, is said to be the only well-kept and intact Byzantine building from that period, in the world. It is the highest peak in Egypt (2,624 m above sea-level) and houses exceptional collections of early Christian manuscripts and icons.

In addition, the mountain setting is one of the country's biodiversity hotspots, supporting a diverse and unique assembly of flora, representing almost 40% of Egypt's total flora, many of which are rare, endangered and locally used as medicinal plants. Moreover, the Protected Area is equally rich in fauna, with several species not found elsewhere in Egypt or the world. All this richness has granted Saint Katherine Protected Area a particular importance as a cultural heritage site of international value which was the basis of a flourishing tourist industry in the past 20 years. Additionally, Bedouin communities living within the Protectorate pursue their traditional ways of life while participating in and benefiting from tourism, as community guards, manufacturers of handicrafts, guides and other ecotourism activities.

Climate. Saint Katherine area has an arid climate and rainfall is irregular. It lies within the Saharan-Mediterranean climate type and is considered the coolest area in Egypt. It has pleasant spring and summer, while the winter season is very cold and the nights could reach −14 °C. In addition, snowfalls in Saint Katherine take place regularly in the winter months (December, January and February) (National Egyptian UNESCO Commission, 2000; Nature Conservation Sector, 2006).

Tourism. Considering the tourist's flow to Saint Katherine Protected Area during the last four years (2010-2013), the number of tourists ranged in average between 320000 tourists and 350000 tourists yearly, in normal times, excluding the times of unrest (unpublished official data, Saint Katherine Protected Area).

4.2. The Egyptian Museum

Description. The Egyptian Museum in Cairo contains the world's most extensive collection of pharaonic antiquities. To prevent the plundering of archaeological sites by local and foreign treasure hunters, as well as, by consuls representing foreign countries and their agents, the Egyptian government collected and situated the Egyptian antiquities for the first time in a small building in the Azbakiah garden in Cairo. In 1858, another museum was established in Bulaq by Auguste Mariette. Later he built a great museum after the flooding of the first Bulaq museum in 1878, when many objects were washed away in 1890. The contents of the Bulaq museum were transferred to an annex of the Giza Palace of Ismail Pasha where they remained until the present museum was opened in 1902 at Tahrir Square (El- Shahawy and Atiya, 2010).

Designed in the Neoclassical style by the French architect Marcel Dourgnon, the Egyptian Museum hosts 107 halls, filled with artifacts dating from the prehistoric through the Roman periods. The museum houses approximately 160,000 objects including mummies, sarcophagi, pottery, jewelry and King Tutankhamen's treasures (the boy-king's death-mask discovered in its tomb is made of solid gold and it has been described as the most beautiful object ever made), covering 5,000 years of Egypt's past (Supreme Council of Antiques, 2011; Egypt Tourism Authority, 2014).

Interior design. The collections found on the ground floor, including an extensive collection of papyrus and coins used in the ancient world, are organized chronologically. On the papyrus, several languages can be observed including Greek, Latin, Arabic, and ancient Egyptian. Besides, on the ground floor, there are artifacts from the New Kingdom, the time period between 1550 and 1069 BC. These artifacts are generally larger than the items created in earlier centuries. Those items include statues, tables, and coffins etc. On the first floor, there are artifacts, grouped according to tomb or category, from the final two dynasties of Egypt, including items from the tombs of the Pharaohs Thutmosis III, Thutmosis IV, Amenophis II and Hatshepsut. On the second floor there are also many of the New Kingdom royal mummies (Supreme Council of Antiques, 2011; Egypt Tourism Authority, 2014).

Tourism. According to the data obtained from the Egyptian Museum, in 2010 42895537 tourists entered the museum. In 2011, the number of tourists fell dramatically to reach 12604891 tourists due to the Egyptian Revolution. Then the numbers increased to 17211417 and 22512320 in 2012 and 2013, respectively, after the political conditions in Egypt have improved. These numbers are depicted by (Table 1).

Table 1 Numbers of Tourists

Year	No. of Tourists
2010	42895537
2011	12604891
2012	17211417
2013	22512320

Source: The Egyptian Museum (unpublished data).

