



***PHYSICAL IMPACT INDICATORS FOR MOUNTAIN TRAILS
AT GUNUNG TAHAN TRAIL, MALAYSIA***

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By

SAM SHOR NAHAR BIN YAAKOB

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
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Philosophy**

March 2019

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Doctor of Philosophy

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March 2019

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Mountain trekking in Malaysia has been growing in popularity as evident from the increasing number of trekkers to popular mountain tops in the country. Mountain trails are usually the most practical access to these mountain tops. These trails are usually subjected to various physical impacts as they are extensively used by the trekkers. Thus, indicators are needed if physical impacts at the mountain trails are to be managed. This study was conducted to determine suitable physical impact indicators for mountain trails in Malaysia.

The Gunung Tahan Trail, which leads up to Gunung Tahan summit in Taman Negara National Park, serves as the study site. A self-administered questionnaire was used to obtain the data for the study. An on-site and off-site survey was used to recruit 336 respondents from Gunung Tahan climbers. In addition, an expert panel consisting of 24 individuals in resource conservation were also included as respondents. The respondents were asked to rate the suitability of 27 selected physical impact indicators based on a 5-point Likert scale ranging from 1 (most unsuitable indicator) to 5 (most suitable indicator). In addition, other variables such as respondent's demographic, motives and previous mountain climbing experience were also gathered. General agreement on the most suitable indicators were determined by subjecting the data to a number of statistical tests of significance; independent t-test, multivariate analysis of variance (MANOVA) and multivariate analysis of covariance (MANCOVA).

The results of the analysis showed that sixteen physical impact indicators were suitable for Gunung Tahan Trail. This covers impacts on soil - depth of trail, width of trail, presence of muddy area, presence of wet surfaces, presence of gully, bare surface area, soil compaction, problem area condition, soil drainage, loss of organic matter, problem area coverage (size); impacts on vegetation - root exposure condition, leaned trees; and physical impacts by human - presence of vandalism and presence of multiple trails. The physical impacts on soil are of the most concerned by the respondents based on the selected number and mean scores of these indicators in comparison to vegetation and human impact indicators. These indicators would be useful in managing the trail resources and mountain trekking experiences. Furthermore, the indicators can be applied to determine the carrying capacity and other visitor management strategies for the mountain trails in Malaysia.



Abstrak tesis yang dikemukakan ke Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

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Aktiviti penjelajahan gunung didapati semakin popular dan ianya terbukti dengan jumlah peningkatan jumlah pendaki di puncak-puncak gunung terkemuka di Malaysia. Denai pendakian adalah laluan yang paling praktikal digunakan oleh para pendaki untuk sampai ke puncak. Pelbagai impak fizikal dialami di denai-denai gunung kerana ia sering dikunjungi oleh pendaki. Justeru itu, senarai indikator kerosakan fizikal perlu dikenalpasti terlebih dahulu bagi mengurus sesuatu denai. Tujuan utama kajian adalah menentukan indikator impak fizikal bagi denai-denai gunung di Malaysia.

Denai Gunung Tahan dipilih sebagai tapak kajian. Ianya merupakan laluan utama ke puncak Gunung Tahan, Taman Negara Pahang. Bagi tujuan pengumpulan data, instrumen secara soal selidik digunakan. Kajian tinjauan di jalankan di lokasi kajian dan luar kawasan bagi memperolehi maklumbalas 336 pendaki Gunung Tahan dan 24 panel pakar konservasi sumber. Kesemua responden dikehendaki memberi nilai tahap kesesuaian ke atas 27 indikator impak fizikal berdasarkan 5 skala Likert, iaitu 1, amat tidak sesuai hingga 5, amat sesuai. Disamping itu, butiran pembolehubah demografik pendaki, motif dan pengalaman lalu turut dikumpul. Persetujuan bersama ke atas indikator-indikator yang sesuai diperolehi menerusi beberapa ujian statistik seperti ujian t, analisis multivariat anova (MANOVA) dan analisis ujian MANCOVA.

