Distribution Pattern of Rare Tree Species in Two Virgin Jungle Reserves in Pahang and Johor, Malaysia

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Abstract: A study on the distribution pattern of rare tree species was carried out in Bukit Bauk Virgin Jungle Reserve (VJR), Terengganu and Gunung Pulai VJR, Johor. A single plot of 2 ha (100 m x 200 m) was established in each VJR by using purposive sampling design. The plot was further divided into contiguous 50 subplots of 20 x 20 m^2. Based on the IUCN categories, six species are critically endangered and two species vulnerable in Bukit Bauk VJR. In Gunung Pulai, five species each are critically endangered and vulnerable. Both VJRs registered tree species distribution that is random and clumped in different proportions.

Key-Words:- Spatial distribution, Rare tree species, Virgin Jungle Reserves, Conservation, IUCN

1 Introduction

The establishment of Virgin Jungle Reserves (VJRs) within the timber production areas in Peninsular Malaysia was initiated in 1950's to serve as permanent nature reserves and natural arboreta; control for exploited and silviculturally treated forest; and undisturbed natural areas for general ecological and botanical studies of fundamental importance [1].

Malaysian rain forests are being managed by establishing an extensive network of protected areas since 1930's. For this purpose, a total of 1.39 million hectares of protected areas have been set aside for the conservation of biological diversity in the form of national parks, wildlife sanctuaries and nature reserves [2].

Although these protected areas and VJRs constitute insignificant proportion as compared to the permanent forest estates, many of the VJRs are now seriously depleted with little conservation value [3]. About 30% of the VJRs established have been lost due mainly to

the excision of the forest for other land use [4].

A major threat to VJRs is from strategic decisions involving land use, and there is a conflict between this and the network's objectives of locating VJRs in all forest types and preserving samples of virgin forests. Broadly, experience has shown in Peninsular Malaysia that lowland forests are primarily targeted for commercial timber extraction, followed by conversion to agricultural use. This trend is likely to accelerate, when state land forest is exhausted, which is likely to occur in the near future [5].

The relevance of the VJRs network of Peninsular Malaysia in an international context has already been recognized [6]. It is, in addition, self evident that as large continuous area of undisturbed tropical rainforest become increasingly scarce and the scope for establishment of large areas of forest as national parks is correspondingly reduced, a positive management strategy, involving setting aside small areas within managed forest becomes increasingly relevant.

In the context of the establishment and management of the VJR network, as undisturbed natural areas for general ecological and botanical studies of fundamental importance, and with the current state of forest and biodiversity affairs in Malaysia, therefore, the requirements for research and evaluation of biodiversity data, especially rare species become more imperative. Baseline data of forest biodiversity especially in tropical countries such as Malaysia is inadequate [7].

The study was aimed to identify the spatial distribution pattern of rare tree species and their conservation in two VJRs in Peninsular Malaysia at Bukit Bauk in the state of Trengganu and Gunung Pulai in the state of Johor.

2 Methods

2.1 Study Site

A study was conducted in the Bukit Bauk and Gunung Pulai VJR (Fig. 1) between 2002-2003. Details of these VJRs are as follows:

Study site 1 (BB): Bukit Bauk VJR, Compartment 8B; altitude: 110-220 m above sea level; slope: 0-40^0; geographical position: 04^{0}41'12N and 103^{0}24'22E; size: 28 ha; annual rainfall: 2,700 mm.

Study site 2 (GP): Gunung Pulai VJR, Compartment 16; altitude: 88-152 m above sea level; slope: 0-50^0, geographical position: 01^{0}37'29 N and 103^{0}32'52E; size: 111.27 ha.

Fig. 1 Location of study sites

2.2 Data Collection

Rectangular plots of 2 ha (100 m x 200 m) were established in the study sites. The plot was further divided into contiguous 50 subplots/sampling units each 20 m x 20 m. The rectangular plot was laid out in the representative forest stand with purposive sampling design. The Global Positioning System/GPS (GARMIN Ltd.) was used to determine the plot coordinates (latitude and longitude) in the field.

In the subplot of 20 m x 20 m, all trees (minimum dbh 5 cm) were tagged with aluminium tags, measured and identified. The following data were recorded from all 50 subplots: (1) botanical and local names of trees, (2) number of trees, and (3) diameter at breast height (dbh) or 30 cm above the butressess of trees, and (4) coordinate of trees to x-y axis.

