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A CHECKLIST OF AQUATIC AND SEMI-AQUATIC BUGS (INSECTA:HEMIPTERA:HETEROPTERA) FROM PULAU TIOMAN, PENINSULAR MALAYSIA

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ABSTRACT. - A list of aquatic and semi-aquatic Hemiptera from Pulau Tioman is given with notes on their habitats. A total of 8 families, 25 genera, and 33 species are recorded from the island. *Rhagovelia sumatrensis*, *Perittopus breddini*, *Ptilomera tigrina* and *Metrocoris nigrofasciodes* are the most dominant species found in the hill streams. *Ventidius modulatus* is common both in freshwater and brackish water habitats. Three species, *Stenobates biroi*, *S. insularis* and *Hebrus nereis* are new records for Peninsular Malaysia.

KEY WORDS. - Aquatic and semi-aquatic bugs, check-list, Tioman, Malaysia.

INTRODUCTION

Two intensive studies on the fauna of Pulau Tioman, Pahang, Malaysia had been carried out by Bullock & Medway in 1966 and Day & Mowbray in 1990. Only the former survey studied the diversity of arthropod fauna on the island and paid attention to the aquatic habitats (Bullock, 1966a). The work revealed that aquatic insects were well represented, but true aquatic bugs (Nepomorpha) were virtually absent. Bullock documented members of Halovelinae, Halobatinae from the open sea and mangrove; and Gerridae, Veliidae and Hydrometridae from freshwater streams, ponds and pools. However, no species list was given. Subsequent records of aquatic bugs from the island can be found in Cheng & Fernando (1969), Fernando & Cheng (1974) and Andersen (1989). The present work provides a check-list of the aquatic heteropteran fauna of the island.

MATERIAL AND METHODS

Tioman is basically a granite island. Streams on hillsides are generally rocky and steep. Fast water flowing over large boulders forms many cascades and rock-pools which can be

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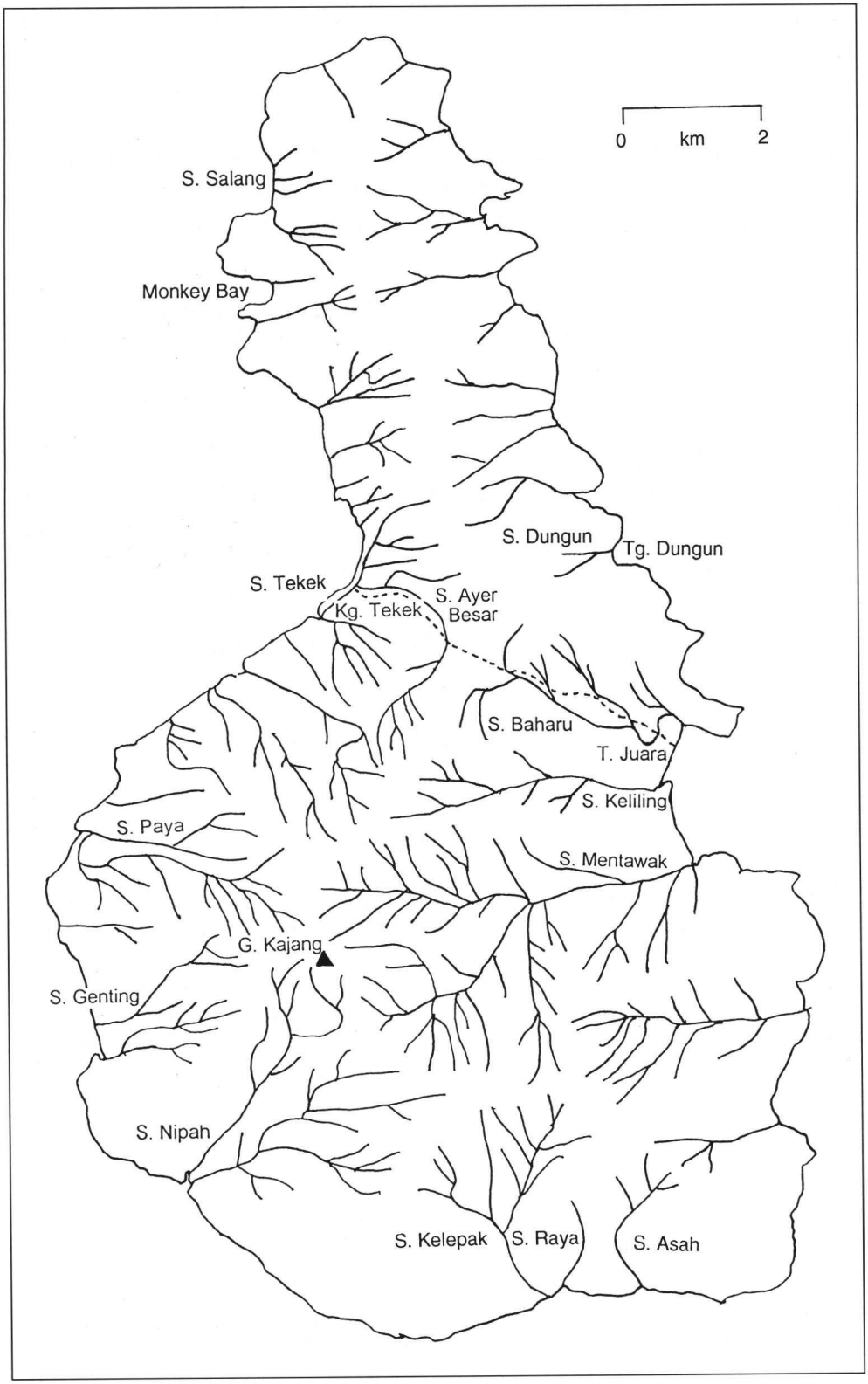

