



## A Review of Interpreting the Parameters of Nature-based Trail Setting in Primary Rainforest using ROS Concept

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### Abstract

Primary rainforest as an old heritage has become widely known because of its old natural, beautiful setting and the richest of its biodiversity. A nature-based trail is a natural path in the rainforest as a medium to explore the uniqueness of the natural beauty assets and the biodiversity of the forest. The development of the nature-based trail settings in a primary rainforest gives the impact towards visitor's experience indirectly to appreciate the biodiversity. Recreation Opportunity Spectrum (ROS) parameters will be used to interpret the effectiveness of the trail. The sustainability of natural resources becomes a major concern towards the management and conservation of the biodiversity.

**Keywords:** Biodiversity; heritage; rainforest; ROS parameter

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### 1.0 Introduction

Primary rainforest parks are protected areas managed at the state level, which uses "state" as a political subdivision. The primary rainforest parks are typically established by a state to preserve a location on account of its natural assets, historic interest, and nature-based recreational potential. In Malaysia, many primary forests function as parks and reserves, including National Parks, and State Parks which are managed by the Department of Forestry. Currently, these rainforests are under threat and tourism has been identified as one industry that has some potential to add value to this important natural resource (McNamara & Prideaux, 2011; Ortleb, 1997). Primary Rainforest is a virgin forest, as well as an old heritage. Usually, the age of this primary forest is in the ranges of million years. This primary rainforest has become widely known because of its old natural, beautiful setting and the richest of its biodiversity (Misni, 2012, 2016; Noss & Cooperrider, 1994).

A nature-based trail is a natural path, track or unpaved lane to routes along rivers, valleys, hillsides, etc. in the rainforest as a medium to explore the natural beauty assets and the biodiversity of the primary rainforest. The development of trail settings in a primary rainforest park gives the impact towards visitor's experience indirectly to appreciate the biodiversity. Nature-based trail settings in state parks are essential management tools for improving both ecological conservation efforts and the quality of visitor experiences. One difficult and the consistent challenge of park planning are to design, nature-based recreational activities that are compatible with conservation (Yamaki & Shoji, 2004). Yamaki & Shoji (2004) added that without park management and systematic planning have resulted in a lack of control, overuse, and degradation of natural settings. It is expected that the park planning for trail aspect would ameliorate these problems. The challenge is to keep impacts to a minimum while providing the desired experience. Besides that, a trail must serve the needs of users for generations to come, while preserving the sense of place and protecting the quality of the surrounding environment. Sustainable trails begin with thoughtful planning, good design, and meticulous layout (DCR, 2012). A successfully designed trail will entice visitors back time and again. The aim of this study is to review and interpret the outdoor

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nature-based trail and recreation activities in the gazetted rainforest that can protect the integrity of natural park resources and the quality of the visitor experience.

## 2.0 Study area

This study highlights a study associated with the sustainable trail of the area that recognized as one of the state heritage sites. The sustainable development practices were selected as the field of study involving the management and conservation requirement in State Park area. Therefore, for this related field of study, the chosen case study for this research was the area Royal Belum State Park. The state of Perak was endowed with rich and diverse biodiversity especially in the lowland and hill dipterocarp forests in northern Perak (Yamada, Niino, Yoshida, Hosaka, & Okuda, 2014). The complex includes Belum Forest Reserve, Temenggor Forest Reserve, Gerik Forest Reserve that declared as Belum-Temenggor Forest Reserve. This Forest Reserve (290,000 hectare) is one of the largest contiguous tropical rainforests still persisting in Peninsular Malaysia, and it is home to many endemic species of flora and fauna (Davison 1995 cited in Joann et al., 2013). Despite its high biodiversity, it remains one of the least studied parts of the country. The rich of biological resources in Royal Belum State Park include various ecosystems, species of plants and animals are assets for the state of Perak which have great economic potentials in horticultural, medicinal plant, aesthetics, urban forestry, and ecotourism (FPR, 2016). All these resources are an ingredient for ecotourism product in the state of Perak.