5 RESULTS

5.1. Carrying capacity estimation for Saint Katherine Protected Area

Physical carrying capacity. PCC = A x V/a x Rf

The available area for visitor use is 2950 km^2 (=2950000 m^2) (unpublished official data, Saint Katherine Protected Area).

Area required per user = 1 m^2

Open period of the Protected Area= 24 hours (Saint Katherine park office).

Average time of one visit= 10 hours (pers. communication with the manager and tour guides of the protected area).

Rotation factor: Open period / Average time of one visit = 24 hours/10 hours = 2.4, this means theoretically, a person could make 2.4 visits in one day.

Thus, PCC= 2950000 x 1x 2.4 = 7080000 tourists per day

7080000 x 365 = 2584200000 tourists per year.

Real carrying capacity. RCC = PCC x 100 -Cf_1/100x 100 -Cf_2/100 x … 100-Cf_n/100

The interview held with the manager and tour guides in Saint Katherine protected area revealed that the climatic conditions are mainly the limiting factors in the area, of which excessive sunshine and snowfall were identified as the most important The days of excessive sunshine and snowfall

were calculated after the investigation of Saint Katherine weather according to Cedar Lake Ventures, Inc (2014) and Weather2Travel (2014).

Excessive sun shine

At Saint Katherine, approximately for 4 hours sunshine is intense all over the year, making visits to the site very uncomfortable. During the winter season, which lasts for three months, intense sunshine is reduced to 2 hours.

Hence, 273 sunny days per year (9 months) x 4 excessive sunshine hours per day=1092 hours of excessive sunshine per year.

92 sunny days (3 months of winter) x 2 excessive sunshine hours per day = 184 hours of excessive sunshine per year

Total hours of excessive sun shine per year:

1092+ 184 = 1276 total hours of excessive shine per year

The total number of sunshine hours per month is displayed by (Table 2).

Table 2 Total Number of Sunshine Hours/Month

Jan	Feb	March	April	May	June	July	Aug	Sp	Oct	Nov	Dec
8	9	9	9	10	12	12	12	11	10	9	8

Source: Weather2Travel (2014)

The total hours of available sunshine =

62 days (2 months) x 8 hours = 496 hours/year

119 days (4 months) x 9 hours =1071hours/year

92 days (3 months) x 12 hours =1104 hours/year

62 days (2 months) x 10 hours =620 hours/year

30 days (one month) x 11 hours =330 hours/year

Consequently, total hours of sunshine per year= 496+1071+1104+620+330= 3621

Thus, CF_3= 1276 hours of excessive sunshine per year/ 3621total hours of sunshine per year x 100 = 35.24%

Snowfall

As snowfall in Saint Katherine occurs during the months of December, January and February (=90 days) then

90/365= 24.658%

Thus, RCC= 7080000 x 0.6476x 0.753 = 3452511visitors per day and 3452511x 365= 1260166515 visitors per year.

5.2. Carrying capacity estimation for the Egyptian Museum

Physical carrying capacity. PCC = A x V/a x Rf

The available area for visitor use is 13600 m^2 (unpublished data, the Egyptian Museum)

Area required per user = 1 m^2

Open period of the Egyptian Museum = 7 hours (Egypt Tourism Authority, 2014)

Average time of one visit = 3 hours (pers. communication with the manager and tour guides of the Egyptian Museum).

Rotation factor: Open period / Average time of one visit = 7 hours/3 hours = 2.3, this means that theoretically, a person could make 2.3 visits in one day.

Thus, PCC= 13600 x 1 x 2.3 = 31280 visitors per day, and 44880 x 365 =11417200 visitors per year.

Real carrying capacity. To investigate the main factors that adversely affect the tourist visit in the Egyptian Museum, the researcher consulted the manager and some tour guides of the Egyptian Museum and three factors were mostly identified including: CF_1= the overcrowding during the tour, CF_2= the unpleasant display of many objects and CF_3= the uncomfortable condition of ventilation. The tourists were asked to express their opinions concerning these arguments according to three point Likert-scale ranging from agree (1), neither agree or disagree (2) and disagree (3). 300 questionnaires were distributed among the tourists during the months of January and May 2013. The results are depicted by (Table 3).