The survey on the spatial distribution was limited to rare tree species which have conservation values and they are considered by World Conservation Monitoring Centre (WCMC) or International Union for Conservation of Nature (IUCN) as critically endangered, endangered and vulnerable [8].

2.3 Data Analysis

Three basic types of patterns are recognized in communities: random, clumped and uniform [9]. In this study, the method of detecting spatial distribution pattern used was the standardized Morisita Index of dispersion [10]. The standardized Morisita index of disperdion (Ip) ranges from -1.0 to + 1.0, with 95% confidence limits at + 0.5 and -0.5. Random gives an Ip of zero, clumped patter above zero and uniform pattern below zero.

The standardized Morisita index of dispersion was calculated by Programs for Ecological Methodology, 2nd edition.

3 Results and Discussion

Conservation status of tree species in Bukit Bauk indicated that there were eight species (six species critically endangered, two species vulnerable). Meanwhile, in Gunung Pulai VJR there were 10 species (5 species critically endangered, 5 species vulnerable). Using the standardized Morisita index of dispersion, the spatial distribution pattern of trees with the above categories in the study sites showed two patterns of distribution which are clumped and random distribution (Table 1).

Table 1. Conservation status and spatial distribution pattern of trees species in the study sites.

Site	Species	Family	Cons. status	Stand. Morisita Index (Ip)	Spatial distrib. pattern	No. of indiv.
BB	*Dipterocarpus eurynchus*	Dipterocarpaceae	CE	0.5031	Clumped	4
BB	*D. rigidus*	Dipterocarpaceae	CE	0.5063	Clumped	23
BB	*Dryobalanops aromatica*	Dipterocarpaceae	CE	0.5027	Clumped	206
BB	*Shorea foxworthyi*	Dipterocarpaceae	CE	0.3769	Random	5
BB	*S. hypochra*	Dipterocarpaceae	CE	-0.1146	Random	5
BB	*S. macroptera*	Dipterocarpaceae	CE	-0.0287	Random	2
BB	*Cleistanthus glaucus*	Euphorbiaceae	V	0.2748	Random	6
BB	*Sarcotheca laxa*	Oxalidaceae				

	var. *seriacea*		V	0.3218	Random	41
GP	*Dipterocarpus rigidus*	Dipterocarpaceae	CE	0.3180	Random	38
GP	*Hopea mengarawan*	Dipterocarpaceae	CE	-	-	1
GP	*Shorea macroptera*	Dipterocarpaceae	CE	0.3159	Random	17
GP	*S. peltata*	Dipterocarpaceae	CE	0.5954	Clumped	9
GP	*Vatica hullettii*	Dipterocarpaceae	CE	0.5018	Random	345
GP	*Memecylon floridum*	Melastomataceae	V	0.2748	Random	6
GP	*Knema hookeriana*	Myristicaceae	V	-0.1146	Random	5
GP	*Syzygium ngadimanianum*	Myrtaceae	V	-0.0287	Random	2
GP	*Anisophyllea apetala*	Rhizophoraceae	V	0.2609	Random	13
GP	*Pentace microlepidota*	Tiliaceeae	V	0.5531	Clumped	6

Remarks : BB= Bukit Bauk, GP=Gunung Pulai, CE = Critically Endanged, V = Vulnerable

In Bukit Bauk VJR, three species had a clumped distribution, e.g. *Dipterocarpus eurynchus*, and five species were randomly distributed, e.g. *Shorea macroptera, Cleistanthus glaucus*. Whereas, in Gunung Pulai VJR, seven species had a random distribution, e.g. *Vatica hullettii, Knema hookeriana*, and two species clumped distribution, i.e. *Shorea peltata, Pentace microlepidota.* One species, namely *Hopea mengarawan* could not be calculated due to the presence of this species with only one individual in Gunung Pulai VJR.

Interestingly, one species namely *Dipterocarpus rigidus* which was found in both sites showed different spatial distribution patterns. In Bukit Bauk VJR, the distribution pattern of *Dipterocarpus rigidus* was clumped but random in Gunung Pulai. In another study, the spatial distribution pattern of *Dryobalanops aromatica* in another VJR was random [11] but here in Bukit Bauk VJR, *D. aromatica* was clumped. These results confirmed that spatial distribution pattern of trees are locally typical.

Figures 2 – 10 show some of the spatial distribution pattern of trees in the study sites.

