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**CARRYING CAPACITY IN VIETNAMESE NATIONAL PARK:
A CASE STUDY OF PHONG NHA- KE BANG**

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ABSTRACT

Implementing carrying capacity is a prerequisite for national parks striving to meet the triple mandate of park management, which are recreational use, conservation and economic value. Vietnam, a developing country, the issue of carrying capacity is recognized and has been mentioned in policy and regulation documents, but with no provision of comprehensive guidelines for implementation. Therefore, this study aims to investigate the application of carrying capacity in Vietnamese park system and assessing its application process for further development of the concept, using Phong Nha- Ke Bang National Park as a case study. The park was selected due to its World Heritage status, which is the only park in Vietnam applying the up to date *public and for profit* model. The qualitative field studies were prolonged conducted from 2012 to 2015 using observation, documentation and in-depth interview methods. The findings show that the park has *partly-used the* carrying capacity concept to control tourist flow. Intervention point of carrying capacity application seems to be rather subjective. Some major factors led to the current application are also discussed for further improvement.

Keywords: *carrying capacity, national park, tourist arrivals, Phong Nha- Ke Bang National Park, Vietnam*

INTRODUCTION

In order to achieve a balance between the dual mandate of use and conservation, the principal aim for national park (NP) managers is to plan carefully in advance and to monitor tourist movement (Zarska, 2006). The question of how much public use is appropriate in NPs is often surrounded by the concept of *carrying capacity* (Manning, 2001). The World Tourism Organization defines carrying capacity as “the level of visitors use an area can accommodate” (Buckley, 1999, p. 706). Therefore, the concept of carrying capacity and the related assessment management techniques, such as Recreation Opportunity Spectrum, Limits of Acceptable Change and Visitor Experience and Resource Protection (Lascuráin, 1996; Manning, 2001; Wearing & Neil, 2009) have become sustainability decision-making frameworks commonly used in national park management. When implemented, these frameworks can help to protect a country’s natural and cultural heritage, enhance public appreciation of the resources and manage conflicts between resources and users (Graham, Nilsen & Payne, 1988; Pigram & Jenkins, 2006). Therefore, it can be stated that the concept of carrying capacity could assist parks in managing nature-based tourism or ecotourism in a sustainable way (Manning, 2001; Pigram & Jenkins, 2006; Plummer, 2009; Wearing & Neil, 2009).

Carrying capacity was first suggested in the mid-1930s as a park management concept in the context of NPs (Sumner, 1936). In fact, the first accurate application of the concept to park management occurred in the 1960s (Dasmann, 1964). The literature of carrying capacity and its alternatives were developed impressively in the past three decades (Prato, 2009). Lindberg, McCool and Stankey (1997) suggested that carrying capacity remains a good idea to propose, but a political nightmare to implement. After 40 years of development, efforts to determine and to apply carrying capacity to NPs have sometimes failed and are limited even in developed countries (Manning, 2001). The concept remains vague and a lack of fixed deterministic approach is unpragmatic for planning and management (Simón, Narangajavana & Marqués, 2004). This vagueness may lead to the hesitation of the developing or under-developed countries to apply the carrying capacity concept in the planning and management of NPs and protected areas (PAs).

Sustaining the dual mandate of use and conservation at NPs is more challenging in developing countries than in developed ones. Economic factors may overshadow ecological considerations (Pigram & Jenkins, 2006). Ma, Ryan and Bao (2009) argue that, in developing countries, the mandate for parks and PAs are not only based on use and conservation but also on their economic value in terms of, “the role of national

parks as an asset in tourism policies directed by centrally determined economic objectives of income and employment generation” (p.2). Unlike park management in developed countries, the researchers found that adding economic development is more appropriate for developing countries such as Vietnam. It is imperative to note that even when ecotourism is deployed in order to supply parks and PAs with economic benefits, especially in developing countries (Suntikul, Butler & Airey, 2010). Parks themselves must be strictly managed, monitored and controlled through protective measures to prevent degradation of the sites by tourists (Wearing & Neil, 2009).

In Vietnam, international and domestic tourist arrivals have increased significantly over the past decades. At the same time, natural-based tourism or ecotourism has also experienced tremendous growth (Vietnam National Administration of Tourism, 2017). The Vietnamese Government has declared nature-based tourism or ecotourism to be one of the country’s key tourism products, and many resources are assigned to be devoted to the development of NPs (Suntikul, 2010; The Government of Vietnam, 2003, 2010). With the current national policy, the Vietnamese Government shows a consistent perspective towards national park management related to ecotourism development (Ministry of Agriculture and Rural Development, 2007, 2011; The Government of Vietnam, 2006, 2010).

The Vietnamese national park system is considered a young and scarcely-developed one. Many researchers believe that there is a lack of management experiences in sustainable tourism activities (Creswell & Maclaren, 2000; Elliott, 1997; Phan, Quan & Le, 2002; Pigram & Jenkins, 2006; Suntikul et al., 2010; Wurm, 1999). The issue of carrying capacity has been stated in Vietnamese national policies on park and PA management. In Article 8, Ministry of Agriculture and Rural Development (2007) has asked the responsibilities of authorities and individuals when they were operating ecotourism activities at parks and PAs: “Based on physical, ecological, landscape and social impact assessment of ecotourism activities on NPs and PAs, to regulate the maximum visitors per day/per site (the environmental carrying capacity)” (p.5). The estimated carrying capacity values exist in the policy and regulation documents alone without further guidelines for implementation. As the significant role of carrying capacity concept in park management sustainability, the knowledge of its application in Vietnamese national park system is rare and therefore in need of further research.