Table 3 Tourists' Opinions Concerning the Limiting Factors for the Egyptian Museum (January and May 2013)

Respondents' opinions	Limiting Factors		
	CF_1	CF_2	CF_3
Agree	150	133	190
Neither agree or disagree	20	45	10
Disagree	130	122	100

RCC= PCC x100 -Cf_1 /100 x 100-Cf_2/100 x … 100-Cf_n/100

Where Cf = (M_1 / M_t) x 100

Cf= No. of people who agree with those arguments / Total people surveyed x 100

The results revealed that the maximum number of tourists who agreed with the first argument were 150 tourists,

Thus, Cf_1=150/300 x 100=50%

The maximum no. of tourists who agreed with the second argument were 133 tourists,

Thus, Cf_2 =133/300 x 100=44%

The maximum no. of tourists who agreed with the second argument were 190 tourists,

Thus, Cf_3= 190/300x100=63 %

RCC=31280 x 0.5x 0.56 x 0.37= 3241 per day x 365= 1182822 per year

6 DISCUSSION, CONCLUSION AND IMPLICATIONS

The purpose of this research paper was to outline the theory and practice of tourism carrying capacity assessment and its significance as a management tool for the tourist sites in Egypt, as well as, to highlight the need to redefine tourism development and management in the existing sites on a more sustainable basis. To realize this objective the research provided a practical attempt for estimating the tourism capacity for two important tourist sites in Egypt (Saint Katherine Protected

Area and the Egyptian Museum), as a starting point to initiate its application on the other sites Egypt to ensure their protection in the future.

The physical and real carrying capacity for both sites was calculated depending on the formulas proposed by Cifuentes (1992). Two corrective factors related to the climate conditions of Saint Katherine were determined including snowfall and excessive sunshine. The physical carry capacity was calculated at 7080000 tourists per day and 2584200000 tourists per year, meaning that the maximum number of people who are allowed to enter the protected area should never exceed this range. Regarding the real carrying capacity, it was calculated at 3452511 tourists per day and 1260166515 tourists per year. By observing the average numbers of tourists who entered Saint Katherine during the last four years (2010-2013), it is obvious that they are below the physical and real carrying capacity values estimated in this research. This may be due the large area of the Protected Area, which attracts a special segment of tourists, who aim adventure and mountains' climbing. Thus, the actual tourists' numbers are suitable for the site and it is still room for increasing the numbers within the protected area's capacity. These results agree with the results of Sayan and Ortaçeşme (2006) and Fadaee et al. (2013).

With reference to the physical carrying capacity of the Egyptian Museum, it was estimated at 31280 tourists per day and 11417200 tourists per year. This means that the museum could not physically sustain more than these numbers. After considering three corrective factors in the Egyptian Museum including the overcrowding of tourists, the unpleasant display of many objects and the uncomfortable conditions of aeration inside the museum, the real carrying capacity was estimated at 3241 per day and 1182822 tourists per year, meaning that the number of tourists who are allowed to enter the museum should not exceed these values. However, the carrying capacity values don't depict the optimal or effective number of tourists which was not calculated in this research.

At the same time, it is worth highlighting that this situation will be changed after the opening of the Grand Egyptian Museum (GEM), the museum for the third millennium. It is situated about three kilometers from the Giza pyramids and described as the largest archaeological museum in the world. The GEM will link the immemorial past with the future and all stored artifacts in the Egyptian Museum will be redistributed between the two museums, about 3500 of which belong to the famous King Tutankhamen. The Grand Egyptian Museum complex is extremely flexible and suitable for permanent and temporary exhibitions with an attendance up to 15,000 visitors per day. It contains a library, a research center, restoration laboratories, a museum for children and one for people with disabilities, a public square with shops and an open air museum and parking facilities. The construction of the new museum was a very suitable and wise solution to the problems that face the tourists in the Egyptian Museum (The Grand Egyptian Museum, 2015). This suggests that proper plans and regulations should be properly taken by the management of Egypt's

tourist sites to keep tourism development, as well as, the tourists' numbers within the carrying capacity limit.

