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Diversity and New Records of Coleopteran Water Beetles (Dyctiscidae, Hydrophilidae) in Kenyir Water Catchment of Terengganu, Malaysia

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Abstract: A survey on coleopteran water beetles were conducted at Teluk Bewah and Sungai Cicir in Kenyir water catchment revealed the presence of only 4 species in total. These are *Lacconeatus* sp. 1, *Lacconeatus* sp. 2, one unidentified species under the family Dytiscidae and *Hydroratus* sp. under family Hydrophilidae. All the members are new records for Tasek Kenyir. The low abundance (Margalef Index; 1.820) and low diversity value (Simpson Diversity Index; 0.098) of the water beetles implies that the ecosystem is under stress. More samplings of the water beetle from the Kenyir water catchment is needed to elucidate actual species range and biodiversity.

Key words: Water beetle, Dytiscidae, Hydrophilidae, Kenyir lake, biodiversity

INTRODUCTION

Water beetles are very integral parts of the biotic component of any water bodies or wetlands. They are indicator of ecological diversity and habitat characteristics (Foster, 1987; Eyre and Foster, 1989; Foster *et al*., 1990; Ribera and Foster, 1993; Sanchez-Fernandez *et al*., 2004) as they meet most of the criteria generally accepted in the selection of indicator taxa (Pearson, 1994). The beetles are especially useful in certain habitats as peat bogs, coastal and saline lagoons, wood and wetland ponds, etc. (Ribera and Foster, 1993).

The diversity assessment and preparation of the water beetle inventories are considered an essential tasks now a day, due to the importance of wetlands in the of conservation planning and endeavours. There is a great deal of papers discussing how to use several methods for estimating the species richness for a wide range of taxonomic groups (Gonzales, 2007).

Water beetle is adapted to live in water. There are few marine species that live in the intertidal zone. Some species of water beetles have aquatic larvae and terrestrial adults. Water beetles from family Gyrinidae, Haliplidae, Noteridae, Amphizoidae, Dytiscidae and Hydroscaphidae are aquatic in all life stages. The adult water beetles from family Hydroscaphidae, Hydrophilidae, Lutrochidae, Dyropidae, Elmidae, Eulichadidae, Heteroceridae, Limnichidae, Psephenidae, Ptilodactylidae and Sphaeriusidae are not aquatic.

Hebauer *et al*. (1999) reported that water beetle fauna of the alluvial riparian swamp system Tasek Cini in West Malaysia revealed a total of 21 species representing the families Noteridae, Dytiscidae, Hydrophilidae, Hydraenidae and Hydrochidae. The Hydrophilidae *Helochares cinensis*, *H. discus*, *H. yangae* and *H. lacustris* are described as new. Recent survey of the water beetle fauna of Pulau Tioman revealed 11 species of the families Noteridae, Dytiscidae, Hydrophilidae, Hydraenidae, Scirtidae and Limnichidae. All identified species (*Canthydrus flammulatus*, *Lacconectus krikkeni*, *Lacconectus corayi*, *Sternolophus rufipes*, *Helochares fuliginosus*, *Oocyclus sumatrensis tiomanensis* and *Amphiops coomani*) are widespread in the Indo-Malayan region. The small size of the island, presence of few lentic habitats, the steep and fast flowing streams are responsible for the lack of a rich aquatic beetle fauna (Hendrich and Yang, 1999).

In view of the important role played by water beetle in the ecosystem, a study was conducted to determine the abundance of water beetle at selected sites of Kenyir water catchment in investigating whether the water catchment is under stress due to many visits by city dwellers to Tasek Kenyir.

MATERIALS AND METHODS

Study Site

A study was conducted from July to August 2007 at Kenyir water catchment known as Tasik Kenyir. Tasik Kenyir (Kenyir Lake) 5^0N 102^048^1E is an artificial lake located in the state of Terengganu in northeast Malaysia sharing its border with Kelantan in the west and Pahang in the south. Tasik Kenyir was created in 1985 by the damming of the Kenyir River. Kenyir Lake is the largest man-made lake in Southeast Asia. This immense lake also serves as a Northern gateway to Taman Negara. There are more than 14 waterfalls, numerous rapids and rivers. Being a reservoir the water level of the lake varies depending on the month. The water level is highest in March and April.

With about 340 islands which were once hilltops and highlands, Tasik Kenyir is also home to numerous species of freshwater fishes and exotic wildlife. Rich with numerous types of flora and fauna, its vast boundary leads to endless discoveries and adventures. Its picturesque landscape of natural grandeur and tranquil serenity transforms Tasik Kenyir into a perfect getaway for city dwellers.

Sampling Sites

Figure 1 shows the location of Kenyir lake within Terengganu state, Malaysia. Figure 2 shows the location of Teluk Bewah and Sungai Cicir at Kenyir Lake.