As of 2016, Vietnam has 30 NPs with a total area of approximately 10,350 km², accounting for 2.93% of the land territory (The Government of Vietnam, 2010). Among

30 NPs of Vietnam, Phong Nha- Ke Bang (PNKB) NP was selected as a case study for several reasons. First, it is the only park in Vietnam applying the *co-existing management model* or *public and for profit model* (Eagles, 2009), which is considered as the most up-to-date park management model in this country (Ly & Xiao, 2016). Second, PNKB NP is the only one park in Vietnam on the World Heritage list (The Government of Vietnam, 2010; UNESCO, 2017). Its world heritage status gives the park greater accountability in managing tourist arrivals in a sustainable way (Hall, 2006). Moreover, its world heritage status has an endorsement effect, as other parks also have the desire to accomplish the same status and hope to improve their management effectiveness where PNKB NP can be used a role model (Ryan & Silvano, 2009).

The implementations of carrying capacity in Vietnamese parks are largely unknown and therefore merit attention. To fill the knowledge gap, this study aims to find out the carrying capacity application situation in Vietnamese park system (using PNKB NP as a case study) and to assess its application process to help further developing of the concept. This study attempts to address two key questions: (1) what is the current situation of the carrying capacity application in PNKB NP? and (2) how PNKB NP applies the carrying capacity concept? The research results bring benefit to researchers, the Vietnamese Government and park managers in establishing the suitable and applicable carrying capacity policy and implemental guide for Vietnamese park system.

LITERATURE REVIEW

Development of Carrying Capacity Concept and its Alternative Visitor Management Tools

Original Concept of Carrying Capacity

The literature on carrying capacity has blossomed since the 1970s (Kuss, Graefe & Vaske, 1990; Lime & Stankey, 1971; Manning, Valliere, Minter, Wang & Jacobi, 2000; Manning, 1999; Shelby & Heberlein, 1986; Stankey & Lime, 1973). Although there is literature about carrying capacity, its application to parks and PAs is quite limited and resulted in failure sometimes. The principal difficulty is determining *how much impact* (e.g., soil compaction and visitor crowding) was *too much* or how much impact should be allowed in a national park before management intervention is required (i.e., the intervention point) (Manning, 2001). Furthermore, the early stage of carrying capacity development requires no standard of indicators for management reference. Park managerial level is based on the number of uses (i.e., how much use is too much) to justify visitor capacity. This judgment process is completely subjective in deciding how much change is acceptable. Further, this action means the intervention point is

thoroughly blurred and flexible during the early development stage of carrying capacity.

Manning (2001) gave out a visual explanation of the pitfall of the original carrying capacity concept (see Figure 1). This figure explains the social impact of crowding. Hence, rising numbers of visitors (from X1 to X2) increase the percentage of visitors who report feeling crowded (from Y1 to Y2). However, what point of carrying capacity has been reached (Y1, Y2 or any other point along the Y-axis) remains unclear. Eventually, subjective management judgments need to be made.

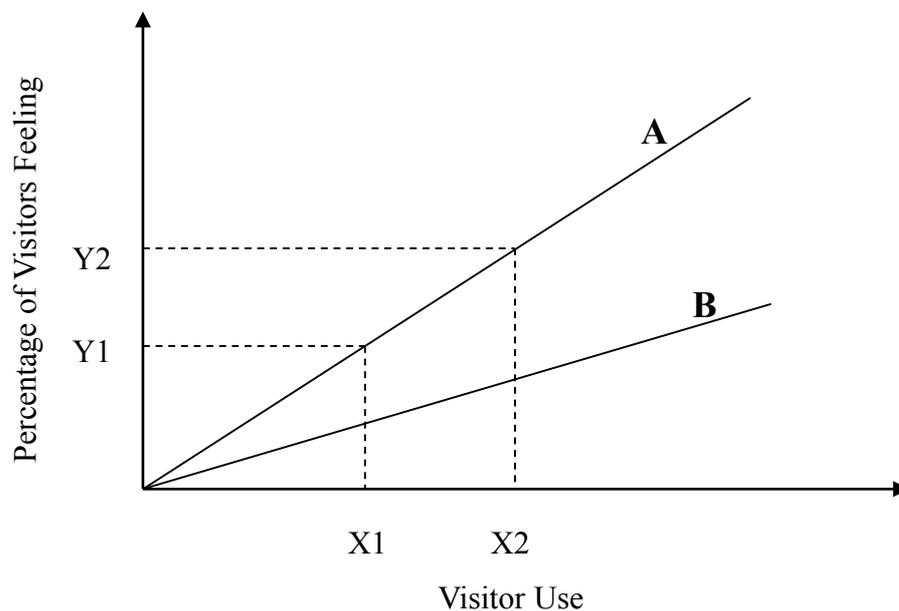


Figure 1. Relationships between visitor use and crowding
Source: Adapted from Manning (2001).