7 LIMITATIONS AND FURTHER RESEARCH

This research estimated the physical and real carrying capacity for Saint Catherine Protected Area and the Egyptian Museum. Therefore, it is suggested that further research should focus on estimating the effective carrying capacity for both sites, as an indication of the optimal number of tourists, which was a limitation in the present research. Furthermore, it is recommended to apply the concept of carrying capacity on the other natural and historical sites in Egypt to prevent the damage that can be caused by the excessive numbers of visitors. In addition, it should be recognized that the carrying capacity value estimated for any site is not fixed, as it develops with time, as well as, tourism growth and can be affected by management and planning techniques and controls. Therefore, it should be constantly assessed and monitored.

REFERENCES

Academia (2015), CARRYING CAPACITY ASSESSMENT FOR SUSTAINABLE TOURISM DEVELOPMENT: A PROPOSAL FOR THE SAINT MARTIN'S ISLAND. Available at:

http://www.academia.edu/5367565/Carrying_Capacity_Assessment_for_Sustainable_Tourism_Development_A_Proposal_for_the_Saint_Martins_Island (accessed 15 January 2015).

Ceballos-Lascurain, H. (1996), TOURISM, ECOTOURISM AND PROTECTED AREAS: THE STATE OF NATURE-BASED TOURISM AROUND THE WORLD AND GUIDELINES FOR ITS DEVELOPMENT. Gland, Switzerland and Cambridge: IUCN.

Cedar Lake Ventures (2014), HISTORICAL WEATHER FOR THE LAST TWELVE MONTHS IN ST. CATHERINE, EGYPT. Available at: http://weatherspark.com/history/29252/2014/St-Catherine-Janub-Sina-Egypt (accessed 4 November 2014).

Cifuentes, A. (1992), DETERMINACION DE CAPACIDAD DE CARGETURISTICA EN AREAS PROTEGIDAS. Turrialba, Costa Rica: CATIE.

Clark, J. (1996), COASTAL ZONE MANAGEMENT HANDBOOK. Boca Raton, Florida: CRC Press, Inc.

Coccossis, H. and Mexa, A. (2004), THE CHALLENGE OF TOURISM CARRYING CAPACITY ASSESSMENT: THEORY AND PRACTICE. England: Ashgate.

Egypt tourism Authority (2014), THE EGYPTIAN MUSEUM. Available at:http://en.egypt.travel/attraction/index/the-egyptian-museum (accessed 4 November 2014).

El-Shahawy, A. and Atiya, F. (2010), THE EGYPTIAN MUSEUM IN CAIRO. A WALK THROUGH THE ALLEYS OF ANCIENT EGYPT, standard ed. Cairo: Farid Atiya Press.

Fadee, R., Ramezani, B. and Fadaee, M. (2013), Tourism development of Anzali lagoon with emphasis on The estimation of physical carrying capacity, EUROPEAN JOURNAL OF ZOOLOGICAL RESEARCH, 2 (5):48-56.

Hall, C. and Lew, A. (1998), SUSTAINABLE TOURISM. A GEOGRAPHICAL PERSPECTIVE. Harlow: Longman.

Hens, L. (1998), Tourism and Environment. Belgium: Free University of Brussels.

Jurincic, I. (2005), Carrying capacity assessment of Slovene Istria for tourism SUSTAINABLE DEVELOPMENT AND PLANNING II, Vol. 1: 725-733.

Kostopoulou, S. and Kyritsis, I. (2006), A Tourism Carrying Capacity Indicator for Protected Areas. ANATOLIA: AN INTERNATIONAL JOURNAL OF TOURISM AND HOSPITALITY RESEARCH, 17(1): 5-24.

Kurhade, S. (2013), Methodological Framework for Evaluation of Tourism Carrying Capacity of Eco Sensitive Region. INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY, 2(3): 781-786.

Lagmoj, M., Shokry, A., Hashemi, S. and Zadegan, H. (2013), Defining the Ecotourism Carrying Capacity of Langeroud City (Case Study: Khorma Forest). GREENER JOURNAL OF SOCIAL SCIENCES, 3 (9): 447-457.

Lobo, H., Perinotto, J., Boggiani, P. (2011), Tourist Carrying Capacity in Caves: Main Trends and new Methods in Brazil, 6th Congress Proceedings: 108-115: Slovak Republic: SNC of Slovak Republic, Slovak Caves Administration.