Hasil dari analisa dapatan kajian, 16 indikator dikenalpasti sesuai dijadikan pengukur impak fizikal Denai Gunung Tahan. Ianya merangkumi indikator impak fizikal ke atas tanah – kedalaman permukaan denai, lebar denai, kehadiran kawasan berlumpur, kehadiran permukaan berair, kehadiran alur, permukaan gondol, tanah mampat, keadaan kawasan bermasalah, tahap

saliran tanah, tahap kehilangan lapisan organik, keluasan kawasan bermasalah; impak fizikal ke atas tumbuhan – keadaan akar terdedah, bilangan pokok condong; impak fizikal oleh perlakuan manusia – bukti kehadiran aktiviti pugut dan bilangan denai buatan pengguna. Indikator impak fizikal ke atas tanah telah mendapat perhatian yang lebih dikalangan responden berbanding tumbuhan dan perlakuan manusia. Indikator impak fizikal amat berguna bagi mengurus sumber di denai dan pengalaman pendakian gunung. Indikator-indikator tersebut perlu digunakan dalam menentukan nilai daya tampung sesuatu denai dan komponen pembentukan strategi pengurusan pelawat denai gunung di Malaysia.



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I certify that a Thesis Examination Committee has met on 18 March 2019 to conduct the final examination of Sam Shor Nahar bin Yaakob on his thesis entitled "Physical Impact Indicators for Mountain Trails at Gunung Tahan Trail, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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CHAPTER 1

INTRODUCTION

1.1 General background

Natural tourism and recreation, including in protected areas and nature parks, is increasing worldwide as well as in Malaysia (Hardiman and Burgin, 2017; Chan and Baum, 2007; WWFNM, 1996). It was reported that about 40 % to 60 % of the international tourist arrivals are nature tourists (Ecotourism Society, 2000), and the contribution of these natural resource-based activities in world tourism industry have been increasing tremendously at 10% to 30 % per annum (Nyaupane *et al.*, 2004). It has been estimated that nature tourism has risen from 2% of all type of tourism in the late 1980s (Weaver and Oppermann, 2000; Ecotourism Society, 2000) to nearly 20% in the year 2000 (Buckley, 2009).

Nature tourism can be defined as all tourism activities directly dependent on the use of natural resources in the relatively undeveloped state, including scenery, topography, water features, vegetation and wildlife (Fennell, 2014; Newsome *et al.*, 2012; Ceballos-Lascurin, 1996). Every type of nature-based tourism is defined by its own unique "spatial" aspect (Newsome *et al.*, 2012). For example, to conduct activities such as jungle trekking, nature interpretation, and mountain climbing, each category needs its own specific setting or surroundings.

The recreation environment or setting comprises of natural resources, ranging from forest areas, national parks, protected areas, rivers, beaches, islands and highlands (Plummer, 2008; Pigram and Jenkins, 2005; Douglass, 2000; McNeely, 1990). In order to fulfill the need and requirements of each activity, visitors must move 'closer' to the exact location of the resources (destination) to engage in recreation activities.

Nature trails are usually the most practical access and function as a mode of traffic to those destinations. Besides being a core component of the recreation infrastructure, trails are also considered as the best option to enhance recreation opportunities and experiences for the visitor. For these reasons, it is plausible that the number of trail users is much higher than at other recreation places. Ballantyne and Pickering (2015), Monz *et al.* (2010), Dawson and Hendee (2008) and Cole (1987) stated that the trails, and campsites, are the favorite locations that are visited by the wilderness user regularly.

Most popular recreation activities such as hiking, camping and mountaineering have a close connection to the trails (Pickering and Barros, 2015; Lynn and Brown, 2003). In mountaineering activities, trails always ensure that the

climbers ascend in the right direction to reach the top. Unfortunately, visitors' movement while participating in recreational activities such as sightseeing and hiking will have an impact on the environment and natural resources. Human-induced impacts will continue to be an important management challenge threatening the integrity of the recreation resource and the quality of visitor experience. Today, users consistently tend to overcrowd at the same place in many recreational areas and such places will be highly impacted.

Increasing recreation usage has been reported as a threat to the natural attractiveness of developed recreation areas (Hammit *et al.*, 2015; Kuss, *et al.*, 1990). Examples of the impacts include soil compaction and erosion, wildlife disturbance, loss of vegetation cover, changing of vegetation composition and aesthetic/cultural resource impacts (Hammit *et al.*, 2015; Newsome *et al.*, 2012; Leung and Marion, 2000; Liddle, 1997). Hammit *et al.*, (2015) and Cole (1985) found that the impact of users on forest trails has a direct relationship with the recreational resources. This means that as the number of visitors or amount of use increased, the impact towards the resources also become greater.