Despite the conceptual development and potential managerial applications of carrying capacity in outdoor recreation, the concept has been criticized (Plummer, 2009). Lindberg et al. (1997) asserted that the definition of carrying capacity lack the specific application to guide practical implementation as they rely on subjective values rather than specific indicators and criteria. Consequently, Lindberg et al. (1997) concluded that the traditional notion of carrying capacity should be replaced in favor of alternative visitor management tools. Carrying capacity tools for outdoor recreation were established. However, “they are not the key to management for which some have been looking. The key to management, in recreation as in range and wildlife management, is specifying management objectives and monitoring conditions”

(Hammit & Cole, 1998, p. 15). This observation explains why the updated visitor management tools have taken into account the content of management objectives and evaluated conditions in their decision-making process for governing parks and PAs.

Management by Objective Alternatives

To refine the concept of carrying capacity, some advocates believe that alternative visitor management tools need to determine the intervention point of management in a more objective platform. Visitor management tools related to the decision-making process for parks and PAs can be very challenging when trying to meet objective legal missions, and the different tastes and preferences of visitors (Newman, Manning, Dennis & McKonly, 2005). Moreover, one comprehensive solution for these challenges and pitfalls can be found in the literature on the development of management by objective (MBO) alternatives (Manning, 2001).

MBO alternatives include three steps, which are (1) establishing explicit management objectives, (2) choosing associated indicators and (3) using standards of quality (Manning, 2001). *Management objectives* are clear and detailed statements define the degree of environmental conservation and the type of visitor experience to be offered in the park. Firstly, *Indicators* are measurable and manageable variables reflecting the essence of management objectives. Additionally, *standards of quality* identify the minimum acceptable condition of each indicator variable (Manning, 2001). By setting up management objectives, relevant indicators and standards of quality, visitor management tools can be determined and managed through a monitoring process. If standards have been disregarded, the carrying capacity would have been exceeded and park managers should act to ensure that the standards of quality are maintained. These MBO approaches (Newman et al., 2005) are common used frameworks for contemporary park and outdoor recreation planning and management, such as Limits of Acceptable Change (LAC) (Stankey, Cole, Lucas, Peterson, Frissell & Washburne, 1985), Carrying Capacity Assessment Process (CCAP) (Shelby & Heberlein, 1986), Visitor Impact Management (VIM) (Graefe, Kuss & Vaske, 1990), Visitor Experience and Resource Protection (VERP) (Hof & Lime, 1997; Manning, 2001) and others tools.

The fundamental difference between the original concept of carrying capacity and the MBO alternatives is the *judgment of intervention point*. The MBO concept focuses on designed conditions (e.g., environmental and experiential ones) rather than number of visitors as in the original carrying capacity concept. Undeniably, the MBO concept is more objective than the original one. However, these judgments are inherently

subjective in nature. Additionally, these judgments are normally based on the social and political preferences of one or more that people consider acceptable or unacceptable. Park managers no longer ensure that environmental degradation is minimized. Rather, park managers need to ensure that degradation is within limits that humans judged as acceptable or unacceptable.

Decision Rules

Prato (2009) stated that contemporary social and environmental carrying capacities (especially the MBO alternatives) can be assessed using a crisp, stochastic, or fuzzy decision rule. This section describes these three rules and explains the subjective nature of these rules when based on conditions to plan and manage parks and PAs.

Crisp decision rule

The presence of internal and external forces of natural areas could be challenging for park managers to achieve the triple mandate of tourism management (Leopold, Cain, Cottam, Garibelson & Campbell, 1963). On the one hand, park managers have little or no control over external forces, such as changes in vegetation, water supply, climate change on fire regime, air pollution and loss and degradation of wildlife habitat. Hence, managers have little ability to reduce those adverse impacts on parks and PAs. On the other hand, park managers have considerable control over internal forces, such as the human use of park resources and facilities (Prato, 2009). Therefore, Prato (2009) concluded that two factors limit the ability of park managers to ease the adverse ecosystem impacts of internal forces. These factors are (1) uncertainty about the current status of park ecosystem with respect to those forces and (2) uncertainty about how the park ecosystem reacts to alternative management actions for alleviating adverse impacts of those forces. Most of the methods of the original concept of carrying capacity and the MBO alternatives (e.g., LAC, VIM and VERP) were based on crisp decision rule, and failed to consider the two uncertainty factors of internal forces.

Prato (2009) argued about the potential issue while applying crisp decision rule in park management. Prato (2009) stated that “a crisp decision rule is valid when observed indicators are non-stochastic and the relationship between observed indicators and the degree of ecosystem consistency with carrying capacities is precise or known with certainty” (p.2552). A crisp decision rule does not consider sampling and measurement errors in the monitoring of indicators and stochastic variability in the indicators. These

omissions can result in *management decision errors* (Prato, 2009). For example, when the mean of user satisfaction of twelve months is below the minimum acceptable level of the park, the manager would assume that carrying capacity has been being exceeded in this year. Because too many visitors have caused user satisfaction to fall below the minimum acceptable level. This is a management decision error because the mean levels only cannot represent all month periods. A further check of each month's figure is needed to avoid this management decision error.

Stochastic decision rule

Unlike the crisp decision rule, a stochastic decision rule considers the stochastic variability in observed indicators; therefore the rule could reduce the likelihood of making decision errors when drawing inferences about user capacity from observations on an ecosystem indicator (Prato, 2007). The use of stochastic decision rule requires park managers to detail probability distributions for observed indicators under present and future management actions. This kind of probability distribution can be obtained by using consensus methods (e.g., Delphi method (Linstone & Turoff, 1975)), or simulation models (e.g., Multiple Attribute Scoring Test of Capacity (MASTEC) (Prato, 2001)). However, park managers may not have access to the experts needed to apply these complicated methods and/or may be unwilling or incapable of specifying such probability distributions (Prato, 2009).

