A Checklist of the Moths of Tasik Kenyir

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Abstract In Peninsular Malaysia, there were not much research conducted on the diversity and composition of moths. Thus, a study was conducted to investigate the abundance and diversity of the moths species at Kenyir Lake, situated in the Taman Negara Terengganu. Sampling was conducted continuously for three night starting from 10 March 2011 to 12 March 2011 with a light trap that was set up before dusk until midnight. A total of 179 individuals from 34 species, and 33 genus were identified from 13 families. Majority of the moth were from the family Lymantriidae (76%), followed by Arctiidae (4%), Geometridae (4%), Limacodidae (3%), Sphingidae (3%), Saturniidae (2%), Bombycidae (1%), Lasiocampidae (1%) and Nolidae (1%). Three families were recorded as the least abundant family and were represented by singletons during the study namely Drepanidae (0.6%), Notodontidae (0.6%) and Uraniidae (0.6%). In addition, results shown that the genus Nygmia (72.5%) was the dominant genus found at Kenyir. The Shannon and Fisher Alpha Diversity Index calculated were $H' = 1.53$ and α-diversity 12.44 respectively, with species richness (D) and species evenness (J) calculated were D = 2.54 and $J = 0.43$. For this study, the preliminary checklist of the moth species at Kenyir was established and an initial result of the moth diversity and composition obtained. As such, this study will be a baseline to initiate more studies conducted on moth diversity in Terengganu.

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Introduction

Insects are important organisms because of their diversity, ecological role, and influence on agriculture, human health, and natural resources (Foottit and Adler 2009). Among the insects, butterflies and moth tend to elicit a range of emotion from humans, from wonder at their incredible beauty, their ability to metamorphose or their unbelievable feats of physical achievement, to dismay at their voracious appetites for our crops and clothing (Balmer 2007).

The Lepidoptera namely, butterflies and moths, are a diverse and abundant insect group in many different ecosystems, playing roles as herbivores, pollinators, prey (Barlow and Woiwod 1989) and pest (Ithnin et al. 2008). Lepidoptera are important in biodiversity studies because they are the major group of plant-feeding insects.

Although moths comprise the vast majority of the order of Lepidoptera (Chong and Choo 2011; Ramel 2008; New 2004; Ricketts et al. 2001; Birkinshaw and Thomas 1999), with some 111,000 species of recorded moths, they generally are not considered as interesting as their brethren, the butterflies. However, moth studies are important as moth inventories can indicate the ecological health of plant communities, and long-term inventories can show changes in these communities over time (Foottit and Adler 2009). As moths exhibit host-plant specialization as a mean to ensure their existence and survival, thus they can act as biological indicators due to their sensitivity to the environment changes (Abang and Karim 2005; New 2004).

In Malaysia, only a few studies on moths were conducted with most in Borneo such as Abang and Karim (2002, 2005), Fiedler and Schulze (2004), and Chey (2000), while in Peninsular Malaysia, there is not much records on the diversity and composition of moths especially on the east coast region particularly in Terengganu. Taman Negara Terengganu is part of the three-state Taman Negara National Parks, and was established under the Taman Negara Enactment (Terengganu) No.6, 1939 *[En.6 of 1358]* (Pakhriazad et al. 2009). Additionally, Tasik Kenyir, the largest man-made lake in Southeast Asia is located in the national park.

The objectives of this study were to investigate the diversity and composition of moth in Tasik Kenyir, Taman Negara Terengganu and to establish the checklist of the moth species that found at the study site. This study was conducted as part of the Program Preliminary Research Baseline Data Preparation at Taman Negara Terengganu, Taman Negara Terengganu, with sampling conducted at a site 500 m from the trail at Tanjung Mentong, Taman Negara Terengganu for three consecutive night sampling, from 10 March 2011 to 12 March 2011. During this study, a single light trap with a 160 w mercury vapour bulb as the light source was set up from 1900 to 2400 h for each night. For sample collection, three individuals were assigned to collect the moths by placing the moths in a container containing ethyl acetate to euthanize the samples.