Fig. 1. Map of Pulau Tioman. G = Gunong; Kg = Kampong; S = Sungei; Tg = Tanjong.

as deep as 2 metres in some areas. Vegetation is rarely found on banks or submerged in water. Headwaters are always underground, seeping through rocks and boulders. The coast is lined with large boulders and the stream waters flow quickly into the sea during low tide (e.g. Sg. Raya). In the flat coastal areas the larger streams tend to meander, such as Sg. Keliling, Sg. Baharu, Sg. Paya and Sg. Mentawak. Sg. Paya has a permanent intertidal mangrove area with sandy substrate. The river mouths of Sg. Baharu and Sg. Mentawak are sandy with coral rocks and do not have intertidal banks. A few saline pools are located at Sg. Tekek and Tg. Dungun.

The material reported here were collected in three periods and were either deposited at the Bishop Museum (BP), Honolulu or the Zoological Reference Collection (ZRC), Singapore:

1) 1962: 18-20 March & 10 April all collected from Kg. Tekek by K. J. Kuncheria. Material was loaned from Dr. D. A. Polhemus, Bishop Museum (BP).
2) 1996: 24-29 June collected by W. W. Chan, K. M. Chang, C. W. L. Fock, A. L. M. Koh, H. K. Lua, C. S. Tang, T. C. M. Wong and C. M. Yang during the 1996 Zoology Honours Field Course, National University of Singapore (ZRC).
3) 1997: 23-27 June unless otherwise stated, all specimens were collected by K. K. P. Lim, H. K. Lua and T. C. M. Wong during the 1997 Zoology Honours Field Course, National University of Singapore (ZRC).

The collections made in 1996 and 1997 were from various habitats at the following locations (Fig. 1) (Gg.= Gunung; Kg.= Kampung; Sg.= Sungai; Tg.= Tanjong):

Sg. Asah and Mukut waterfall (26 June 1996, 24 June 1997)
Sg. Ayer Besar and Juara waterfall (25 June 1996, 23 June 1997)
Sg. Baharu (28 June 1996, 27 June 1997)
Sg. Genting (27 June 1996)
Sg. Kelepak (26 June 1996)
Sg. Keliling (27 June 1996, 26 June 1997)
Sg. Mentawak (26 June 1996, 24 June 1997)
Sg. Nipah (28 June 1996, 24 June 1997)
Sg. Paya (25 & 27 June 1996, 25 June 1997)
Sg. Raya (26 June 1996)
Sg. Salang (25 June 1997)
Sg. Tekek (24 June 1996)
Gg. Kajang (28 June 1996) a rock stream, 500 m a.s.l.
Kg. Tekek (25, 28 & 29 June 1996)
Monkey Bay (25 June 1997)
Tg. Dungun (24 June 1997)

INFRAORDER GERROMORPHA

FAMILY MESOVELIIDAE

Mesovelia horvathi Lundblad, 1933

Material examined. - 1 male, 5 nymphs, Sg. Ayer Besar. — 8 males, 6 females, Sg. Paya. — 4 males, 5 females, Sg. Keliling. — 1 male, 4 females, Sg. Dungun.

