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# Proceedings of the 1<sup>st</sup> International Summit Conference on Exercise Science, Sports Management, Outdoor Recreation, and Physical Education, ExSPORT 2024, 28<sup>th</sup> - 29<sup>th</sup> August, Malaysia

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# A Preliminary Study on Assessing Recreation Resource Impacts at GeoBudaya Berkeley Trail at Lenggong Geopark, Perak, Malaysia



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**Abstract** | Recreation ecology is a field of study that assesses, examines and monitors any impact due to visitors coming to carry out recreational activities, especially in natural areas. In line with the recognition of Lenggong Geopark as a National Geopark on 16 September 2021, it is sure to be the primary destination focus for visitors who want to enjoy the uniqueness of geological heritage in this geotourism area. In fulfilling the visitor's desire to engage more closely with these ecological heritage resources, the trail is a specific medium that connects the resources and the prospective visitors who are interested. However, the large number of visitors can cause problems with the overall quality of the trail system, causing undesirable changes and damaging components of natural resources such as soil, vegetation, wildlife, and water. This problem has directly affected the integrity of the management in maintaining recreational benefits, even creating conflicts between visitors and difficulties in achieving management sustainability. Therefore, this study aims to assess the conditions along the Berkeley GeoBudaya Trail and subsequently provide the management with an understanding of the current status of the trails so that appropriate actions can be taken to curb damage from continuing to occur. Through data collection, 24 sampling points were obtained with a consistent distance gap of 50 meters, each from one to another, making the entire distance of the Berkeley GeoBudaya Trail 1.2 kilometers long. The assessment was carried out using three main techniques, Rapid Survey Technique, Census Sampling Technique, and Cross-sectional Measurements, to determine the factors influencing the recreation resource impact of the trail. The findings of the study show that the current status of recreation resource impacts on the Berkeley GeoBudaya Trail is between low to moderate, preserved, and the environment still retains its naturalness. The significant contribution of such an assessment is believed to be advantageous to the management in ensuring the sustainability of the trail system by accommodating visitation while enhancing the protection of natural resources along the Berkeley GeoBudaya Trail.

**Keywords:** *Recreation ecology, recreation resource impacts, trail impact assessment, GeoBudaya Berkeley Trail.*

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## I. INTRODUCTION

Lenggong Geopark has been recognized as a Malaysian National Geopark since December 16, 2023. The Geopark represents an area of international importance with high-value geological heritage and aesthetic value and an integrated concept that includes conservation, education, and the local economy [1]. Hence, the Geopark is most likely to become one of the most visited destinations among visitors seeking to enjoy the uniqueness of the geological heritage experience. The trail is a specific medium that connects the resources and the interested prospective visitors [2]. In this case, the particular route is known as the Berkeley GeoBudaya Trail. However, the large number of visitors can cause problems with the overall quality of the trail system, causing undesirable changes and damaging components of ecological heritage resources such as soil, vegetation, wildlife, and water [3][4]. This problem has directly affected the integrity of the management in maintaining recreational benefits, even creating conflicts between visitors and difficulties in achieving management sustainability. Exploring recreation resource impacts is vital because trail-related recreation activities such as hiking and wildlife viewing are popular and receive some of the most intensive visitor use within the parks [5]. The outcome of this research contributes to determining the causes and consequences of recreation resource impacts, which are challenging and highly site-specific. Thus, recreation resource impacts are a concern for managers because the trail may become difficult or unsafe, aesthetic aspects of ecological heritage resources may be diminished, and substantial funding or staffing may be required to repair or maintain trails. Therefore, this study aims to assess the conditions along the Berkeley GeoBudaya Trail and subsequently provide the management with an understanding of the current status so that appropriate actions can be taken to prevent damage from continuing to occur.

## II. METHODS

This study applied the structured observation method using inventory form and was supported by three techniques. The Rapid Survey Technique was conducted to collect data within a 50-meter distance from one sample point to another, and the Census Sampling Technique involved census problem areas at the entire trail system. Cross-sectional measurement was used to understand trail depth and width changes. Through data collection, 24 sampling points were obtained, making the entire distance of the Berkeley GeoBudaya Trail 1.2 kilometers long. An expert judgement has sought the content of the inventory form before the data is collected on-site. Therefore, the inventory form comprises ecological aspect parameters divided into sections focusing on impacts on soil, vegetation, wildlife, and water; trail width, transect line depth, and overall trail condition [6] – [8]. Each of the chosen parameters is rated into four classes: 1 = high impact, 2 = critical impact, 3 = moderate impact, and 4 = low impact, respectively.