The samples were then transferred into a paper envelope to temporarily protect the soft body and moth wings from being damaged and also to prevent the mix-up of scales from different moths before brought back for preservation in the laboratory. The specimens were identified to species level by referring to Holloway (1986, 1997, 1999), Robinson et al. (1994), Barlow (1982), and 'The Moths of Borneo' website (2017 http://www.mothsofborneo.com/). Diversity indices including Shannon Index (Shannon and Weaver 1949), species richness and evenness and Fisher's alpha indices were used in this study.

Moth Diversity and Composition

A total of 179 individuals belonging to 34 species, 33 genera and 13 families were sampled. In the first sampling night, only 44 moth individuals were collected. However, the number of moths collected increased during the second and third sampling night. The second night of sampling collected 53 individuals, followed by the third sampling night, which had the greatest number of moth collected among the sampling nights with 82 individuals. Figure 1 shows the number of moths collected during the study while Table 1 shows the species recorded.

Figure 2 showed the moth composition percentage according to family. Majority of the moth collected in this study were from the family Lymantriidae (75.98%), followed by family Arctiidae (3.91%), Geometridae (3.91%), Limacodidae (3.35%), Sphingidae (3.35%), Noctuidae (2.23%) and Saturniidae (2.23%). While Bombycidae, Lasiocampidae and Nolidae were recorded as the least abundant family found at the study site (1.12% respectively). The Drepanidae, Notodontidae and

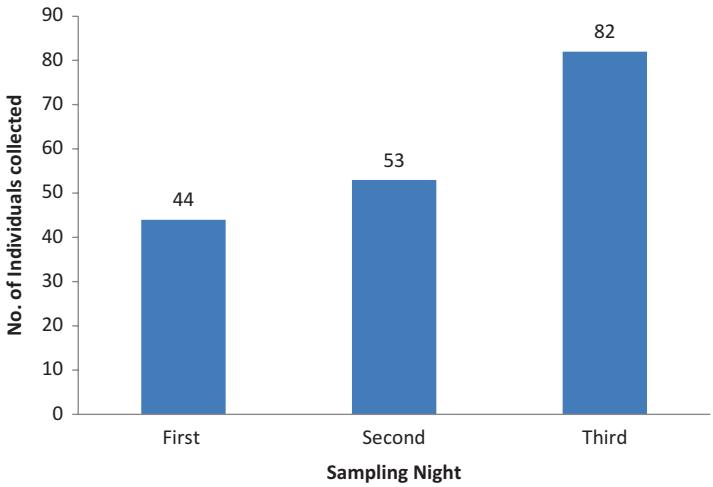

Fig. 1 Number of moths collected according to sampling nights

Table 1 Moth species collected

Family	Species	Number of individuals
Arctiidae	*Barsine rubricostata*	1
	Adites cornutata	3
	Lyclene biseriata	1
	Cyana perornata	2
Bombycidae	*Mustilia dierli*	2
Drepanidae	*Drapetodes matulata*	1
Geometridae	*Ornithospila cincta*	1
	Ornithospila submonstrans	3
	Hypochrosis pyrrhophaeata	3
Lasiocampidae	*Hallicarnia albipectus*	1
	Kunugia drakei	1
Limacodidae	*Narosa concinna*	4
	Scopelodes albipalpalis	1
	Griseothosea cruda	1
Lymantriidae	*Somena aurantiacoides*	1
	Nygmia fumosa	129
	Carriola ecnomoda	4
	Parapellucens aphrasta	1
	Arctornis pseudungula	1
Noctuidae	*Anuga rotunda*	1
	Thyas honesta	1
	Tamba delicata	1
	Eudocima homaena	1
Nolidae	*Siglophora bella*	2
Notodontidae	*Euhampsonia gigantea gilesi*	1
Saturniidae	*Loepa sikkima*	2
	Attacus atlas	2
Sphingidae	*Megacorma obliqua*	1
	Meganoton analis	1
	Ambulyx pryeri	1
	Daphnis hypothous	1
	Elibia dolichus	1
	Marumba juvencus	1
Uraniidae	*Lyssa zampa*	1
Total		179

Uraniidae were singletons with only a single individual collected respectively (0.56%) during this study.

As for the diversity indices, species richness and evenness were calculated and the result was shown in Table 2.

