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A Note on Diversity of Aquatic Insects in Rivers of Royal Belum State Park, Perak

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Abstract

Royal Belum State Park is one of the oldest, protected and pristine land masses that joins hundreds of small tributaries that feed Lake Temenggor. A scientific expedition was conducted, and the diversity of aquatic insects was studied. Five rivers namely Sungai Ta Ng, Sungai Papan, Sungai Gen, Sungai Ruok and Sungai Rambutan were chosen. A kick-sampling technique was deployed to collect the aquatic insect larvae. The study recorded a total of 42 families and 61 genera of aquatic insects which Sungai Papan has the largest number of taxa recorded (18 families, 26 genera). The number of intolerant taxa (Ephemeroptera, Plecoptera, Trichoptera; EPT) in Sungai Papan was substantial (15 genera). Odonata was discovered to be the most diverse order (13 genera), followed by Ephemeroptera (10 genera) and Trichoptera (10 genera). The findings provided a concise richness of aquatic insects, which might serve as a good tool for evaluating the conservation needs of the area.

1. INTRODUCTION

One of the most common types of macroinvertebrates is the aquatic insects which are found primarily in inland waters and encompass a wide variety of aquatic environments, including lakes, streams, pools, estuaries, marshes, groundwater, and hot springs (Yule and Yong, 2004). This group of arthropods spends a portion of their life cycle, which is during the larva stage, in water bodies and becomes terrestrial as they mature into adults. Aquatic insects play a key function in the ecosystem of the aquatic environment. In addition to providing a food source for fish and other organisms, aquatic insects may also act as excellent, reliable and accurate bioindicators of water quality due to their wide range of environmental disturbance tolerance levels (Arimoro and Ikomi, 2009). The degree of pollution in the water ecosystems may be determined by the presence or absence of certain aquatic insects. Ephemeroptera, Plecoptera and Trichoptera are among aquatic insects that are very susceptible to pollution (Yap et al., 2021), although Diptera may survive in disturbed and highly polluted water.

Royal Belum State Park, located in Perak, Malaysia was gazette as Hutan Simpan Belum in 1971 and as National Heritage Site in 2012 (Suksuwan, 2006). This forest is highly recognized for a biodiversity conservation area. The state park, which spans an area of 117,500 hectares (Abdullah et al., 2013), may serve as a location for biodiversity education and scientific research, as well as for ecotourism. Royal Belum State Park comprises a sizable area of rainforest with an immense wide lake that joins rivers and hundreds of smaller streams and tributaries. This geographically diversified area serves as the habitat to thousands of species of noteworthy flora and fauna which are unique, uncommon, endangered, or otherwise threatened in Malaysia and the surrounding region. Aquatic insects play an important role in most processes in aquatic ecosystems such as food sources for fish, birds and bats. Its loss can bring negative effects on entire communities. This research determined the diversity and distribution of aquatic insects found at rivers in this forest as it is an essential component of a balanced ecosystem functioning.

2. MATERIALS AND METHODS

2.1 The study area

Five rivers of Royal Belum State Park (Sungai Ta Ng, Sungai Papan, Sungai Gen, Sungai Ruok and Sungai Rambutan) were chosen for their accessibility to the area (Figure 1). Sungai Ta Ng features rocky, multi-sized cobbles and sandy substrates with moderate flowing water. Like Sungai Ta Ng, Sungai Papan has shallow water bodies with stony and sandy streambed substrates. Sungai Ruok is comprised of waterfalls that create a recreational area along the river's downstream course. The sampling was done at the upper stream where it is less often disturbed by humans. The area is densely forested with leaves and detritus in the rivers adhering to the stones and rocks. Substrates consist of large rocks and stony bottoms with clear swiftly flowing water. Sungai Gen is partially canopied, with a variety of

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substrates made up of rocks and pebbles of varied sizes. The water flow was moderate with low turbidity. Sungai Rambutan is partially covered by low to moderate vegetation. The riverbed is mostly composed of pebbles and sand, with a few rocks. The water is clear and flows at moderate velocity.

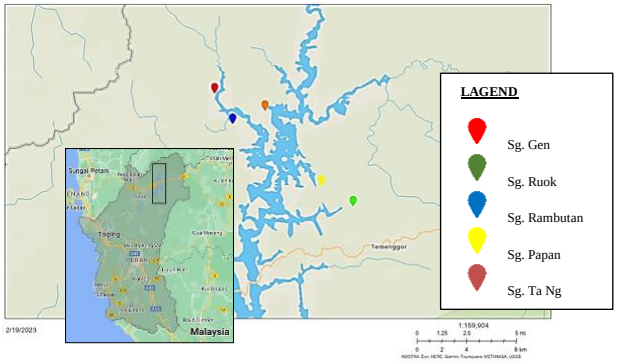

Figure 1: Map of the rivers studied in Royal Belum State Park, Perak.