Marion and Leung (2004) further re-emphasized that excessive activity within the resources is the main contributor towards the decrease in wilderness resource quality, especially to nature trails. Activities such as hiking and mountaineering are physically affecting mountain recreational resources including the trails (Barros and Pickering, 2017; Bar, 2017; Nepal and Chipeniuk, 2005; Monz, 2000; Mieczkowski, 1995). The mountain trails in Malaysia are also experiencing similar impacts from an increasing number of visitors (Sam Shor *et.al*, 2011). One example is the Gunung Tahan Trail (GTT) in Taman Negara National Park (TNNP). The heavy use of the GTT over the years has degraded the park's recreation resources especially along the trails (Azita *et al.*, 2009; Arham, 2003; Subari 2002; Aziz 2001; Safarin 2000).

1.1 Problem statement

Mountain ecosystems are recognized as the most sensitive environment to human impacts (Pickering and Barros, 2015; Hammitt *et al.*, 2015), and will be adversely affected when intensively visited. Areas at higher altitude generally have a low ability to absorb and assimilate recreation impacts (Hammitt *et al.*, 2015; Price, 1998). The trails found in these areas, especially when located along the hilly and thin soils, are highly susceptible to surface run-off and soil erosion. As the number of visits increase, the trails will be intensively used and thus resulted in further soil loss and compaction. The impact of the damage will be aggravated and become unmanageable if no restoration and monitoring actions are undertaken.

This will lead to the degradation of resource quality and affects recreation experiences among visitors. Although the mountain ecosystem is resilient, it can only withstand environmental changes and human-induced interferences to a certain degree (Nepal and Nepal, 2004). Upon reaching the optimum limit, the degradation of the natural resources' quality will inevitably occur. Thus, understanding these limits will not only allow the recreation manager to enhance the management of the recreation resource but more importantly, it will enable the protection of the recreation resource as well as enriches recreation experiences among the users. In order to determine these optimum limits and as well as to better understand the associated resource impacts, trail physical impact indicators are crucially required (Svajda *et al.*, 2016; Hammit *et al.*, 2015; Leung and Marion, 2000).

These indicators should be recognized and acknowledged for the sustainable management of mountain recreational resources. Indicators are needed to prove the type and severity of recreation impacts. In the long-term, impact indicators will help recreation resource administrators in the development of recreation impact monitoring systems (Marion and Wimpey, 2017). It also helps the administrators to protect the natural environment as well as providing opportunities which could enhance visitor satisfaction while promoting conservation and ecological sustainability at the recreation site (Newsome *et al.*, 2012; Roggenbuck *et al.*, 1993; Hendee *et al.*, 1990). Over the last two decades, amidst the growing concern on issues related to the environment and impact from human activities in recreation areas, Malaysians have started to become aware of the importance of research in outdoor recreation and nature tourism in the country (DWNP, 1996). This is shown by the growing number of research activities done by local researchers, which focused more on tourism and recreation demand aspects especially on user preferences, attitudes, and marketing elements (Azlizam, 2001).

There is, however, a lack of attention given to recreation ecology research in Malaysia. Such research should include, among others, the study on visitor's impact, development of recreation resource monitoring system and carrying capacity. In addition, there is limited visitor's impact monitoring system practiced or taken as an acceptable guideline in the management of recreational resources in Malaysia's protected areas and national parks. Without proper guidelines on recreation resources planning at mountain areas, the recreational resources will consequently deteriorate. In Malaysia, some researches on recreation impact has been undertaken in selected protected areas and forest recreational sites such as study on visitor perception towards trail impact in forest reserve (Nur Amalina, 2017); visitor impact on vegetation (Suhaimi, 2002); problem area assessment (Nor Suyhadah, 2017; Arham, 2002); and trail impact assessment (Nuazri, 2008; Zulkifli, 2001). These researches used indicators which were developed in temperate regions due to lack of indicator suitable for the tropical environment.

1.2 Justification of the study

Recreation impacts are influenced by the number and behavior of users as well as the environmental factors such as the type of vegetation, soil type, topography, climate and mitigation actions taken by the management (Hammit *et al.*, 2015; Marion and Olive, 2006). One of the most important practices that need to be implemented for effective trail management is monitoring. Monitoring is a systematic and periodic measurement of key indicators which is carried out either on biophysical or social factors. It is perceived as an essential component in any plan or management process of recreation resources.

Through monitoring efforts, resource managers will be able to address undesirable impacts that occur on recreation and tourism resources (Marion, 2018; Ceballos-Lascurain, 1996). Monitoring is also instrumental in detect changes which occur on recreation resource over time and to gauge whether the changes are a result of natural causes or impact caused by human activities. Furthermore, monitoring will help park managers to determine how much unacceptable change which is recorded on recreation resource is caused solely by human activities. This prevention step also provides a better understanding for resource managers of the natural environment and identifies any weaknesses or inefficiency within the existing recreation resource management system (Eagles *et al.*, 2001).