During this study, the number of moth sample collected gradually increased from first sampling night until the third sampling night, which could be influenced by the

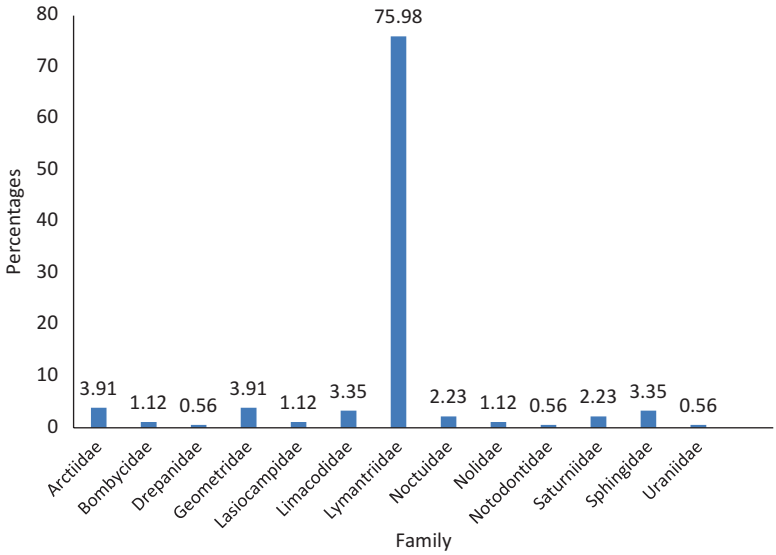

Fig. 2 Moth percentage according to family

Table 2 The diversity indices, species richness and evenness calculated for the moth community of Tasik Kenyir, Taman Negara Terengganu

Shannon index (H')	1.53
Species richness(D)	2.54
Species evenness (J)	0.43
Fisher alpha diversity (α-diversity)	12.44

different weather conditions during the sampling. On the first and second sampling night, the weather was clear, without rain or wind during the sample collection. However, rain on the third sampling night could have caused an increase in the number of moth collected as moths usually increased in numbers when there were light rains or drizzle and little wind (Barlow 1982).

Results recorded from this study indicated that most of the species collected were characteristics of the lowland tropical forest. The Lymantriidae family (75.98%) was the most abundant family found and was recorded as having the highest proportion of lowland dipterocarp forest moths (Chong and Choo 2011; Chey 2000). The abundance of family Lymantriidae was mainly contributed by the species *Nygmia fumosa* which was the most abundant species found at the study site. *Nygmia fumosa* was found to be constantly collected during every sampling night and a large number was collected. Both females and males was collected during sampling. It was also found that most females captured in the container containing ethyl acetate will quickly lay eggs before they died.

The second highest family recorded was Arctiidae (3.91%) and Geometridae (3.91%). According to Hill and Abang (2010), Arctiidae is well-represented in South-east Asia with many species being widespread and common in the rainforest canopy. As for Geometridae, they are ecologically dominant in most forest habitats and are mostly found in forests. The most diverse family found in the study was the Sphingidae family as six genera were collected during sampling, although each genus was represented as singletons. The diversity index calculated in this study was considered as low when compared to the other studies (Choo and Chong 2011; Abang and Karim 2005; Chey 2000) with Shannon index at 1.53 and α-diversity of 12.44. This could be due to the restricted number of sampling efforts as sampling were only carried out for three nights and only using light trap. It is assumed that this forest might be diverse with the moth community and their host-plant vegetation to ensure their survival as with only three night sampling effort, 179 individuals of moth were collected, with the assumption that the number of sample collected could be increased and the number of diversity value could be greater should sampling be continued.

Conclusion

In this study, a total of 34 moth species were recorded, with 33 genuses from 13 families, representing the moth diversity and composition of Kenyir Lake. The Lymantriidae family was the most abundant, due to the abundance of one species, *N. fumosa*. Drepanidae, Notodontidae and Uraniidae were the least abundant family and were represented by singletons. The diversity index obtained in this study was considered low in lieu of other studies, which could be due to the restricted sampling period and also due to that only light trap were used in this study for sampling. As such, results of this study will form the baseline data of moth studies for conservation and monitoring changes in the biological community of Kenyir Lake and Taman Negara Terengganu.

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