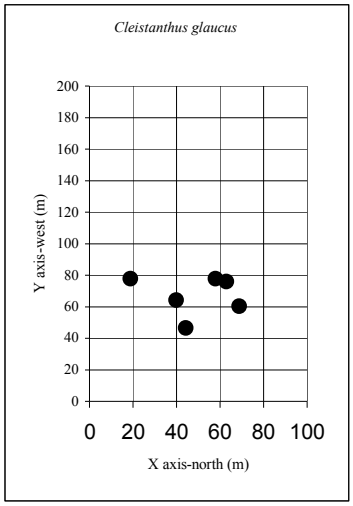

Fig. 2 Random distribution pattern of *Cleistanthus glaucus* in Bukit Bauk VJR (I_p = 0.2748)

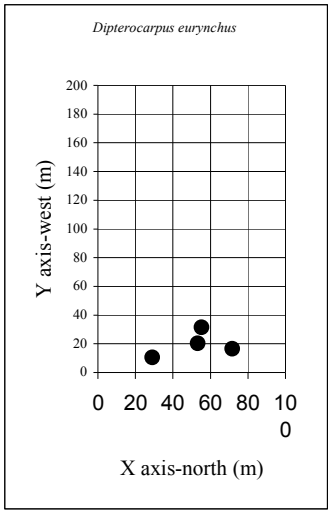

Fig. 3 Clumped distribution pattern of *Dipterocarpus eurynchus* in Bukit Bauk VJR (I_p = 0.5031)

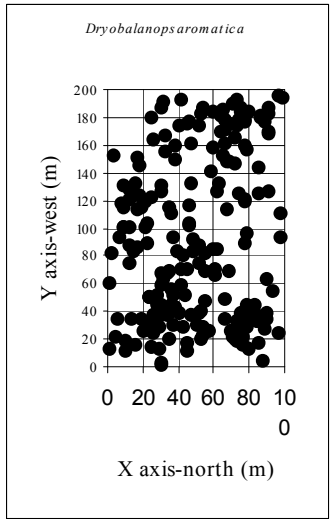

Fig. 5 Clumped distribution pattern of *Dryobalanops aromatica* in Bukit Bauk VJR (I_p = 0.5027)

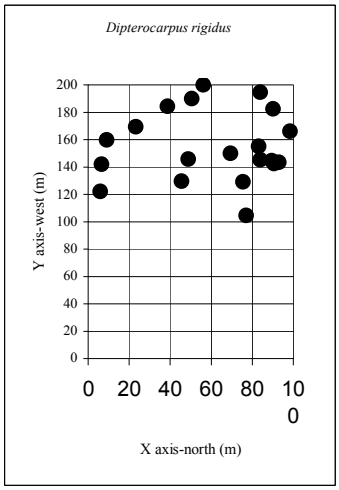

Fig. 4 Clumped distribution pattern of *Dipterocarpus rigidus* in Bukit Bauk VJR (I_p = 0.5063)

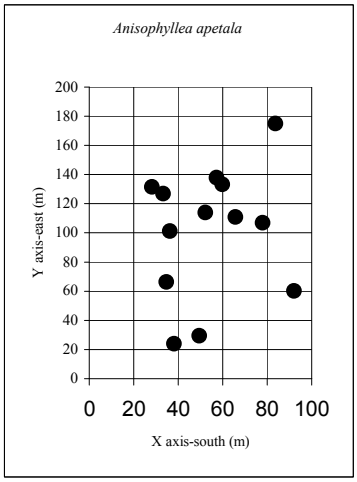

Fig.6 Random distribution pattern of *Anisophyllea apetala* in Gunung Pulai VJR (I_p=0.2609)

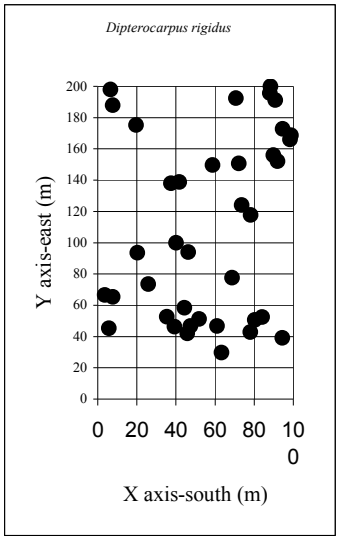

Fig. 7 Random distribution pattern of *Dipterocarpus rigidus* in Gunung Pulai VJR (I_p=0.3180)