## III. RESULTS AND DISCUSSION

### A. *The trail condition is based on the width and depth.*

Trail width and depth have been described as part of the trail corridor, which directly supports most recreational traffic in natural settings. However, it is not applicable when the sample point is not situated on the trail surface [9]. The result shows that trail width readings range from 73 cm to 475 cm throughout

the trail (Table 1). Based on the record, only 8% (2 points) stated reading below 90 cm. Significantly, 98% (22 points) marked the reading as more than 90 cm in width, and this represented excessive trail width because the trail exhibits a greater than 90 cm expansion in width that is attributable to recreational uses, such as walking around tree falls, wet or muddy areas, eroded areas and multiple treads [10][11]. This result was then supported by the reading of the trail depth, which was calculated in three different sections of the trail, which are the middle trail depth (D), the right side of trail depth (D1) and the left side of the trail depth (D2).

TABLE 1  
THE WIDTH AND DEPTH OF BERKELEY GEOBUDAYA TRAIL

	Minimum (cm)	Maximum (cm)	Mean (cm)
Trail Width	73	475	210
Trail Depth (D)	0	10	3
Trail Depth (D1)	0	10	2
Trail Depth (D2)	0	13	3

Contradicting the trail width result, the mean depth in the middle of the trail is low (3 cm) and almost equal to the readings on the right (2 cm) and left (3 cm). The overall segmentation has a 100% minimum trail depth measurement of 0 cm. Still, the maximum trail depth measurement is classified as highly impacted for specific points because the depth recorded up to more than 8 cm deep, such as the readings on the middle trail depth (D), which stated 25% (6 points) reaches 10 cm, the right side of the trail depth (D1) represented only 8% (2 points), and the left side of the trail depth (D2) was 21% (5 points).

*B. The overall assessment of recreation resource impacts.*

Table 2 represents the comprehensive evaluation of recreation resource impacts at the Berkeley GeoBudaya Trail, consisting of four variables for soil, ten for vegetation, four for wildlife, and four for water resources.

TABLE 2  
THE OVERALL ASSESSMENT OF RECREATION RESOURCE IMPACTS

Impact	Variables	Level of Impact
Soil	Problem areas	Moderate
	Soil erosion	Low
	Soil drainage	Low
	Soil exposure	Moderate
Vegetation	Root exposure	Moderate
	Loss of vegetation	Moderate
	Canopy coverage	Moderate
	Damages to vegetation	Moderate
	Tree stumps, fallen trees and lean trees	Moderate
	Vegetation density	Moderate
	Vegetation composition	Moderate
	Unique and endangered species	Low
	Mechanical damage	Moderate
	Exotic species and weeds	Low
Wildlife	Wildlife disturbance	Low
	Wildlife harvesting	Low
	Loss or modification of wildlife habitats	Low
Water	Wildlife dependency on food	Low
	Contamination of useable water resources	Low
	The presence of bacteria	Low
	Water quality	Low
	Solid suspended matter	Low

Undoubtedly, a “low level of impact” of wildlife disturbance, wildlife harvesting, habitat loss or modification, and wildlife reliance on food were the outcomes of the impact on wildlife. Similarly, the impact on water is shown as having a “low level of impact” for every parameter, including bacteria from leftover food and domestic animal waste, water quality changes, and solid suspended matter. These factors all contribute to the contamination of useable water resources in natural areas caused by erosion of riverbanks and camping activities. Impacts on soils occur when changes in soil compaction, chemical and microbiological properties and soil loss occur due to recreational activities along the trail [12]. There are equal levels of impact recorded for “low level of impact” classified for soil erosion and soil drainage, while “moderate level of impact” shown by the variables of problem areas and soil exposure. Soil exposure is clearly understood as the ground condition with very little or no organic litter (partially decomposed leaf, needle, or twig litter) or vegetation cover within the site boundaries [11]. Lastly, for vegetation, the result indicated that 80% of the impact variables were confirmed at the “moderate level of impact” compared to only two variables, which are unique and endangered species and exotic species and weeds. The findings of the study show that the current status of recreation resource impacts on the Berkeley GeoBudaya Trail is between low to moderately preserved, and the environment still retains its naturalness.

## IV. CONCLUSIONS

In conclusion, the Berkeley GeoBudaya Trail at Lenggong Geopark is projected to become one of the most visited destinations for those seeking the uniqueness of the geological heritage experience. Referring to the findings that indicated the environment remained naturally preserved, it is vital for the management to conduct a long-term recreation resource impacts assessment and monitoring together with the implementation of management actions designed to maintain standards of quality to ensure the sustainability of the trail in accommodating visitation to meet the user's expectations, as this will reflect their memories and experience while enhancing natural resource protection.

**ACKNOWLEDGMENTS:** The authors would like to acknowledge the Perak State Government, Lenggong District Council, Gerik District Council, Department of Mineral and Geoscience, and the Ministry of Natural Resources and Environmental Sustainability for supporting the Lenggong Scientific Expedition. Thank you to Universiti Teknologi MARA (UiTM), especially the College of Built Environment, for the support and provision of facilities and equipment needed for the success of this expedition. The authors most profoundly appreciate all the subjects who succeeded in this study.

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