2.2. Insect Sampling and Identification

Aquatic insect larvae were sampled using a D-pond net with a dimension of 20 x 40 cm frame and 300 µm mesh size. Ten replicates at approximately 100 m stretch were randomly selected at each sampling location. A kick sampling technique following Merritt et al (2008) was applied by placing the net against the water current. The area of 1 m2 in front of the net was disturbed by feet and hands for 1-2 minutes. The substratum surfaces were gently disturbed, while large stones were hand-lifted and washed to dislodge the organisms into the net. The net was also dragged along the vegetation of the river's bank for a few meters. The collected samples in the net were transferred into a plastic bag and brought back for the sorting process. The samples were then preserved in 80% ethanol prior to identification. The aquatic insects were identified at the genus level using the taxonomic keys of Yule and Yong, (2004) under a dissecting microscope.

3. RESULTS AND DISCUSSION

The diversity of the aquatic insects' groups of all rivers varied from 6 to 8 orders (Table 1). A total of 42 families and 61 genera of aquatic insects were recorded from all five rivers (Table 2). Sungai Papan has the largest number of taxa recorded with 18 families, 26 genera, followed by Sungai Ruok (17 families, 21 genera) and Sungai Ta Ng (17 families, 19 genera). With just 14 families and 14 genera, Sungai Rambutan had the lowest diversity of aquatic insects. The fraction of intolerant taxa (Ephemeroptera, Plecoptera, Trichoptera; EPT) in Sungai Papan was significant consisting of 15 genera, with Ephemeroptera and Trichoptera being the most two dominant taxa (6 genera). With a combined total of 10 genera, the bulk of which are Trichopteran, Sungai Ruok and Sungai Ta Ng are the second-most diversified rivers in the EPT. Sungai Gen and Sungai Rambutan each have 8 and 6 genera of EPT, respectively, with Plecopteran and Ephemeropteran dominating their respective EPT communities. Comparing to prior studies in Malaysian rivers such Kimanis River, Crocker Range National Park, Sabah (Vi Vian *et al*., 2018) and Hutan Lipur Bukit Soga Perdana in Johor (Zakaria and Mohamed, 2018), the studied rivers offered more favorable and suitable habitats for a variety of aquatic insects species. However, the research data was less diversified than those from Kinabalu Park, Sabah (Wong and Fikri, 2016) and Gunung Ledang, Johor (Suhaila *et al*., 2014).

Regarding the aquatic insects' populations in all rivers, Odonata was the most diversified order discovered (13 genera) followed by order Ephemeroptera and Trichoptera with both having 10 genera. In the Odonata order, *Euphaea* (Euphaeidae) was the most prevalent genus found, reported to be in three out of five rivers (Table 2). Euphaeids are capable of laying their eggs in swiftly moving water, such as tiny woodland streams and pools beneath waterfalls (Lok and Orr, 2009). The studied rivers were conducive to the survival of this family, whose nymph may be discovered beneath rocks or amid debris in the stream's riffles (Orr, 2003). Plecopteran, *Etrocorema* (Perlidae) and Trichopteran, *Cheumatopsyche* (Hydropsychidae) are the most prevalent genus that can be found in all of the rivers. *Etrocorema*, a stonefly species that belongs to the family Perlidae, was the most prevalent plecopteran family reported globally. According to Amiruddin and Suhaila (2020), Perlidae was discovered in Gunung Jerai and Gunung Ledang, making it the most rampant plecopteran family in the tropical area. The moderate to swiftly moving rivers in Royal Belum State Park provide a perfect habitat for the inhibition of plecopteran larvae due to their high oxygen level and low water temperature. This is the ideal environment for plecopterans, which are renowned as outstanding bioindicators of water quality, that are confined to highly oxygenated water, and sensitive to both organic and thermal pollution (Ratitorn and Chitchol, 2013). Besides, the environment is also favorable for *Cheumatopsyche* to inhabit. *Cheumatopsyche* larvae served as the common filter feeders, by which they are often found in streams with low to moderate temperatures. This species also populates the aquatic invertebrate groups of the majority of perennial streams and forms an essential part of fish diets.