Mesovelia vittigera Horvath, 1895

Material examined. - 7 males, 13 females, tidal, river mouth of Sg. Raya. — 1 female, Sg. Genting. — 1 female, Sg. Paya. — 1 male, 1 female, Sg. Keliling. — 5 males, 4 females, tidal, Sg. Kelepak.

Remarks. - Mesoveliids are commonly found among marginal vegetation on standing waters of ponds and streams. *M. vittigera* was collected from both freshwater and brackish-water habitats.

FAMILY HEBRIDAE

Hebrus nereis Polhemus & Polhemus, 1989

Material examined. - 9 males, 13 females, Sg. Paya.

Remarks. - *H. nereis* is a new record for Peninsular Malaysia. Specimens were found under gravels, in holes of decaying logs submerged in brackish-water or on mangrove shore. This species was previously known from mangrove swamps in Singapore and Thailand (Polhemus & Polhemus, 1989).

Hebrus sp.

Material examined. - 1 female, stagnant pond, Kg. Tekek. — 1 male, 1 female, Mukut waterfall.

Timasius sp.

Material examined. - 3 males, 1 female, Juara waterfall, Sg. Ayer Besar. — 1 male, 2 females, Sg. Keliling. — 2 males, Mukut waterfall. — 1 female, Sg. Paya.

Remarks. - *Timasius* was collected from wet rocks at waterfalls and along streams. This is likely to be a new species as the buccula and metanotal are different from known species described by Andersen (1981).

FAMILY HYDROMETRIDAE

Hydrometra jaczewskii Lundblad, 1933

Material examined. - 2 male, 10 females, Sg. Baharu. — 1 female, Sg. Keliling.

Hydrometra maidli Hungerford & Evans, 1934

Material examined. - 1 male, 1 nymph, Sg. Ayer Besar. — 8 males, 3 females, Sg. Keliling. — 1 female, Sg. Salang.

Remarks. - Found in the weedy margins of streams, ponds and pools. *H. maidli* is the most common and widespread *Hydrometra* species in Malaysia and Singapore. It has also been

recorded from brackish waters in Singapore by Murphy (1990). Hydrometrids have been found in the stomach contents of *Rana erythraea*, a common frog collected from a stagnant pond near Kg. Tekek (Bullock, 1966b).

FAMILY VELIIDAE

SUBFAMILY MICROVELIINAE

Microvelia sp. 1

Material examined. - 2 females, Sg. Ayer Besar. — 1 female, Sg. Paya. — 5 males, 1 female, Sg. Salang. — 5 males, 6 females, Sg. Baharu.

Microvelia sp. 2

Material examined. - 1 male, 1 female, 1 macropterous female, Sg. Baharu. — 2 males, 4 females, 1 macropterous male and 1 macropterous female, Sg. Keliling.

Microvelia sp. 3

Material examined. - 1 female, 2 macropterous males, 1 macropterous female, Sg. Paya.

Remarks. - All *Microvelia* species were collected from small puddles along forest streams.

SUBFAMILY HALOVELIINAE

Halovelia abdominalis Andersen, 1989

Material examined. - 4 females, Tekek Bay — 1 nymph, Monkey Bay.

Remarks. - This marine bug is easily recognized by the upturned connexiva to the dorsum and very narrow and long abdomen. This species was previously collected from rock pools at low tide from Tioman, and at light from the Java Sea (Andersen, 1989). The four adults were collected along with *Halobates proavus.*

Haloveloides sundaensis Andersen, 1991

Material examined. - 13 nymphs, Monkey Bay, H. H. Tan.

Remarks. - The specimens were found under submerged rocks. This species has been collected from coasts of Mersing, Penang and Langkawi, and in mangroves and coastal areas of the Sunda Shelf (Andersen, 1991).

Xenobates sp. 1

Material examined. - 3 males, 2 females, tidal margins of Sg. Paya. — 44 males, 21 females, among vegetation, tidal margins of Sg. Mentawak.

Xenobates sp. 2

Material examined. - numerous males and females, tidal margins of Sg. Baharu.