Fuzzy decision rule

Prato (2009) indicated that the fuzzy adaptive management approach aims “to determine whether a protected area ecosystem is consistent with ecological and social carrying capacities” (p.2551). If not, Prato (2009) suggested that to park managers should identify management actions that are most likely to achieve consistency when there is uncertainty about the current degree of consistency and how alternative management actions are likely to influence that consistency. Fuzzy decision rule is based on fuzzy logic, which is a *mathematical way* of representing the vague or approximate nature of decision-making under uncertainty (Andriantiatsaholiniaina, Kouikoglou & Phillis, 2004; Klir & Yuan, 1995). This rule accounts for stochastic variation in the indicator as well as vagueness and uncertainty in the relationship between the observed indicator and the degree of ecosystem consistency with carrying capacity.

The application of the proposed fuzzy decision rule requires park managers to first

define fuzzy sets on ecosystem indicator and the degrees of ecosystem consistency with carrying capacities. Secondly, they need to define the fuzzy relation between them. Thirdly, park managers have to select a suitable implementation that allows the degree of ecosystem consistency to be inferred from observations on the ecosystem indicator (Prato, 2007, 2009). Parks and PAs could use a web-based, interactive and spatial decision support tool (Loucks, 1995; Sugumaran, Meyer & Davis, 2010) to improve the ability of managers in implementing the proposed fuzzy decision rule and fuzzy adaptive management approach. Prato (2009) found that fuzzy logic is well fitted to infer ecosystem consistency with carrying capacity concept when observations are subject to errors and uncertainty about relationship exists between the indicator and the ecosystem consistency. More importantly, a fuzzy decision rule does not have the above mentioned limitations associated with crisp and stochastic decision rules, which may add extra cost in operating the carrying capacity concept (Prato, 2009).

Vietnamese National Park System

Vietnam has two types of NPs: the cross-provincial parks, under the management of Ministry of Agriculture and Rural Development; and the within-provincial parks under the administration of the Provincial People's Committee. Among the 30 NPs in Vietnam, eight of them are under the management of the former while 22 belong to the latter (The Government of Vietnam, 2003, 2010). Although the Ministry of Agriculture and Rural Development and/or Provincial People's Committee take responsibility to manage NPs, they are not involved in daily operations and management. This task is separated to another unique organization called: the National Park Management Board (NPMB), a state-owned organization, which has the functions and tasks of a forest owner and the state-assured conditions for managing, protecting and developing Special Used Forests (SUF). In addition, it is responsible for conserving and promoting special values in terms of nature, standard specimens of ecosystems, biodiversity, gene sources, historical-cultural relics and landscape and conducting scientific research and provision of forest environmental services (The Government of Vietnam, 2010).

In 2006, the SUF Policy obtained a radical update in the management bodies of ecotourism/recreation activities in parks and PAs. The first legal article dealt with ecotourism activity organization methods in the Vietnamese NPs, which was announced in Article 55 of Decree No.23/2006/ND-CP on implementing the Forest Protection and Development Law (The Government of Vietnam, 2006). Then, it was updated and redeveloped in 2007, 2010 and 2011 respectively (The Government of Vietnam, 2010; Ministry of Agriculture and Rural Development, 2007, 2011). Since the SUF

ecotourism management policy was introduced in 2006, the Vietnamese park system has been through a change from a *parastatal management model* to a *public and for profit model*, which combines public and private sectors in park management (Eagles, 2009; More, 2005). This development is a core step towards decentralization in the SUF system from de-concentration to delegation (Ribot, 2002).

According to Decision No.104/2007/QD-BNN (Ministry of Agriculture and Rural Development, 2007), the new management model has the following criteria: (1) ownership of lands and resources still belong to the government; (2) the income for management mostly comes from fees and charges, while the government grant is small; (3) combinations of any three types of management models could exist simultaneously within one NP (i.e., *state-management model*, *private-management model*, and/or *joint-venture model*); and (4) the NPMB is responsible for the supervision of all tourism/recreation activities in the parks (Eagles, 2009; The Government of Vietnam, 2006). Ly and Xiao (2016) state that the shift of management model (i.e., toward the public and for profit model) is not a common practice in Vietnamese NPs. Only Phong Nha- Ke Bang NP is applying the new model while the majority of parks are still with the parastatal status.

The NPMB is the management unit that governs and manages tourism/recreation business in Vietnamese parks (Ministry of Agriculture and Rural Development, 2011). The NPMB has different sub-units under its control working in park tourism business. There is a sub-unit named *Park Tourism Center* in each park, which conducts, manages and operates all of the tourism and recreation activities regarding the *state-management model*. At the same time, there are private companies or groups joining park tourism sites management since the allowance of the new SUF policy in 2006. The private companies or groups are the representatives of the *private-management model* and under the supervision of the NPMB. Moreover, there are tourism sites managing under the cooperation between public and private sector regarding the *joint-venture model*. There are three major stakeholders involved in park tourism businesses: the NPMB, the Park Tourism Center and the private company/group. Among the three groups, *only* the NPMB has the right to decide carrying capacities for tourism sites in parks. Therefore, managerial people working for the NPMBs in Vietnamese parks (e.g., directors, managers and/or supervisors in tourism operation) become the primary potential interviewees in assisting the researchers reaching the study objectives. Also, the representatives of private sector can submit the important information of the carrying capacity implementation situation, which helping the researchers to sketch out a full picture for research findings.