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Table 1: Summary of aquatic insects' community structures.

Richness measures	Sungai Ta Ng	Sungai Papan	Sungai Gen	Sungai Ruok	Sungai Rambutan
No. of Order	6	7	8	7	8
No. of Family	17	18	14	17	14
No. of taxa	19	26	18	21	14
No. of EPT taxa	10	15	8	10	6
No. of Ephemeroptera taxa	2	6	1	2	3
No. of Plecoptera taxa	3	3	4	3	1
No. of Trichoptera taxa	5	6	3	5	1

Table 2: Distribution of aquatic insects genera in rivers at Royal Belum State Park, Perak

Order	Family	Genus	Sungai Ta Ng	Sungai Papan	Sungai Gen	Sungai Ruok	Sungai Rambutan
Plecoptera	Perlidae	*Etrocorema*	+	+	+	+	+
		Neoperla	+	+	+	+	-
		Phanoperla	-	-	+	+	-
		Kamimuria	-	+	-	-	-
	Peltoperlidae	*Eryptoperla*	-	-	+	-	-
	Nemouridae	*Indonemoura*	+	-	-	-	-
Ephemeroptera	Heptageniidae	*Thalerosphyrus*	-	+	+	+	+
		Compsoneuria	-	+	-	-	-
		Epeorus	-	+	-	-	-
	Potamanthidae	*Rhenonanthus*	-	-	-	-	+
	Baetidae	*Baetis*	-	+	-	+	-
		Platybaetis	+	+	-	-	-
	Isonychidae	*Isonychia*	+	+	-	-	+
Trichoptera	Stenopsychidae	*Stenopsyche*	-	-	-	+	-
	Hydropsychidae	*Hydropsyche*	+	+	+	+	-
		Macrosternum	-	+	-	-	-
		Cheumatopsyche	+	+	+	+	+
	Polycentropodidae	*Polycentropus*	+	-	+	+	-
	Calamoceratidae	*Anisocentropus*	-	+	-	+	-
	Glossosomatidae	*Glossosoma*	+	+	-	-	-
	Philopotamidae	*Chimarra*	+	+	-	-	-
Odonata	Libellulidae	*Zygonyx*	-	+	-	-	-
		Onycothemis	-	+	-	-	+
	Gomphidae	*Nepogomphus*	-	-	+	+	-
	Calopterygidae	*Vestalis*	-	+	-	+	-
	Euphaediae	*Euphaea*	-	+	+	+	-
	Amphiterygidae	*Devadatta*	-	-	+	-	+
	Aeshnidae	*Tetracanthagyna*	-	-	-	-	+
	Platystictidae	*Drepahosticta*	-	+	-	+	-
	Platycnemididae	*Copera*	-	+	-	-	-
Coleoptera	Gyrinidae	*Porrorhynchus*	-	-	-	-	+
	Psephenidae	*Eubrinax*	-	-	-	-	+
	Eulichadidae	*Eulichas*	-	-	+	+	-
	Elmidae	*Potamophilus*	+	+	+	+	-
	Hydrophilidae	*Laccobius*	+	-	+	+	-
	Dysticidae	*Neptosternus*	+	-	-	-	-
	Scirtidae	-	+	-	-	-	-
Hemiptera	Nepidae	*Cercotmetus*	-	-	-	-	+
	Gerridae	*Metrocoris*	+	-	+	+	-
	Veliidae	*Rhagovelia*	-	-	-	+	-
Diptera	Tipulidae	*Hexatoma*	-	+	+	+	+
		Tipula	-	-	+	+	-
	Tabanidae	*Tabanus*	-	-	-	-	+
	Simuliidae	*Simulium*	+	+	-	-	-
	Chironomidae	*Chironomus*	+	-	-	-	-
	Athericidae	*Asuragina*	+	-	-	-	-
Megaloptera	Corydalidae	*Protohermes*	+	-	+	-	+

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4. CONCLUSION

The distribution of aquatic insects in particular rivers varied. Nevertheless, all rivers sustained reasonably large populations of aquatic insects. The variety of aquatic insect taxa was highest in Sungai Papan. The order Odonata, family Euphaeidae, was discovered to be the most diverse, followed by the orders Plecoptera (Perlidae) and Trichoptera (Hydropsychidae). The selected rivers were discovered to be excellent habitats for various aquatic insect groups, which contribute to the area's species variety. This study's findings and outcomes are crucial for monitoring and ensuring the sustainability of aquatic insects and determining their conservation needs.

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