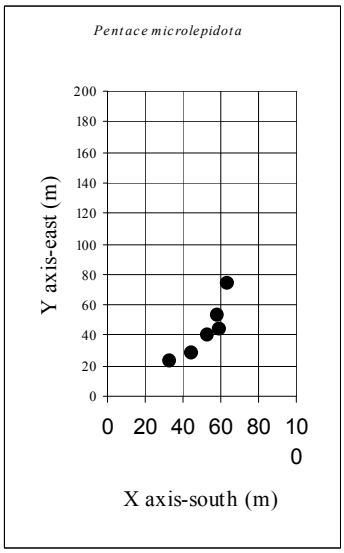

Fig. 8 Clumped distribution pattern of *Pentace microlepidota* in Gunung Pulai VJR (I_p= 0.5531)

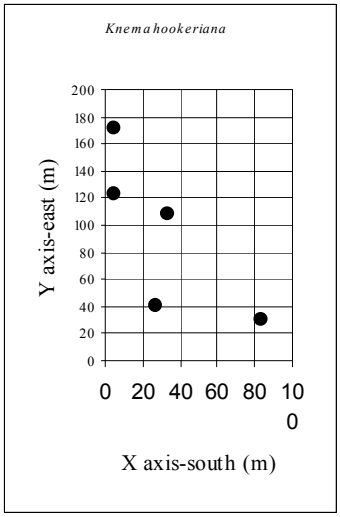

Fig.9 Random distribution pattern of *Knema hookeriana* in Gunung Pulai VJR (I_p = -0.1146)

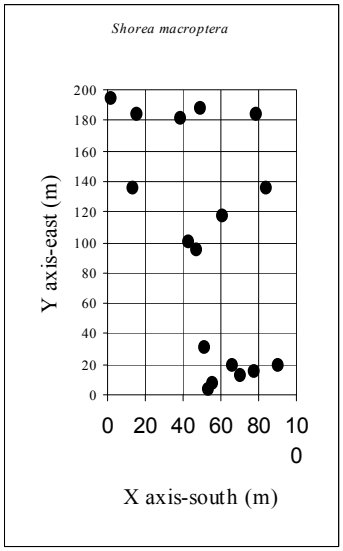

Fig. 10 Random distribution pattern of *Shorea macroptera* in Gunung Pulai VJR (I_p=0.3159)

The need for VJRs as vital contributors in the management and conservation of biodiversity especially rare species should be further highlighted and propagated to lay strength to their very existence in Permanent Forest Reserves.

The justification for the establishment of VJRs was due mainly to the need for having specifically designated areas for

research purposes, where data could be collected systematically over a long period of time. This was further compounded by the more pressing issues related to the commercial logging activities in the virgin forests and the rapid rate of forest conversion for agricultural purposes, especially that of the highly rich and diverse lowland rainforest. Thus, there was an urgent need to maintain representative samples of virgin forest where rare species grow, in its original state.

Generally, threats to the network of VJRs came from development projects e.g. agriculture, recreation, logging, road building, and military use [5]. In Bukit Bauk VJR they came from e.g. illegal utilization of *Aquilaria hirta* (gaharu) and electric tranmission cable and posts which causes erosion. In Gunung Pulai VJR, threats came from the erosion due to quarrying. The network of VJR is made up of very small areas of forests, this factor has in the past contributed to its neglect [5].

The VJRs in Peninsular Malaysia range in size vary over a wide range, from 11 hectares up to an area of 2,747 hectares [4]. Many silviculturist,e.g. [12] maintain that even an area 80 hectares is too small to be established as a VJR. Others, e.g. [5], [13] have different opinion and pointed out that small forest pathces are effective in capturing good representation of a region's flora. As far as possible, the function of each VJR should be clearly and specifically identified so as to justify its size which is significant when comparing silvicultural studies.

Based on the above discussion, the existence of the VJRs in Peninsular Malaysia are very relevant in context to the conservation of biodiversity. It is now recognized that biodiversity plays a significant role in maintaining the major equilibriums of the biosphere. Biodiversity is involved in the water cycle and the major geochemical cycles, including the carbon and oxygen cycles. It contributes to the regulation of the physical/chemical composition of the atmosphere, influences the major climate equilibriums, and thus impacts the condition of life on Earth. All ecological functions are a product of the complex relationships among living species [14].

4 Conclusion

In terms of the conservation status of these rare tree species, in Bukit Bauk there were eight species (six species critically endangered, two species vulnerable). Meanwhile, in Gunung Pulai VJR there were 10 species (five species critically endangered, five species vulnerable).

The spatial distribution of trees in the two study sites showed two patterns of distribution which are clumped and random distribution. These patterns are typical of natural forests.The spatial distribution pattern of plants is an important characteristic of ecological communities.

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