As of the important role of carrying capacity concept in helping NPs achieving the triple mandate, there is hardly find any research about the concept application in Vietnam. The issue of carrying capacity is recognized and has been mentioned in policy and regulation documents in Vietnam, but with no provision of comprehensive guidelines for implementation (Ministry of Agriculture and Rural Development, 2007). It is, therefore, necessary to understand the application situation in Vietnam for further development and improvement.

PHONG NHA- KE BANG NATIONAL PARK: A CASE STUDY

PNKB NP is located in the western part of Quang Binh Province, approximately 500 kilometers south of Hanoi and in the narrowest part of Vietnam between Laos and the Tonkin Gulf. It is the largest limestone area in Asia and the second largest in the world (Nguyen, Dang, Nguyen, Nguyen & Phan, 2006). The full core zone of the PNKB NP was recognized as a World Natural Heritage Site in 2003 under Criteria VIII (Geological and Geo-morphological) and became the fifth World Heritage site in Vietnam (UNESCO, 2017). The related core zones are divided into three functional areas: strictly protected area (64,894 ha), ecological restoration area (17,449 ha) and administrative and service area (3,411 ha). The buffer zone has a total area of 217,908.44 ha and includes 13 communes with a population of more than 64,000. The present study focuses on tourism activities in the core zone because this area is an official NP and World Heritage Site.

Tourism Management in PNKB NP: Stakeholders and Tours

The government of Quang Binh Province manages PNKB NP. Daily operation and management are direct responsibilities of the NPMB, which is under the authority of the Provincial People's Committee of Quang Binh. The NPMB governs a tourism management unit called the Phong Nha Tourism Center (PNTC) to oversee tourism activities in the park under the *state-management model* (People's Committee of Quang Binh Province, 2010). Apart from the state-owned tourism management unit, the park has three private management companies operate tourism activities at the park, the Oxalis Company, the Phong Nha Discovery Company and the Truong Think Group.

When the research was completed in 2015, only six *mass sites* are found within the core zone (five sites are managed by PNTC and one site (i.e., Paradise Cave) is managed by the Truong Think private group) (Table 1). They are called mass sites

because they are generally visited by mass tourists. All of these six sites or tours are under the authority of the NPMB. The Truong Think Group is a local company in Quang Binh Province. In 2010, the Provincial People's Committee allowed the group to invest, operate and directly manage tourism in the Paradise Cave under a 50-year forest-renting contract. This cooperative form can be considered as a format of the *private-management model*. Research data show that this site is the only tourism site in PNKB NP operated under the private-management model. Both Oxalis Company and Phong Nha Discovery Company do not directly manage any tourism sites within the core zone of the park under any of the three management models (Oxalis, 2017; Phong Nha Discovery, 2017).

Year	Tourism Site	Location	Site Characteristics
2008	Nuoc Mooc Spring Eco-trail site	Administration and service area	Scenery value, eco-walk within the primate forest
2009	Eight Heroic Volunteer Cave site	Ecological restoration area	Spiritual value, a monument to worship Vietnamese martyrs
2010	Paradise Cave site (managed by private group)	Ecological restoration area	Dry cave value
2011	Chay River- Toi River site	Administration and service area	Dry cave value and boat service on the Chay River
2013	1,500 meters deep in the Phong Nha Cave site	Administration and service area	tour into the deeper parts of the Phong Nha Cave
2013	New Phong Nha- Tien Son Caves site	Administration and service area	Dry and wet cave value, the reopening of the Phong Nha- Tien Son Cave after facility upgrading in September

Table 1- Mass tourism sites of Phong Nha- Ke Bang National Park

Apart from those mentioned six mass sites, there are some *adventure tours* allowed visitors entering the *strictly protected area* within the core zone. There are (1) Hang En Cave tour opened in 2011 and (2) Son Doong Cave tour opened in 2014. Because of their unique features, the NPMB directly manages these adventure tours. First, they are located at the strictly protected area of the park. Second, the sites only serve selected

eco-tourists who are willing to pay for the pure-nature trekking tour. Third, the operation of the tours is flexible. PNTC, Truong Thinh Group, Oxalis Company and Phong Nha Discovery can operate the tours. However, the operation process needs to be based on the planned process of the NPMB. Lastly, all trips to the sites need the supervision of the forest rangers from the Forest Protection Department.

Data Acquisition Through Case Study

The key researcher has longitudinally observed the changing system of the park's management models since 2010, especially after the implementation of the new Vietnamese SUF policy about the co-existing management model (The Government of Vietnam, 2006, 2010). The researchers have witnessed the transformation of the park's management from the "old" to the "new" model. In 2012, the key researcher went back to the park to collect data for his doctoral study about the co-existing management model and discovered the research gap of carrying capacity application. This incentive signaled the researchers to conduct the current study.