Without any monitoring activity, information on recreation-related problems in recreation area cannot be obtained. The lack of data has forced recreation managers to rely largely on their own personal experience, common sense and judgment to draw conclusions about trends and even about whether or not recreation-related problems exist. They also have to depend on experience when deciding which management decisions are appropriate to correct problems, as well as to assess whether or not the actions they implemented were successful (Marion, 2018). Therefore, monitoring activity is important in ensuring the management of the trail or a protected area at large can be carried out in a systematic manner and fulfilling the need for providing the best and most meaningful recreation activity and preserving the ecological condition of the trail (conservation).

Whittaker *et al.* (2011) stressed that it is important to identify the attributes or impact indicators that can be used as the benchmark information of the trail impact that can be used as the guiding principle in the decision-making process for an effective trail management. An indicator is also important for the establishment of a standard of care for future action for the trail monitoring purposes. In the long-term, the contribution of indicators will provide essential elements for recreation resource planning and management framework such as for the determination of carrying capacity and visitor planning framework (Marion and Wimpey, 2017; Watson *et al.*, 2003; Manning, 2005; Roggenbuck *et al.*, 1993; Vaske *et al.*, 1993).

Moreover, it is also important that the impact indicators to be used in the trail impact management are in line with management objective (Hammit *et al.*, 2015; Whittaker *et al.*, 2011). Furthermore, the selection of the impact indicators has to be associated on the locality of one particular area that matched its environmental condition (Newsome *et al.*, 2012) and behavioral norms (Brown *et al.*, 2010) of the target area. Thus, identification of impact indicator that is congruence to the surrounding of the local area *i.e.*, environmental factors, suitable for the local norms and type of user (recreation user behavior, as well as the management objective, are crucially needed for the effective trail monitoring system.

1.3 Research Questions

This research attempted to identify the standard set of physical trail impact indicators based on the attitude of stakeholders (expert panel, mountain guides, experienced climbers, and climbers). Specifically, the study was carried out to find answers the following questions:

- 1) What is the difference between stakeholders' attitude towards physical trail impact indicator?
- 2) Which are among the predisposing factors have the influence on stakeholders' attitude towards the physical impact indicators for a mountain trail?
- 3) What are the motivational factors that influence stakeholders' attitude towards physical impact indicators for a mountain?
- 4) Which are among the physical trail impact indicators are important to be selected as the physical impact indicators for a mountain trail?

Specifically, this study focuses on identifying suitable trail physical impact indicators at Gunung Tahan Trail in Taman Negara National Park. As this trail shares many similar characteristics (geography, landscape, climate, and usage) with many other trails in the country, findings may be generalized to other trails.

1.4 Research Objectives

The general aim of this study is to determine the standard set of physical trail impact indicators that can be drawn as a guideline for measuring the degree of physical impacts for Gunung Tahan Trail for monitoring purposes. Based on the aim of the study, the following objectives were formulated such as;

- I. to examine the stakeholders' attitudes towards physical trail impacts indicators at Gunung Tahan Trail,'
- II. To examine the differences between stakeholders' attitude towards the physical impact indicators,
- III. to investigate the influence of predisposing factors on their attitudes towards the trail impact indicators,
- IV. to investigate the influence of travel motivation on their attitudes towards the trail impact indicators

1.5 Definition and measurement of key terms

- i. Visitor management framework
 - Visitor management framework is the planning framework emphasizing on carrying capacity that is used in the protected area, national park, ecotourism destination as the planning framework (Worboys *et al.*, 2005). In this study, visitor management framework is used interchangeably with planning framework.
- ii. Physical trail impact Indicator
 - An indicator is a variable (Chevalier *et al.*, 1992; Gallopin 1997) or a measure (measurement) of an aspect of the criteria (McQueen and Noak 1988; Prabhu *et al.*, 1996). In this study, indicators were referring to the physical trail impact indicators that were used as the indicators to measure the trail impact. In this study, the physical trail impact indicator was measured based on the expert and public's attitudes towards the importance of the physical trail impact indicator to represent the standard set of physical impact indicator for GTT.

iii. The standard set of physical trail impact indicator

- The standard set of physical trail impact indicator is referring to the physical trail impact indicators that are selected as the physical trail impact indicators for Gunung Tahan Trail.