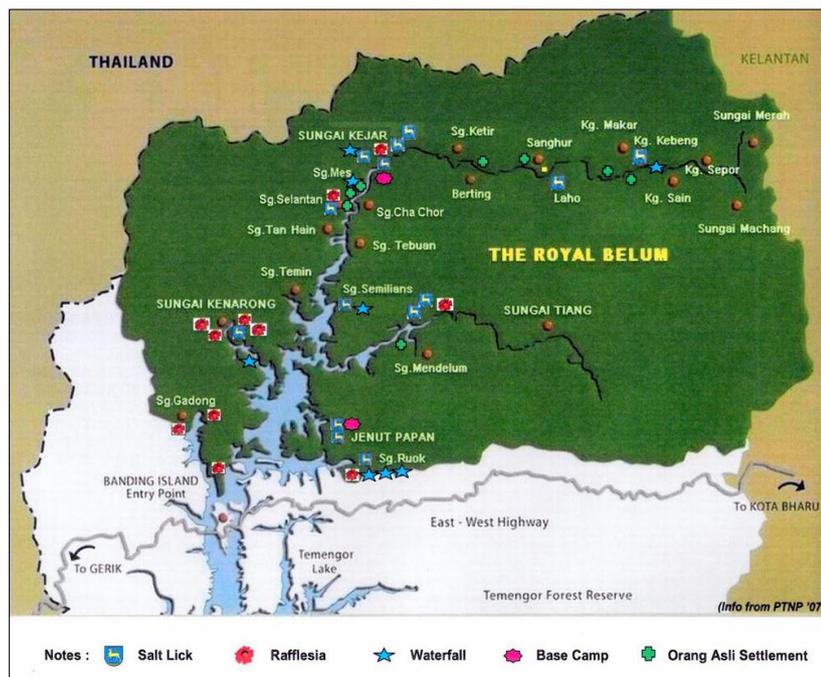


Fig. 1. Location plan of Royal Belum Rainforest (Source: PTNP, 2016)

The study area located at Kenarong and Ruok rivers as streams/ rivers that located at lower west and east of Royal Belum (Fig. 1). Kenarong river is located at 5°N and 101°E with an elevation of about 300 meters above sea level. The second study area located at Ruok river as a Mahseer fish sanctuary that pointed at the lower east located at an elevation around 200 meters. Both streams/ rivers are surrounded by lowland dipterocarp forest areas. The boundaries of The Royal Belum follow those of the former Belum Forest Reserve north of the East-West Highway, adjoining forests in Kelantan and southern Thailand. Gateway to the park is Tourist Centre Banding Island that's easily accessible by road from Gerik (45 minutes), Ipoh (3 hours), Penang (2 hours) and Kota Bharu (4 hours).

## 3.0 Classification of trail

The prescribed level of trail development represented the intended design and management standards of the trail. Trail Classes are general categories reflecting trail development scale, arranged along a continuum. The Trail Class identified for a National Forest System (NFS) trail prescribes its development scale, representing its intended design and management standards. Local deviations from any Trail Class descriptor may be established based on trail-specific conditions, topography and other factors. The study defines three types of ROS areas for trail classification, there are wilderness, special consideration and service (Gundersen, Tangeland, & Kaltborn, 2015). Five trail class categories are defined in terms of tread, obstacles, constructed elements, signs and typical recreation experience:

- Class 1 Trails: Minimal/undeveloped trails

- Class 2 Trails: Simple/minor development trails
- Class 3 Trails: Developed/improved trails
- Class 4 Trails: Highly developed trails
- Class 5 Trails: Fully developed trails

Existing Nature-based trails in the study area can be categorized as Standard Natural Surface Trail. According to USFS (2016), it defines the predominant surface is ground, and the trail is designed and managed for ground-based travel. This trail is common with natural forest and provides several of flora and fauna. It will be suitable to organize an activity that relates to conservation and recreation program with low risk.

### 3.1 Trail Design

Principles of ecologically sustainable trails are our most important tool for linking conservation and recreation. As such, they must be developed and maintained in ways that avoid negative impacts to the ecological resources of the Commonwealth, especially those that the DCR (2012) directly stewards. All development, including trails, has direct and indirect impacts to the environment. This element help minimizes these impacts by proposing the following “guiding principles” when developing and maintaining trail systems:

- i. Avoid Sensitive Ecological Areas
- ii. Develop Trails in Areas Already Influenced by Human Activity
- iii. Provide Buffers to Protect Sensitive Ecological and Hydrologic Systems
- iv. Use Natural Infiltration and Best Practices for Stormwater Management
- v. Limit tread erosion through design and construction
- vi. Provide Ongoing Stewardship of the Trails
- vii. Ensure Trails Remain Sustainable
- viii. Formally Decommission and Restore Unsustainable Trail Corridors