After reviewing the development of carrying capacity concept and its alternative visitor management tools, the interview questions were developed and reviewed for in-depth interviews. Qualitative research uses selective methods of participant recruitment or purposeful sampling (Hennink, Hutter & Bailey, 2011). Data for this research were collected in different field trips from 2012 to 2015. The researchers visited the park and interviewed park management staff in the public and private sectors. The number of participants for interview is determined by the principle of saturation (Glaser & Strauss, 1967). The researchers stop recruiting interviewees when no newer information is obtained (Hennink et al., 2011). In total, twelve interviewees were conducted. All of them are park management staff of public and private sectors, whose have the power in governing and monitoring carrying capacity application in the park (Ministry of Agriculture and Rural Development, 2011). To "enhance contextual richness and minimize fragmentation" (Foster, 2004, p.230), all participants were interviewed in their work environment or tourism sites in the park (Table 2).

Year	Informant Groups	Sector	No. of interviews	Sites
2012 (from July to	PNTC's officer	Public	1 interview	NPMB's office
	Site managers of PNTC	Public	2 interviews	Nuoc Mooc Spring Eco-trail site; Eight

September)				Heroic Volunteer Cave site
2013 (from February to April)	PNTC's officers	Public	1 interview	NPMB's office
	Site managers of PNTC	Public	2 interviews	Chay River- Toi River site; Phong Nha- Tien Son Cave sites
	Truong Think Group's manager	Private	1 interview	Paradise Cave site
	Site manager of Truong Think Group	Private	1 interview	Paradise Cave site
2014 (March)	Phong Nha Discovery Company's manager	Private	1 interview	Dong Hoi City's office
	Oxalis Company's manager	Private	1 interview	Phong Nha Town's office
2015 (December)	PNTC's officer	Public	1 interview	NPMB's office
	NPMB's representative	Public	1 interview	NPMB's office
Total			12 interviews	

Table 2. Informants and interviews

Interviews were audio-taped after obtaining participant consent. For anonymity and confidentiality, where appropriate, pseudonyms are used in the research. Besides, the researchers took notes and wrote diaries during field trips. Digital voice recordings were transcribed and translated from Vietnamese to English verbatim by the researchers whose first language is Vietnamese.

Triangulation involves the investigation of a subject from two or more angles to enrich reliability and validity of research (Padgett, 1998). Field observation and documentation were employed to capture related data to address the research objectives apart from in-depth interview method. During observation, the researcher was systematically watching, listening, questioning and recording people's behaviors and interactions, as well as noting social setting, locations or context related to the park situation (Mays & Pope, 1995). As the main aim of the research is to understand the carrying capacity situation in PNKB NP, therefore, a non-participant observation is

deemed as proper. The researcher has blended into the park and not influenced the observation (Hennink et al., 2011). Documents play an explicit role in any data collection related to case studies (Yin, 2003). In this study, most of the related documents were provided by park management. Table 3 lists major documents which have been collected and used for data collection and analysis.

Period	Major Documents for Further Analysis
2012	<p>Ministry of Agriculture and Rural Development. (2007). <i>Regulations No.104/2007/QĐ-BNN on management of ecotourism activities in National Park and Nature Reserves</i>. Hanoi, Vietnam: the MARD, the Government of Vietnam.</p> <p>People's Committee of Quang Binh Province. (2010). <i>Sustainable tourism development plan 2010 to 2020: Phong Nha- Ke Bang national park region</i>. Quang Binh, Vietnam: Tourism Resource Consultants, GIZ.</p> <p>The Government of Vietnam. (2003). <i>Decision No.192/2003/QĐ-TTG of the Prime Minister to approve the management strategy for a protected areas system in Vietnam to 2010</i>. Hanoi, Vietnam: the Government, the Government of Vietnam.</p> <p>The Government of Vietnam. (2006). <i>Decree No.23/2006/NĐ-CP on the implementation of the law on forest protection and development</i>. Hanoi, Vietnam: The Government, the Government of Vietnam.</p> <p>The Government of Vietnam. (2010). <i>Decree No.117/2010/NĐ-CP on organization and management of the special-use forest system</i>. Hanoi, Vietnam: The Government, the Government of Vietnam.</p>
2013	<p>Ministry of Agriculture and Rural Development. (2011). <i>Circular No.78/2011/TT-BNNPTNT on guide the implementation of the Decree No.117/2010/NĐ-CP dated 24/12/2010 of the Government on organization and management of special use forest system</i>. Hanoi, Vietnam: the MARD, the Government of Vietnam.</p> <p>The Government of Vietnam. (2012). <i>Decision No.24/2012/QĐ-TTG on investment policy for development of special-use forests in 2011-2020</i>. Hanoi, Vietnam: The Government, the Government of Vietnam.</p>

Table 3. Major documents collected for PNKBNP' case study

In light of the exploratory nature of the study, the qualitative content analysis

approach guided the data analysis (Hsieh & Shannon, 2005; Mayring, 2000). The researchers did not have any specific expectations for the data before the analysis started. Instead, they expected that concepts and themes related to carrying capacity application in Vietnam park system would emerge from the texts through inductive content analysis. The initial coding process was an open coding process (Strauss & Corbin, 1998). Therefore, the researchers closely read and annotated each interview transcripts. During this process, the texts were utilized and concepts were highlighted and labeled. Analysis of twelve interview transcripts were supported by Nvivo 10 (Bazeley, 2007; QSR International, 2016) in terms of storage, organization, coding and management of the collected data.