iv. Stakeholder

- According to Freeman (1984), a stakeholder is 'any group or individual who can affect or is affected by the achievement of the organization's objectives'. In this study, stakeholders were also used interchangeably with the public as in public participation. In this study, stakeholders are defined as comprising of several groups.
 - Climbers: Visitors / Tourists
 - Guides: Mountain guides and tour operators, which all are the local communities at Taman Negara National Park
 - Expert panels: park authority, government agencies in the related field, academician and researchers and NGOs
 - Experienced climbers: Skilled climbers from local climbing associations.

v. Expert panel

- The expert panel is referring to a person with extensive knowledge about a certain field of study that usually invited for evaluation of specialized input and opinion. In this study, expert panels are individuals who are knowledgeable, experienced and actively participates in the planning and development activities of ecotourism in Malaysia.
- Furthermore, the expert panel is also an individual who is frequently involved in the process of formulation of laws and policies regarding Malaysian natural resources. In addition, the expert panel in this study was comprised of academician, researchers, NGOs, personnel from the park authority and personnel from relevant government agencies such as personnel from the Department of Wildlife and National Park, the Department of Forestry, Ministry of Youth and Recreation of Malaysia and Ministry of Culture, Arts and Tourism of Malaysia.

vi. Climbers

- Climber is defined as someone who climbs or a mountaineer. In this study, climbers were referring to the person who had climbed Gunung Tahan. Moreover, climbers were also referring to the mountain guide at Gunung Tahan Trail.

vii. Mountain guides

- Mountain guide is referring to a person who is specially trained and experienced mountaineers and professionals who are certified by relevant mountain guide association that is recognized by the relevant authority. In this study, mountain guides or also known as guides who are registered as mountain guides with Department Wildlife and National Park at Taman Negara National Park. The guides are certified by the Ministry of Tourism, Arts and Culture Malaysia as the official nature guide in park area, and members of local nature guide association.

viii. Attitude

- Ajzen (1991) refers to attitudes as a set of behavioural beliefs about the expectation of certain behaviour and its consequences where it is weighted by the evaluation of those consequences either it's positively or negatively valued. In this study, attitude is referring to the stakeholders' attitude towards the physical impact indicators. Its measured based on based on the stakeholders' beliefs on the importance of the impact indicators to represent the standard set of physical impact indicators for Gunung Tahan Trail and weighted the strength of the beliefs through the evaluation (strongly agree or vice versa) that was made during the visit to Gunung Tahan Trail.

ix. Predisposing factors

- In this study, predisposing factors were based on the Theory of Wilderness Responsible Behaviour. Such predisposing factors were previous experience and demographic factors.

x. Motivation

- Motivation refers to the underlying forces that arouse and direct an individual's behaviour (Iso-Ahola, 1999). In this study, motivation refers to the combination of the visit and setting motivation that motivate visitors to climb Gunung Tahan.

1.6 Outline of the Thesis

This research was organized into five chapters and the arrangement of topics is listed as below:

- i. **Chapter 1** covers the fundamentals of the research or general orientation of research; such as the development of the research, the justification of research, the significance of the research and the direction of the research in order to achieve the research aim and objectives.
- ii. **Chapter 2** consists of a literature review which covers aspects of conservation and significance of mountains and the background of the mountain trail in Malaysia. It also elaborates on the literature review on the impact towards recreational resources, the importance of indicator and the reflection of relevant theories in the field of recreation ecology.
- iii. **Chapter 3** consists of a comprehensive research methodology of the study and it comprises three main components, namely: study area description, the research question and hypothesis and research design. The research design covers procedures such as the rationale behind research methodology adopted, the sample selection process, respondent's category, the development and refinement of the questionnaire, data collection (field survey), data handling and manipulation, and technique used in data analysis.
- iv. **Chapter 4** discusses the results and analysis of the research in accordance with the research objectives. The information and interpretation of each research objective and results are mapped out accordingly in order to enhance readers' understanding towards every rational and given analysis. Besides, this format helps the presentation of results systematically and effectively as the main research component is trail (mobile impact or spatial). Further explanation of the results obtained will also be discussed. The discussion will elaborate available data in detail on the process to determine impact indicators, while taking into consideration relevant prior research and theory, stated research aims and objectives.
- v. **Chapter 5** consists of the conclusions and recommendations of the research. In this chapter, several conclusions are made by drawing together results and information from the literature on previous research. This chapter also identifies 'gaps' in research and suggests several implication such as management guideline and prospect research topics which need to be addressed further.

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