Remarks. - Both species are found along the margins of very slow flowing mangrove streams. Large groups of individuals were found during low tide at Sg. Baharu, among floating vegetation near the river mouth, about 200 metres from the coast. They are not sympatric in the same estuaries on Tioman. These two undetermined *Xenobates* will be described by Andersen, who is revising the genus (Andersen, pers. comm.).

SUBFAMILY RHAGOVELIINAE

Rhagovelia sumatrensis Lundblad, 1933

Material examined. - 16 males, 17 females, 1 macropterous male, 1 macropterous female, Kg. Tekek (BP); numerous macropterous and apterous males and females, various flowing streams.

Remarks. - This is the commonest and most widespread of the five known species of *Rhagovelia* in forest streams of Peninsular Malaysia and Singapore (Yang & Polhemus, 1994). It is very abundant in slow to moderately fast-flowing streams on the island. Groups of individuals are usually found on slow riffles or behind stones on moving water.

SUBFAMILY PERITTOPINAE

Perittopus breddini Kirkaldy, 1901

Material examined. - 1 male, 1 female, Kg. Tekek (BP); numerous apterous and macropterous males and females, various forest streams and waterfalls.

Remarks. - This beautiful chestnut red bug is very common on sheltered puddles, side pools and rock pools along forest streams and waterfalls on the island. Macropterous individuals are always more numerous than apterous ones.

FAMILY GERRIDAE

SUBFAMILY RHAGADOTARSINAE

Rhagadotarsus kraepelini Breddin, 1905

Material examined. - 5 males, 12 females, brackish, Sg. Baharu. — 4 males, 7 females, 1 macropterous male, Sg. Keliling.

Remarks. - This species is common on standing waters of ponds, lakes, reservoirs, temporary pools and also quiet parts of flowing streams in Southeast Asia. It is rare on Tioman because most of the streams are fast flowing. However, a population was found on the slightly brackish region of Sg. Baharu. It was collected along with *Ventidius modulatus* and *Stenobates biroi*. Specimens of *Rhagadotarsus* and *Ventidius* were at the quieter margin of the stream, whereas *Stenobates* occurred midstream with stronger currents. It has been collected from mangroves in Singapore (Polhemus & Karunaratne, 1993) and in Sri Lanka (Andersen & Foster, 1992).

SUBFAMILY GERRINAE

Limnogonus fossarum Fabricius, 1775

Material examined. - 2 males and 2 females (all macropterous), Kg. Tekek (BP). — 2 males, Sg. Ayer Besar. — 5 males, 3 females, 2 macropterous females, Sg. Paya. — 1 macropterous female, Sg. Genting. — 12 males, 12 females, 4 macropterous males, 6 macropterous females, Sg. Keliling. — 3 males, 1 female, 1 macropterous male, 1 macropterous female, freshwater and brackish-water of Sg. Baharu.

Remarks. - This is the commonest and most widespread of Malaysian gerrids and is found in all sorts of standing waters to very slow flowing streams or even brackish waters. Macropterous forms are common, thus it can colonize temporary habitats successfully (Cheng & Fernando, 1969).

Tenagogonus (Limnometra) ciliatus Mayr, 1865

Material examined. - 1 macropterous female, brackish stagnant pool, Kg. Tekek. — 1 male, 1 female, 5 macropterous male, 2 macropterous female, tributary of Sg. Keliling. — 7 males, 3 females, 8 macropterous males, stagnant pool, Tg. Dungun. — 1 male, Sg. Keliling. — 1 macropterous female, Sg. Baharu.

Tenagogonus (Limnometra) femoratus Mayr, 1865

Material examined. - All macropterous. 1 male, 2 females, saline pool, stagnant, Kg. Tekek. — 3 females, brackish, Sg. Keliling. — 1 female, Sg. Baharu.

Remarks. - These two species of *Tenagogonus* are not common and were found in stagnant waters of both brackish pools and at quiet edges of forest streams. Although Cheng & Fernando (1969) reported that this species was only found to inhabit forest ponds, it has colonized brackish-waters on Tioman.

SUBFAMILY CYLINDROSTETHINAE

Cyclindrostethus malayensis D. Polhemus, 1994

Material examined. - 1 male, Sg. Baharu.