This study was followed the four criteria (i.e., credibility, transferability, dependability and confirmability) of Lincoln and Guba (1985) to evaluate the quality of research. Credibility was established mainly through member checking and peer debriefing. Member checking was used in three ways at various stages of data collection and data analysis. Firstly, at the early stage, the researchers discussed the interview questions with participant of Phong Nha- Ke Bang NP through email and telephone, as the interviewees have worked with the researchers for prolonged studies in many years. Secondly, during formal interviews, the researchers fed ideas back to participants to refine, rephrase and interpret. Thirdly, in an informal post-interview session, each participant was given the chance to discuss the findings and provide feedback on the transcripts of their own interview as well as evaluate the research findings in their own wills. Peer debriefing was used in the research to “confirm interpretations and coding decisions including the development of categories” (Foster, 2004, p.231).

CARRYING CAPACITY APPLICATION SITUATION IN PNKB NP

The Overview of Carrying Capacity Management

All interviewees from PNKB NP affirmed that they were aware of the concept of carrying capacity. They have heard and learned about the basic concept of carrying capacity in school or during their work at the park. However, when they were asked for some well-recognized concepts (i.e., LAC, CCAP, VIM, VERP and other tools), only three of them knew these tools. It seems their knowledge on park management regarding carrying capacity is rather limited. Hence, most of the interviewees reported and explained that there was no scientific research and official guideline of carrying capacity application in Vietnamese park system. Furthermore, one PNTC’s officer stated that “there is no NP in Vietnam has thoroughly studied or applied carrying capacity into park operation”.

Both public and private sectors claimed that the park is currently not applying any carrying capacity methods. The collected data and field observation showed that there are no mass tourism sites of the park (Table 1) applying any carrying capacity tools for their daily operation. However, the researchers have discovered an *exception* for the adventure tours which trek into the jungles (i.e. the *strictly protected area*), such as Hang En cave and Son Doong cave. For these tours, a limited number of tourists is well-established. For example, maximum 16 people can enter Hang En Cave at once time (Ly, 2015). It is, therefore, more accurate to calling PNKB NP as a *partial-use of carrying capacity*.

The Intervention Point of Carrying Capacity Method

As discussed in the literature review, the most difficult part of carrying capacity management is in determining the *intervention point*. For parks with the existence of carrying capacity application, without discussion on how objective the decision of maximum numbers of visitors, park management boards usually refers to the *over-crowded situation*. On the other hand, for those parks without carrying capacity application, it is necessary for park management boards to make decision on a case-by-case basis only when over-crowded situation happened. Therefore, this situation will certainly be enclosed more subjective ideas in such real-life scenarios. As a rule of thumb, either using or not using carrying capacity to manage tourist arrival numbers, parks need to know the *numbers of tourist arrival* and have a chance to face over-crowded situation in daily management. The approaches which were used in PNKB NP to deal with *numbers of tourist arrival* were analyzed through the following aspects: (1) method or means to manage tourist arrivals, (2) the largest tourist arrival numbers, (3) intervention point decision, (4) degree of subjective intervention, and (5) over-crowded situation and solution.

PNKB NP using tickets to count and control tourist arrivals. The largest average number for each cave site is from 5,000 to 6,000. An officer at PNTC reported that the caves would become *over-crowded* when reaching this number or it is likely for the site being blocked by the visitors at the cave entrances. The NPMB indeed intervened in the tourist arrivals in these cases. PNTC stopped selling tickets and controlled numbers of boats entering the caves. PNKB NP is a famous tourism spot due to its World Heritage Site status. Comparing to other NPs in Vietnam, PNKB thus has to intervene in crowd management frequently in order to control the number of visitors, especially in national holidays and those peak seasons.

The *intervention point decision* was made by the management team of PNTC

based on their *own judgment* and *feeling*. The deputy manager claimed that “we don’t use any international [carrying capacity] method to measure numbers of tourist in one square meter or such method. It is only based on our *feeling* to judge the situation. It is solely qualitative approach, not quantitative”. He even claimed that this was the scenario of the whole Vietnamese national park system. This degree of intervention seems to be *too subjective*. Moreover, it indicated that “the trend now in Vietnam focuses strongly on the economical or commercial benefits. As a result, the park tourism centers only manage tourism sites to ensure that all tourists have the opportunity to visit the site and they don’t really consider conservation issues”. Economic benefits seem to overshadow most parks in Vietnam. The management team of PNTC however claimed that they would be willing to use international carrying capacity method to manage tourism arrivals. The challenge is that they have no personnel with the ad-hoc knowledge to execute and that it lacks the support from the central Government.

Meanwhile, with the control and support given by a professional organization, the British Caving Association, the management of carrying capacity does exist. There are some adventure tours to the *strictly protected area* of the park using the maximum numbers to control tourist accessibility (maximum 16 people per departure for Hang En Cave and ten people for Son Doong Cave). The managers of three private companies confirmed that a maximum number of tourists to enter Hang En Cave and Son Doong Cave is very strictly followed. The private companies were rejected when tried to bring more tourists to those sites. After several years of operation (six years for Hang En Cave tour and three years for Son Doong Cave tour), the NPMB reported that all tours have been following the guideline of carrying capacity application, the amount of visitors have never exceeded the suggested limit. However, when asking how the *intervention point* was made and decided, the PNTC was unable to explain what they were based on to have those maximum numbers for the adventure tours. In fact, all adventure tours into the jungles were revealed to be under the leading and guiding of the British Caving Association. The Association has offered professional guidelines in how to operate ecotourism tours to the core zone of the park since the opening of Hang En Cave tour in 2011. The NPMB might just take advices from the Association in carrying capacity management, yet have no idea how to calculate those numbers by themselves. This finding indicates that although carrying capacity management exists in PNKB, it was passively executed.

