

Spatial Distribution of Butterfly (Lepidoptera: Papilionoidea) in Taman Negara Johor Endau Rompin (Peta), Mersing, Johor, Malaysia

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Abstract: Being the largest protected area and an old tropical rainforest in the southern Peninsular Malaysia, Taman Negara Johor Endau Rompin (TNJER) is home for diverse flora and fauna. The present biodiversity and ecology of forest ecosystem need to be understood to facilitate park management and conservation effort. Butterfly is useful for ecological evaluation of terrestrial landscapes and management of natural areas due to their sensitivity in responding toward environmental variations. The samplings were conducted manually using aerial net and trapping using fruit baits along two of 1 km transects in the eastern part of TNJER (Nature Education and Research Centre and Kuala Jasin) from April 2014 to July 2015. A total of 131 species comprising 491 individuals from five families were recorded. This study had also successfully added 27 new records for TNJER. The most dominant species are *Graphium sarpedon*, *Bassarona teuta* and *Zizeeria karsandra*. The value of Shannon diversity and species evenness indices were 4.123 and 0.471 respectively. This indicated the high diversity of butterfly in the park. The curve of species accumulation graph was still increasing by the end of this study. Using Inventory Completeness Index, this sampling effort had covered only 51.15%. Using non-parametric estimator namely Chao1 suggested an estimated additional 87 species are expected to be found if the sampling continued. The chances of finding additional species are considered high due to high number of singletons (48.9%) and doubletons (16.8%) species recorded in this study. More comprehensive diversity and ecological studies are crucial to facilitate in comparing species from newer tropical forest of Borneo and other parts of Southeast Asia and to gauge in term of biogeography and conservation aspects. This study had produced a comprehensive checklist of butterfly in TNJER, comprising of 349 species, and it could be a reference point to understand the overall diversity of butterfly in Johor.

Keyword: TNJER; Lepidoptera; Butterfly; Spatial distribution.

1. Introduction

Johor is a state located in the south Peninsular Malaysia and houses the southernmost protected areas of substantial sizes, such as Taman Negara Johor Endau Rompin (TNJER). TNJER was officially gazetted as national park on 2nd September 1993 [1]. This park is one of the remaining lowland forests in the southern part of Peninsular Malaysia, and the Endau part of the park lies in the state of Johor with an area of 48, 905 ha [2]. It has been known to exist for more than 70 million years and considered as old tropical rainforest, of which, the oldest rock dated in TNJER at least 248 million years old and oldest plant fossil reported at least 160

million years old [3]. This forest site harbors rich diversity and high endemism of flora and fauna especially butterfly [4, 5, 6].

Rapid infrastructural and socio-economic developments in Johor inevitably cause landscape changes and decrease size of forest areas, which could eventually lead to erosion of biodiversity. It is therefore vital to understand the relative values of biodiversity of the forest and the overall ecology of forest ecosystems. Besides butterflies are known as winged beauties which had fascinated mankind, butterflies are consistently proven to be a good indicator to monitor environmental changes such as climate change and forest fragmentation [7, 8]. The baseline data of this biological indicator could facilitate park

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management and conservation effort. Thus, the aims of this study are to determine butterfly's diversity and species composition and estimate species richness of butterfly fauna in TNJER.

2. Materials and Methods

Study area. This study was conducted in TNJER (Peta), located in Mersing district, at the eastern region of the park. The collections were conducted at two of 1 km transects, covering Nature Education Research Centre (NERC) and Kuala Jasin areas (latitudes 2°32' N and longitudes 103°24' E). The sampling areas are classified as lowland mixed dipterocarp and secondary lowland forest as the areas were logged nearly 20 years ago [9, 10, 1]. The elevations range from 30 to 100 m a.s.l.

Data collection. Butterfly collections were made periodically from April 2014 until July 2015. At each visit, sampling was conducted for at least for 3 consecutive days with 2 to 3 man efforts. The samplings were conducted manually using aerial net and trapping using rotten fruit baits from 0900 to 1700 hours. All butterfly specimens were identified using keys and illustrations by [11, 12, 13].

Data analysis. The species diversity was determined using Shannon diversity index (H') and species evenness index (E') to determine the pattern of species distribution in an assemblage [14]. Also, the diversity t-test was used to compare the diversity of butterfly between two transects. The p-value was determined to indicate statistical significance. All the data were calculated using statistical software PAST (version 1999-2013) [15].

To estimate the species richness in the area, species accumulation curve (Sobs) was plotted. The abundance data were analysed using non-parametric estimator such as Chao 1 in EstimateS v.9 to estimate species richness of butterfly in TNJER and graph was plotted using Microsoft Excel 2013 [16].

3. Results

A total of 131 species comprising 491 individuals from five families were recorded during the inventory from two sampling sites: NERC and Kuala Jasin. Nymphalidae was the richest family, which recorded 67 species, whereas Hesperiiidae has the lowest number of butterfly species with only seven species recorded (Fig. 1).

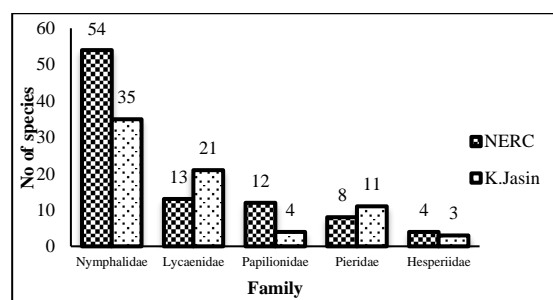


Fig. 1 Composition of butterfly species at two different sampling transects.