Remarks. - This species is very rare on the island, only one specimen was collected from an open area of a stream with moderate water flow. It has previously been recorded as *C.*

costalis from smoothly flowing streams of swamp forest in Peninsular Malaysia and Singapore by Cheng & Fernando (1969). *C. costalis* Schmidt, 1915 is only known from Indochina, north of the isthmus of Kra (Polhemus, 1994).

SUBFAMILY PTILOMERINAE

***Ptilomera tigrina* Uhler, 1860**

Material examined.- numerous males and females, various flowing forest streams.

Remarks. - Widespread and very common in the slow to fast flowing forest streams on the island.

***Rheumatogonus intermedius* Hungerford, 1933**

Material examined. - 5 males, 1 female, Sg. Ayer Besar. — 37 males, 30 females, Sg. Paya. — 23 males, 27 females, Sg. Keliling. — 1 female, Sg. Nipah.

Remarks. - Common in slow to moderate flowing forest streams in the Peninsular Malaysia.

SUBFAMILY HALOBATINAE

***Halobates proavus* White, 1883**

Material examined. - 10 males and 10 females, Kg. Tekek (BP). — 26 males, 22 females, Tekek Bay. — 14 nymphs, Sg. Baharu.

Remarks. - Cheng & Fernando (1969) reported this species near the coasts of Pulau Tioman and southern islands off Singapore. It is common around coasts of Tioman and the nearby island Pulau Permangil.

***Metrocoris nigrofasciodes* Chen & Nieser, 1993**

Material examined. - 1 male, 1 macropterous male, Kg. Tekek (BP); — numerous males and females, various flowing forest streams.

Remarks. - This species is very common in rock pools of both slow and fast flowing forest streams and waterfalls. It is also the only aquatic bug found in the rocky stream on Gg. Kajang, at a.s.l. 500 m. Five species of *Metrocoris* has been recorded from Peninsular Malaysia (Chen & Nieser, 1993; Yang & Kovac, 1995), so far *M. nigrofasciodes* is only known from rocky hill streams of primary forest in Belum (Perak) and Tioman.

***Ventidius modulatus* Lundblad, 1933**

Material examined. - 7 males, 11 females, brackish, Sg. Paya; — 6 males, 4 females, Sg. Raya; — 13 males, 17 females, brackish, Sg. Baharu. — 11 males, 15 females, freshwater and brackish-water reaches of Sg. Keliling; — 7 males, 14 females, freshwater and brackish-water reaches of Sg. Mentawak.

Remarks. - Of the seven species of *Ventidius* recorded from Peninsula Malaysia, six inhabit slow to moderate flowing forest streams. Only *V. modulatus* is more common in standing waters of reservoirs, lakes and ponds than in slow flowing forest streams.

Although a largely freshwater species in Peninsular Malaysia, groups of individuals including nymphs were commonly found on brackish-waters on Tioman island. A few specimens were even found during rising tide at the river mouth, about 50 metres from the coast. This freshwater gerrid has adapted well in the brackish environment.

SUBFAMILY TREPOBATINAE

***Stenobates biroi* (Esaki, 1926)**

Material examined. - 14 males, 21 females, tidal stream of Sg. Baharu.

***Stenobates insularis* Polhemus & Cheng, 1982**

Material examined. - 25 males, 28 females, tidal stream of Sg. Paya.

Remarks. - These two species of marine bugs are recorded here for the first time in Peninsular Malaysia. They were first discovered from mangrove streams in Singapore (Esaki, 1926; Polhemus & Cheng, 1982), and have not been found elsewhere. These new records from Tioman indicate their likely presence in mangroves of mainland Peninsular Malaysia.

On Pulau Ubin in Singapore, Murphy (1990) and Polhemus & Polhemus (1991) found *S. biroi* on the outer fringes of mangrove while *S. insularis* occurred in the quieter tidal waters of the same mangrove estuaries. On Tioman, *S. biroi* was observed skating swiftly on the stronger tidal stream at Sg. Baharu, occurring in the whole mangrove stream, until about 200 metres from the coast. *S. insularis* was found at the quieter tidal area of a tributary of Sg. Paya, about 400 metres from the coast. They do not inhabit the same mangrove stream. *S. biroi* was found on the eastern side of the island while the other, *S. insularis* occurred on the western side. *Ventidus modulatus* was found with both species in the mangrove streams.