### 4.0 The importance of Recreation Opportunity Spectrum (ROS) approach

Increasing numbers of visitors to primary forests are causing damage to the natural forest environment and often results in the use of natural resources that are overused and less sustainable. The management issue is particularly important due to the often-competing mandates of natural parks, to protect important natural and cultural resources and to offer opportunities for the public to use and enjoy these areas. The issue of how to manage outdoor recreation in ways that can protect the integrity of natural park resources and the quality of the visitor experience (Moyle, 2013). The category of trail need to indicate that those areas classified should implement the regulation according to trail standard and guideline. The lack of enforcement in application this guideline shows that there are no coherent, thus creating conflicts in the implementation process. It also made inefficient towards our forest complex and will cause fragmentation of heritage sign. The sustainability of natural resources becomes a major concern towards the management and conservation of the biodiversity. Therefore, the sustainable manner by Recreation Opportunity Spectrum (ROS) approach will interpret the effectiveness of existing trail (Yamaki & Shoji, 2004).

The Recreation Opportunity Spectrum (ROS) is a classification tool used by Forest Service managers since the 70s to provide visitors with varying challenges and outdoor experiences USFS (2016). ROS is the primary tool for providing recreation input to Forest planning. ROS is more than identifying zones on a map, it's a different way of thinking about recreation – it's an outcomes-based approach. Besides, ROS setting emphasizes recreation activities and opportunities that are appropriate to remote natural settings USFS (2016). ROS describe different recreation settings, opportunities, and experiences. Forest recreation settings vary from semi-primitive – where there is some evidence of other people, difficult access, and opportunities for self-reliance – to more developed rural areas which offer more facilities, better access, and opportunities to interact with other people. The primary focus in this study is to manage the natural conditions of the forest without degraded the natural setting and surrounding natural resources, and maintain the richest of the biodiversity.

### 4.1 ROS concept

ROS was developed by the US Forest Service in the late 1970s (Clark & Stankey, 1979; Driver & Brown, 1978). The six different ROS classes are primitive, semi-primitive non-motorized, semi-primitive motorized, road natural, rural, and urban (USDA, 1990). According to USDA (1990), the ROS offers a framework for understanding relationships and interactions between visitors and their surroundings by classifying recreation experiences from urban to primitive based on the following criteria such as physical setting (access, remoteness, naturalness, and visitor impact), social setting (social encounters), and managerial setting (facilities, site management and visitor management). This approach is effective to design activity based on the trail capacity. Thus, provision of official trail must be interpreted according to trail design and concept. More specifically, ROS is conceptualized as a four-tiered framework that links activities, settings, motivations, and benefits. The basis for this system is often described as “experience based setting management” (Floyd & Gramann, 1997; Manfredo, Driver, & Brown, 1983), and may be thought of as a type of “production process”. It theorizes that experiences are derived from recreation activities, and that these activities are linked to the settings in which they occur. Settings, in turn, are comprised of three categories of factors; resource, social, and managerial. His concept development is important to fulfill visitor expectation along a trail. Clark and Stankey (1979) notify the types and quality of park recreational experiences are defined by the attributes of the available surroundings, both natural and managed. For example, walking along extensive, undeveloped trails with

difficult access and few facilities offers a sense of solitude, challenge, and self-reliance; in contrast, walking in a setting characterized by easy access and highly developed facilities offers more comfort, security, and social opportunities (USDA, 1990). These amenities are important to support the definition and management of diverse outdoor recreation opportunities in diverse settings.

#### 4.2 ROS application

According to DCR (2012) in trail guidelines and best practices manual, trail offering a rich and enjoyable experience with intersection of conservation and experience. It's also creating a sense of place and a sequence of events that add interest and offer challenge are essential to good trail design. In the applied ROS system, some early conceptual articles assume a linear relationship among physical, social, and managerial settings. Sustainable trails begin with thoughtful planning, good design, and meticulous layout. Therefore, Heywood, Christensen, & Stankey (1991) suggested the need for more flexible mapping criteria than found in current ROS applications. Many of trails suffer from lack of planning and poor design that's user created pathways, leftover routes from historic farm roads and logging activities that are not appropriate for long-term recreational use will be trace by ROS application. Gray et al. (2010) examined that a ROS-based planning framework can help identify, classify, and preserve a variety of setting types for recreational. The Recreational Opportunities Spectrum recognizes that the user experience and expectations will vary along a continuum from primitive facilities to semi-developed sites in urban areas. Some DCR facilities are naturally going to provide a more urban or sub-urban recreational experience and some a more natural or even semi-primitive experience. The ROS helps provide management guidelines across this continuum.