The most dominant species were *Graphium sarpedon*, *Bassarona teuta* and *Zizeeria karsandra* (Fig. 2).

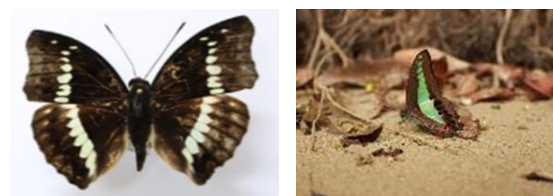


Fig. 2 Dominant species were found in TNJER, *Bassarona teuta* (left) and *Graphium sarpedon* (right).

Comparing the two sites, NERC recorded higher number of species than in Kuala Jasin. Meanwhile, the values of Shannon diversity Index (H') and species evenness index (E') were 4.021 and 0.613 respectively in NERC. By contrast, Kuala Jasin presented much lower values of H' (3.475) and E' (0.436) than NERC (Fig. 3). Based on diversity t-test, there is significant difference ($p < 0.05$) in diversity of butterfly between both sampling sites.

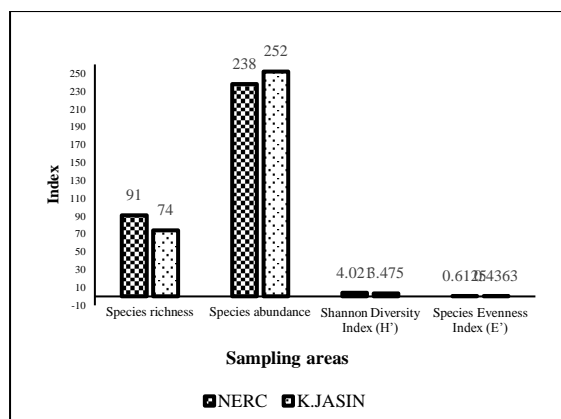


Fig. 3 Quantitative indices of butterfly species diversity in two sampling transects.

Overall, species accumulation curve (Sobs-observed species) was plotted to determine species richness at TNJER (Fig. 4). The curves are still increasing as more species richness and abundance in the assemblages. Based on inventory completeness index, the sampling effort in this study had covered only 51.15%, which indicates more species are expected to be discovered if the sampling efforts continue. Based on the Chao1 estimator, it estimates a total of 218 species could be recorded in TNJER which suggests 87 additional species are expected to be found.

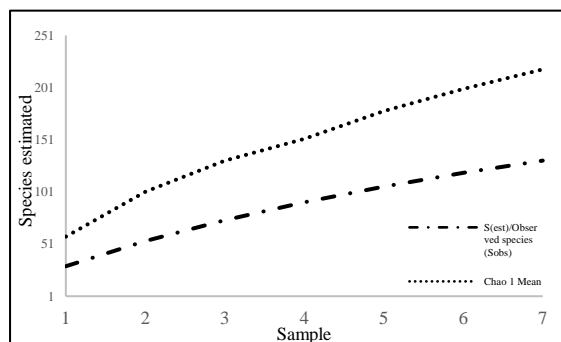


Fig. 4 Species accumulation based on observed species and Chao1 estimator curves of butterfly species in TNJER increase.

4. Discussion

Despite of limited sampling efforts (i.e. sampling time and areas), this study had successfully added 27 new records for TNJER when compared to previous reports [17, 18, 19, 20]. Overall, the present checklist of butterfly species from a 28 years collection is 349 species. The number of species recorded

in TNJER is higher than other tropical lowland forests such as Krau Wildlife Reserve, Pahang (92 species) [21], Endau Rompin State Park, Pahang (89 species, [22]), Mulu National Park, Sarawak (276 species) [23] and Kuala Belalong, Brunei (324 species) [24].

The pattern of butterfly distribution in NERC is much diverse and even than Kuala Jasin due to the differences in vegetation types and microhabitats [25, 26]. In NERC, the vegetation is diverse and this provides wide range of habitats and food sources for butterflies [10, 27]. Also, various habitat heterogeneity ranging from dense forest to cleared ground foster that allowed for diverse butterfly fauna [28].

In fact, the species accumulation curve (Fig. 4) showed an increasing trend with no tailing off effect indicating the continuous addition of new species to the sample. This suggests that there is a potential of adding more species to the current checklist of TNJER if more intensive and continuous surveys will be conducted in the future. Based on Chao1 estimator, it estimated that there could be 87 additional species than the observed species. Apart from inadequate sampling effort (only 51% of inventory completeness index), the presence of high number of rare species/singletons (48.9%) in the sample could affect the species accumulation and estimator curves to reach the asymptote [99, 30]. More sampling intensity will increase the number of species that could be collected and low number of singleton species will increase the chances of reaching asymptote (completeness of sampling) especially at diverse area such as TNJER, an old tropical rainforest [31].

5. Conclusions

Significantly, this one year sampling has provided updated checklist of butterfly species, which prove that TNJER is rich diversity spot for butterfly fauna. If the climate change, forest fragmentation and deforestation occurred rapidly, the butterfly population especially forest species and species with narrow geographical ranges would be greatly affected and could lead to migration and extinction. Thus, the conservation of biodiversity in TNJER as one of the last remaining protected areas in southernmost part of Peninsular Malaysia should be implemented as it could

accommodate as refuges for butterfly species in the future.

More comprehensive diversity and ecological studies are crucial to facilitate in comparing species from newer tropical forest of Borneo and other parts of Southeast Asia and to gauge any peculiar influence of forest age (biogeography) and enhance conservation efforts (rapid biodiversity assessment).

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