Mallarah, J.M. (ed.) (2008), 'Protected Landscapes and Cultural and spiritual Values', Vol. 2, in THE SERIES VALUES OF PROTECTED LANDSCAPES AND SEASCAPES. Heidelberg: IUCN, GTZ and Obra Social de Caxia Catalunya, Kasparek Velarg.

McNeely, J. and Thorsell, J. (1987), Guidelines for the Development of Terrestrial and Marine National Parks for Tourism and Travel. Gland: IUCN.

Mexa, A. and Coccossis, H. (2004), 'Tourism Carrying Capacity: A Theoretical Overview'. In Coccossis, H. and Mexa, A. (eds.), THE CHALLENGE OF TOURISM CARRYING CAPACITY ASSESSMENT: THEORY AND PRACTICE. England: Ashgate.

Ministry of Environment, (2015), Protectorates, Egypt: EEAA, Ministry of Environment Egypt. Available at http://www.eeaa.gov.eg/English/main/protect_desc.asp (accessed 15 January 2015)

Mondal, D. (2012), Assessment of Tourism Carrying Capacity for Hazarduari Palace Museum in Murshid Abad Municipal Town, West Bengal. INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH, 2 (8): 91- 101.

Mowforth, M. and Munt, I. (2003), TOURISM AND SUSTAINABILITY. DEVELOPMENT AND NEW TOURISM IN THE THIRD WORLD, 2nd ed. New York: Routledge.

Munar, F. (2002), Análisis de capacidad de carga en los espacios litorales, calas e playas, situados en áreas naturales de especial interés de la Isla de Menorca. Spain: Universidad de Almería.

National Egyptian UNESCO Commission (2000), WORLD HERITAGE SCANNED NOMINATION. Available at: http://whc.unesco.org/uploads/nominations/954.pdf (accessed 4 November 2014).

Nature Conservation Sector (2006), PROTECTED AREAS OF EGYPT: TOWARDS THE FUTURE. Cairo: Egyptian Environmental Affairs Agency. Available at:

http://www.fpir.noaa.gov/Library/PRD/Spinner%20Dolphin/HSD_articles_for_reference/Nature%20conservancy-egypt%20protected%20areas.pdf (accessed 10 November 2014).

Nghi, T., Lan, N., Thai, N., Mai, D. and Thanh, D. (2007), Tourism carrying capacity assessment for PhongNha-KeBang and DongHoi, QuangBinh Province. VNU JOURNAL OF SCIENCE, EARTH SCIENCES, 23: 80-87.

Rajan, B., Varghese, V. and Pradeepkumar, A. (2013), Beach Carrying Capacity Analysis for Sustainable Tourism Development in the South West Coast of India. ENVIRONMENTAL RESEARCH, ENGINEERING AND MANAGEMENT, 1(63): 67-73.

Sayan, M. and Atik, M. (2011), Recreation Carrying Capacity Estimates for Protected Areas: A Study of Termessos National Park. EKOLOJI, 20 (78): 66-74.

Sayan S and Ortaçeşme V (2006), 'Recreational Carrying Capacity Assessment in a Turkish National Park'. In Siegrist, D., Clivaz, C., Hunziker, M. and Iten, S. (eds.). EXPLORING THE NATURE OF MANAGEMENT.

Proceedings of the Third International Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas. University of Applied Sciences Rapperswil, Switzerland, 13-17 September 2006, pp. 2011-2016. PERIPLO SUSTENTABLE 13: 33-61.

Supreme Council of Antiques (2011), THE EGYPTIAN MUSEUM. Available at: http://www.scaegypt.org/eng/MUS_Egyptian_Museum.htm (accessed 4 November 2014).

The Grand Egyptian Museum, (2015). Available at: Overviewhttp://www.gem.gov.eg/index/AboutGEM.htm (accessed 15 January 2015).

Weather2Travel (2014), ST CATHERINE CLIMATE. Available at: www.weather2travel.com/climate-guides/egypt/st-catherine.php (accessed 8 November 2014).

Wolters, T. (1991), TOURISM CARRYING CAPACITY. Paris: WTO/UNEP.

Zacarias, D., Williams, A. and Newton, A. (2011), Recreation carrying capacity estimations to support beach management at Praia de Faro, Portugal. APPLIED GEOGRAPHY, 31: 1075-1081.