Recreation opportunity settings are consisted of physical, social, managerial conditions, appropriate variables that represent recreation opportunity settings. The variables are based from ROS objective of Forest Plan that prescribes a variety of opportunities, settings and experiences of recreation (HNF, 2014). The variables are as follows:

- i. Trail condition
- ii. Bench and table
- iii. Guide sign
- iv. Interpretation board
- v. Warning sign
- vi. Rope for no trespassing
- vii. Ranger
- viii. Frequency of meeting other visitors
- ix. Possibility of encountering wild animal
- x. Walking hours from trailhead to destination

The trail settings will be evaluated based on the visitor classification by calculating the distance between the trail settings and the gravity of each visitor group. The trails will divided into segments depending on the physical, social, and managerial conditions of the environment, and then data sets were made for each segment. For the distant analysis, the Mahalanobis distance accounts for the variance of each variable and the covariance between variables (Todeschini, Ballabio, Consonni, Sahigara, & Filzmoser, 2013). The process of data collection and analysis in this study can be one approach for producing ROS maps, which provide visitors with recreational opportunities of greater diversity and higher quality. By integrating physical and biophysical information and a consensus of the existing building system within ROS approach, hope can propose more effective management plans for trails.

#### 4.3 ROS parameters

The ROS recognizes that the user experience and expectations will vary along a continuum from primitive facilities for semi-developed sites in urban areas. Some DCR facilities are naturally going to provide a more urban or sub-urban recreational experience and some a more natural or even semi-primitive experience. The facilities (including trail facilities) across this spectrum will obviously be managed differently, with different standards and different levels of management. The ROS helps provide management guidelines across this continuum. In urban and sub-urban settings: Accessible, multi-use hard surface paths may be more appropriate with a relatively high level of use, and greater signage and management presence. In developed and semi-developed natural settings: Users may expect a diversity of trail types and experiences from woodland only pedestrian trails to mountain biking trails to soft-surface multi-use trails, but they will also expect to encounter a variety of users, especially in core areas. In semi-primitive settings: Expectations will vary depending on whether the facility allows motorized use or not. In non-motorized areas, trails will tend to be narrower and more rugged with a minimum of management presence. Users will expect to find a certain level of solitude and may not expect many other users.

#### 4.4 The Theoretical Framework of ROS parameters and variables

The parameters of trail setting are accessible; remoteness, facilities, visitor management, naturalness, social encounters and visitor impact were used as primary amenity characteristics. The variables related to the main parameters are as follows:

1. Access
  - (i) Trail condition
2. Remoteness
  - (i) Walking time to destination
3. Facilities
  - (i) Bench and tables

- (ii) Inn
- (iii) Restaurant
- (iv) Shop
- 4. Visitor management
  - (i) Guide signs
  - (ii) Warning Signs
  - (iii) Rope to prevent trespassing
  - (iv) Interpretation board
- 5. Naturalness
  - (i) Artificial structures
    - Social encounters
      - (i) Frequency of encounters
      - Visitor impact
        - (i) Loss of vegetation

These parameters of the trail are used to clarify the present situation of the trails and the existing of utilization plan. Furthermore, this study will classify the type and category of trails in the primary rainforest, to control the users with some limitation using trails setting. In the future, Department of Forestry and State Government can use the parameters as a guideline or references to set or upgrade their trail settings at all primary forest parks in Malaysia. The ROS maps will be created using Geographical Information System (GIS) by classifying actual trail settings indicate that the most of the trails considered as developed will be located in accessible places, while the most of the primitive trails will be located in remote areas far from the main entrance and difficult to access. These trail classification will provide a better protection and planning for the most sensitive areas and bio-diversities groups in the virgin rainforest from any public disturbance and illegal activities.