INFRAORDER NEPOMORPHA

FAMILY NOTONECTIDAE

SUBFAMILY NOTONECTINAE

***Enithares* sp.**

Material examined. - 1 nymph, Sg. Keliling.

SUBFAMILY ANISOPINAE

***Anisops tahitiensis* Lundblad, 1934**

Material examined. - 8 males, 12 females, 14 nymphs, Sg. Ayer Besar. — 6 males, 4 females, 11 nymphs, Sg. Raya. — 3 males, 1 female, Sg. Keliling.

***Nychia sappho* Kirkaldy, 1901**

Material examined. - one male, stagnant pool at Tg. Dungun.

Remarks. - It was previously known as *N. malayana* Lundblad, 1933.

FAMILY PLEIDAE

***Plea quinquemaculata* Lundblad, 1933**

Material examined. - 6 males, 6 females, stagnant pond, Kg. Tekek. — 1 male, 3 females, stagnant pool, near Sg. Raya.

FAMILY BELOSTOMATIDAE

***Diplonychus rusticus* (Fabricius, 1781)**

Material examined. - 10 nymphs, Sg. Ayer Besar.

DISCUSSION

Based on published literature there are about 40 genera and 100 species of Gerromorpha on the mainland of Peninsular Malaysia. The present study has documented only 25 genera and 33 species (or 60% and 33% respectively) on Pulau Tioman.

Rhagovelia sumatrensis, *Metrocoris nigrofasciodes*, *Ptilomera tigrina* and *Perittopus breddini* are the commonest species found on or along the rocky hill streams, followed by *Rheumatogonus intermedius*, *Ventidius modulatus* in some forest habitats. Small numbers of *Limnogonus fossarum*, *Tenagogonus ciliatus*, *T. femoratus* and *Rhagadotarsus kraepelini* are scattered in some areas of stagnant or slow flowing waters as well as the brackish environment. In the estuarine habitats *Ventidus modulatus*, *Stenobates insularis*, *S. biroi*, *Xenobates* spp. and *Hebrus nereis* are common. For the true marine bugs, *Halobates proavus* is common, *Halovelia abdominalis* and *Haloveloides sundaensis* are present too.

Three species are new records for the Malaysian fauna: *Stenobates biroi*, *S. insularis* and *Hebrus nereis*. The two former species were previously found only in Singapore, and the later was from Thailand and Singapore. The presence of these species from Tioman indicate that they could be expected to occur in mainland Peninsular Malaysia.

Since all species found on Tioman also occur on mainland Peninsular Malaysia, the island must have been connected to the mainland when there were major changes in the sea level which occurred at intervals during the Pleistocene (Bullock & Medway, 1966). According to Andersen (1982), species which are found on islands are most often those which are most widely distributed on the mainland and are known to colonize new temporary habitats.

The poor diveristy of aqautic insects on Tioman could be due to the island's very steep granite terrain. The excessively well-drained watercourses have very limited quiet microhabitats. Aquatic vegetation, leaf litter and permanent stagnant waters are rare, therefore many common aquatic (Nepomorpha) and semi-aquatic (Gerromorpha) bugs, especially the former, are very poorly represented. Although the present list is probably not complete, we have found several species (5) of Nepomorphan bugs which were reported to be virtually absent by Bullock (1966a). Other aquatic insects, such as aquatic beetles, are also infrequently found (see Hendrich & Yang, 1998).

Through the kindness of Dr Dan Polhemus of the Bishop Museum, the first author was able to examine specimens of *Rhagovelia sumatrensis, Perittopus breddini, Limnogonus fossarum, Metrocoris nigrofasciodes, Halobates proavus* and *Timasius* sp. reported by Bullock in 1965. The other reported species, such as *Hydrometra* and *Mesovelia,* could not be found in the Bishop Museum nor in the University of Malaya collection. Since no species list was given by Bullock, we are therefore unable to compare the present hemipteran fauna with those collected in 1965. However, it is to be expected that some species may be more abundant during the 1965 survey, since freshwater swamps and more ponds were present then. Bullock (1966b) studied the food of amphibians and found that besides hydrometrids and veliids, the major item in the diet of *Rana erythraea* was gerrids. *Rana erythraea* was mostly collected from a stagnant pool near Kg. Tekek which no longer exists. Gerrids were also found in the stomach contents of another frog, *Rana cancrivora* which inhabits coastal habitats on the island.

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