Fig. 1: Kenyir lake, Terengganu, Malaysia

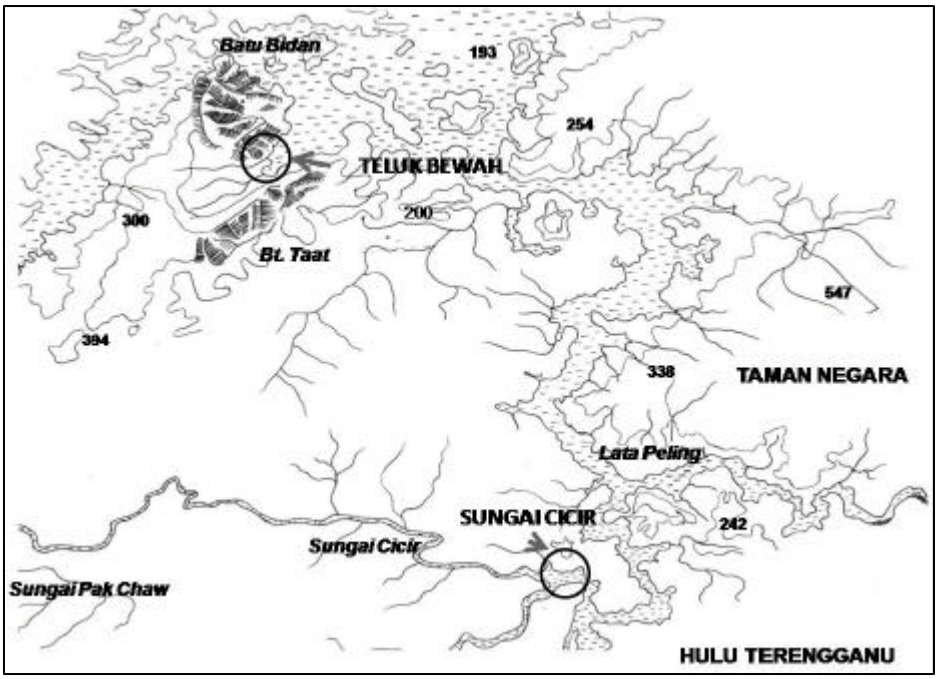

Fig. 2: Location of research at Teluk Bewah and Sungai Cicir

A three and half hour boat ride from Jetty brought us to Teluk Bewah base camp. The first sampling site was along the rugged terrain of the 1.5 M trail behind the base camp at Teluk Bewah. The trail ended with a limestone wall (Fig. 3). The second sampling site was located in the forest of Sungai Cicir which situated about 2 h boat ride from the base camp (Fig. 4). The boat has to be maneuvered slowly in between the many trees tops emerging along the way to Sungai Cicir.

Sampling Methods

A dangerous and slow boat ride carefully moving in between the tree tops projecting along the river passage brought the team to Sungai Cicir. Two light traps were set up for 4 h from 1900-2100 h, 100 M from each other along the trail at Teluk Bewah on 30th July 2007. On 1st August 2007 four light traps were set up at different site in the forest at Sungai Cicir 100 M from each other one beside the river and the other three in the forests. The 160 watt mercury bulb was powered by a Honda generator providing light to the light trap made up of white mosquito net (Fig. 5). However, due to heavy rainfall through out the night of 31st July, the assemblage was unsuccessful. Thus the assemblage was repeated on the following night on 1st August 2007 but placing four light traps at different location in the forest adjacent to Sungai Cicir.

Sorting and Identification

The water beetles collected were sorted to morpho species at the base camp at Teluk Bewah and preserved in 70% alcohol. The specimens were brought back to University of Malaya, piuned and dried in the oven before being identified using Regimbert (1889), Balfour (1939), Gschwendtner (1931), Brancucci (1983; 1986), (Bistrom, 1983), Wewalka (1975), Bistrom (1996), Wewalka (1997), Hansen (1991), Zaitzev (1909), Knisch (1924), Hebauer (1992) and Lars *et al*. (2004).

Fig. 3: The first sampling site was at Teluk Bewah along a rugged terrain of 1.5 M trail which ends with a limestone wall

Fig. 4: The second sampling site was at Sungai Cicir about 2 h boat ride from Teluk Bewah

Fig. 5: Light trapping with mosquito net

RESULTS

Two families of water beetles Dyctiscidae and Hydrophilidae were assembled in this study. Two species of Dyctiscidae were caught by light trap at Teluk Bewah. Whereas one species from family

Fig. 6: *Lacconeatus* sp. 1 (2.069 mm)

Fig. 7: *Hydroratus* sp. (1.73 mm)

Fig. 8: *Unidentified* sp. (2.432 mm)

Hydrophilidae and one species from family Dyctiscidae were caught by sweep net at Sungai Cicir (Fig. 8).