Assessment of Carrying Capacity Development Stage

The development of carrying capacity literature has introduced alternative tourism arrival management tools (Lindberg et al., 1997) to make judgments on intervention

point more objective than the original one (Manning, 2001). A few interview questions were designed to ask about the assessment of the current stage of carrying capacity development. It is, either *original* level, or *MBO* level, or *decision rules* level. Table 4 summarizes the characteristics of PNKB NP in visitor management tool level. It is obvious that *partial-use* of carrying capacity park is not belong to any above mentioned levels. The interviewees of those parks consider that the concept of carrying capacity is unrealistic for them. Although some adventure tours of PNKB NP have maximum numbers of tourists, the officers of PNTC did not know the original of these numbers.

Characteristics	Partial-use Park	References
MBO- management objectives	Economical or commercial consideration	Manning (2001)
MBO- associated indicators	Not-available	Manning (2001)
MBO- standards of quality	Partly <ul style="list-style-type: none"> ● Mass tours: not-available; ● Adventure tours: visiting permission of park management board 	Manning (2001)
Crisp decision rule- current status of park ecosystem	A research project of ecosystem change, yet not in use for tourism management	Leopold et al. (1963); Prato (2009)
Crisp decision rule- park ecosystem reacts to management actions	Not-available	Leopold et al. (1963); Prato (2009)
Renew the maximum number of carrying capacity application	Not-available	Leopold et al. (1963); Prato (2009)
Stochastic Decision Rule: Changing status of selected ecosystem indicators	Not-available	Prato (2007)
Fuzzy decision rule- mathematical way	Not-available	Andriantiatsaholiniaina et al. (2004); Klir and Yuan (1995)

Table 4. Carrying capacity development stage of PNKB NP

DISCUSSIONS AND CONCLUSIONS

Over 40 years of research and experiences of carrying capacity management have led to several established, repeatedly tested and enhanced visitor management frameworks or alternative tools. The aim of these tools is to help solving visitor management problems to a limited extent. Hence, the initial triple mandate of sustainable development in parks and PAs have been achieved. Many of these tools come from researchers and federal agency staff in developed countries (e.g., mostly the United States and followed by Canada) (Manning, 2001; Prato, 2009). One commonality in those frameworks has been confirmed in Manning (2001), which is the refinement of the concept of carrying capacity and the finding of an answer for principle difficulty in determining the *intervention point*. This study thus attempts to investigate this concept and its application in Vietnam in order to understand the current situation in the country as well as the applicability of this concept in a developing context.

This prolonged qualitative research indicates that PNKB NP *partial-used* the concept of carrying capacity. On the one hand, all mass tours in the core zone have no control on numbers of tourist arrival, when over-crowded situations happened, the management team using their own *feeling* to solve the issues *subjectively*. On the other hand, only adventure tours organized within the strictly protected area have established a number for visitors. However, none of the staff at PNTC can explain the origin of the number of carrying capacity. To conclude, there is no real intervention point method used by park management in PNKB NP. Obviously, park management needs more objective solution for intervention point.

By generalized the following reasons that describe carrying capacity is not widely used in Vietnamese park system, the researcher hopes to give hints to further studies to find solution for intervention point issue in Vietnam. *First*, the Vietnamese Government has a general decision in applying carrying capacity since 2007 (Ministry of Agriculture and Rural Development, 2007), however it has no clear guideline to apply in reality. As mentioned by the representative of the park, a *master plan* needs to submit to Ministry of Agriculture and Rural Development if park wants to apply new concept like carrying capacity. However, issues go back to the lacking of ad-hoc knowledge to commit this plan. *Second*, the operation of tourism sites is not suitable for carrying capacity to develop. It is necessary to apply ecotourism setting as a visitor management tool. However, the major tours in Vietnamese park are designed and catered for mass tourists. Mass tourism is the most common travel form in the country and this creates challenges to the management of ecotourism in its national parks. *Last but not least*, economic and

finance issues are other reasons which delay the application of carrying capacity. Parks need to generate an income source from selling tickets to maintain the current tourism operation task. Moreover, a financial quota from central government is another target that parks need to achieve. For national parks in developing countries such as Vietnam, this financial burden is not toward park operation but also a desire of economic gains from the government as well as local authority. Therefore, these parks primarily focus on attracting tourists and thus would not *deny* to mass tourism practices.

From parastatal to public and for profit model, the Vietnam park system aims for better efficiency and effectiveness and determine the better alternative for fulfilling the triple mission of park management (Ly & Xiao, 2016; Su & Xiao, 2009). Although PNKB NP has applied the new management model since 2010, because of the reasons mentioned above, it did not fully consider the application of carrying capacity into its visitor management tool. In other words, carrying capacity concept is a potential prerequisite to obtain the three mandate of park management for development countries in a long term (Wearing & Neil, 2009). Taking into account the unreached issues of a case study, the researchers are calling for a broader review of more parks in Vietnam for a fully understanding and discussion of the situation.

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