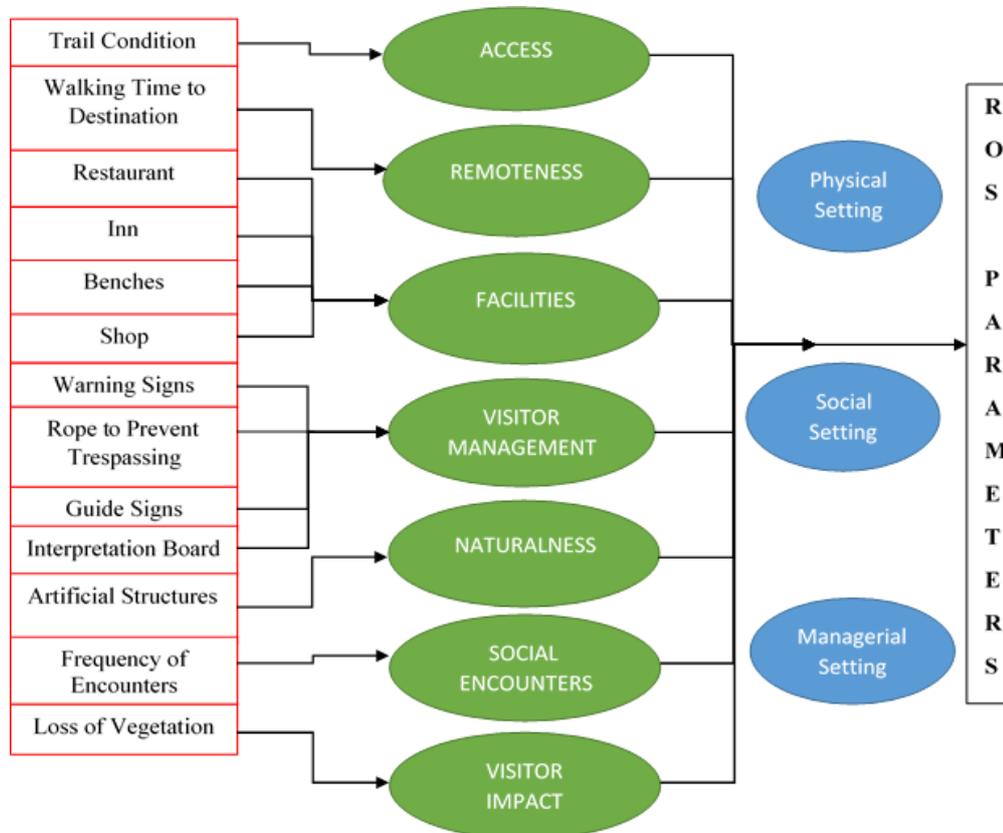


Fig. 2. The Theoretical framework of relationships between ROS parameters and variables (items)  
 (Source: Modified from Yamaki & Shoji (2004), HNF (2014), DCR (2012) and USDA (1990))

The trail settings will be evaluated based on the visitor classification by calculating the distance between the trail settings and the gravity of each visitor group. The trails will be divided into segments depending on the physical, social, and managerial conditions of the environment, and then data sets were made for each segment. For the distant analysis, the Mahalanobis distance accounts for the variance of each variable and the covariance between variables (Todeschini et al., 2013). The process of data collection and analysis in this study can be one approach for producing ROS maps, which provide visitors with recreational opportunities of greater diversity

and higher quality. By integrating physical and biophysical information and a consensus of existing building system within ROS approach, hope can propose more effective management plans for trails.

## 5.0 Conclusion

This study reviewed and interpreted the outdoor nature-based trail and recreation activities in the gazette rainforest that can protect the integrity of natural park resources and the quality of the visitor experience. The present situation of a state park is clarifying using the ROS approach include its parameters and variables (items) as an attempt to apply guidelines for the nature-based trail and recreation activities in utilization plan. Therefore, the parameters of nature-based trail setting for improving the performances of state park conservation and management will be used in the next stage of this study; to plan of questionnaires survey to be distributed among management people and actual users regarding to the existing/current situation of nature-based trail and furthermore the findings will be used to provide a manageable, safe and practical of nature-based trail setting. It is focused to help in promoting while protecting heritage assets in the development of state park especially in Malaysia. Hope to help state park area to maintain the status as one of the well-known gazette forest complex, especially for the Royal Belum State Park itself as well as to provide the best of nature-based trail setting in it future utilization plan. This study also helps in providing a better strategy and guidelines for decision-making in future state park utilization plan and provide a better understanding of the role of the nature-based trail itself.

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