Three specimens have filiform anteunae which were not pubescent, palps not enlarged characteristics of family Dyctiscidae. The specimens have visible scutellum and the eyes when observed from anterior view were laterally emarginated thus belonging to subfamily Copelatinae. Two specimens have metacoxal lines and anteriorly obsolescent thus both belong to genus *Lacconeatus*. The first specimen is named *Lacconeatus* sp. 1 (Fig. 6) of 2.069 mm in length and the second specimen was much smaller at 1.733 mm in length named as *Lacconeatus* sp. 2. Hendrich *et al*. (2004) reported that the genus *Lacconeatus* is usually between 3.6-7.0 mm, however the specimens collected in this study were much smaller thus in this study are labelled as *Lacconeatus* sp. 1 and *Lacconeatus* sp. 2. The third specimen was *unidentified species* of length 2.432 mm (Fig. 8). The fourth specimen (Fig. 7) is oval in shape, brown and shiny. It has a distinctive dorsally curved body with short anteunae and four segmented thoracic legs characteristic of family Hydrophilidae and a ten segmented abdomen with segment nine and ten being reduced. This specimen is identified as *Hydroratus* sp.

Table 1 shows that the abundance value of Dyctiscidae using Margalef Index was 1.820, whereas the value of Simpson Diversity Index of Dyctiscidae was 0.099. Table 2 compares the abundance of water beetles between three location of samplings at Tasek Kenyir with that of Langkawi

Table 1: The species of water beetles assembled at Teluk Bewah and Sungai Cicir

Family	Species	No. of individual	Margalef index	Simpson Diversity Index
Dyctiscidae	*Lacconeatus* sp. 1 (Teluk Bewah)	1	1.820	0.099
	Lacconeatus sp. 2 (Teluk Bewah)	1		
	Unidentified sp. (Sungai Cicir)	1		
Hydrophilidae	*Hydroratus* sp. (Sungai Cicir)	1		

Table 2: Comparison of Margalef index and Simpson diversity at different location

Sampling site	Margalef index	Simpson Diversity index
Tasek Kenyir	1.82	0.098
Langkawi island	0.90	0.700
Endau Rompin	4.50	0.500

island and Endau Rompin. The values show that the diversity of water beetle at Kenyir water catchment is lowest compared to that of langkawi island and Endau Rompin. The abundance of water beetle at Tasek Kenyir was less than that of Endau Rompin but more than that of Langkawi island.

DISCUSSION

In this study both diversity and abundance of water beetles are low with only four species of water beetles assembled. This indicates that the ecosystem is under stress. Dycticidae assemblages are mainly structured by water permanence and most species are found in permanent water bodies (Nilsson and Holmer, 1995; Lundkvist *et al*., 2002). Most Dycticidae favoured open areas with a high proportion of permanent wetlands. Diversity of Dycticidae was positively correlated with high permanence and little forest cover. Dycticidae species assemblages were mainly influenced by water permanence, especially at intermediate spatial scales. Permanent wetlands in an open landscape, which would favor colonization by Dycticidae, a potential predator of mosquito larvae, while also supporting the diversity of both taxa (Schafer *et al*., 2006).

Dycticidae were negatively correlated with forest cover and favoured open areas. This is in accordance with the result of Lundkvist *et al*. (2001). This is also the reason of poor assemblage because the light traps were placed in the forests adjacent to the river instead of at open space beside the river. This is supported by reports from Lundkvist *et al*. (2002), who trapped few flying Dycticidae in shaded areas compared to open ones. Similarly, Nilsson and Holmen (1995) observed a slower colonization rate of Dycticidae in shaded than in open environments. Dycticidae faunas are more diverse in densely vegetated wetlands (Nilsson and Holmen, 1995).

Dycticidae are predators of mosquitoes both as larvae and adults (Service, 1973; Onyeka, 1983; Petric *et al*., 1995). The importance of Dycticidae as a natural control of mosquito larvae is inconclusive (Lundkvist *et al*., 2002). High water permanence and open surroundings could reduce colonization by nuisance mosquito species, while at the same time providing favorable conditions for Dycticidae and mosquito diversity.

Studies conducted by Fauziah (2006) at Langkawi and Fauziah (2007) at Endau Rompin showed that the water beetles assembled at Tasek Kenyir is more abundant than Langkawi island but less abundant than that of Endau Rompin. However, the diversity of water beetle at Tasek Kenyir is less specious than both Endau Rompin and Langkawi Island (Table 2). This could be due to water quality and changes that often occur on the water level of Tasik Kenyir. Being a reservoir the water level of the lake varies depending on the month. Dycticidae is commouly found in ponds and quiet streams whereas Tasek Kenyir has many rapids and waterfalls not a habitat preferred by Dycticidae. Being

predaceous, this beetle feeds on various small aquatic creatures and preferred small shallow bodies of water with little or no current. Tasek Kenyir has fast moving water bodies not a habitat for mosquito larva. Hydrophilidae also lives in quiet pools and quiet areas of lakes or streams. Tasik Kenyir is under stress and not suitable for the water beetles because many tourist are moving on houseboats on the lake and along its rivers. A longer study duration conducted at Tasek Kenyir to investigate in more detail the abundance and diversity of water beetle at Kenyir Lake would enlighten conservation strategies for our national heritage.

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