

GUIDE TO AQUATIC HETEROPTERA OF SINGAPORE AND PENINSULAR MALAYSIA. IV. CORIXOIDEA

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ABSTRACT. - This is the fourth guide to the aquatic Heteroptera of Singapore and Peninsular Malaysia dealing with the families Corixidae and Micronectidae. Corixidae, with two genera and two recorded species, is poorly represented. On the contrary Micronectidae, with two genera and 17 recorded species of which six are only known from the area under consideration, is well represented. Keys to genera and species occurring in Singapore and Peninsular Malaysia, outline drawings of a representative of each genus and figures of structural details essential for identification are presented. In addition short diagnoses and distributional notes are given for each species.

KEY WORDS. - Corixidae, Micronectidae, Malay Peninsula, keys.

INTRODUCTION

The Corixoidea are represented in the Malay Peninsula by two families, the Corixidae or water boatmen and the Micronectidae or pygmy water boatmen. They belong to the heteropteran infraorder Nepomorpha which is characterized by having the antennae shorter than the head in combination with well developed eyes. The antennae are inserted under the eyes and are either concealed or with only their apices visible in dorsal view. Corixidae is an exceptional family as they are most richly represented in temperate regions whereas other nepomorphan families are richest in tropical areas. In Singapore and Peninsular Malaysia only two species have been recorded (Leong, 1966) a third species may occur. Micronectidae are predominantly tropical although some species reach into the colder areas of the temperate zone. Leong (1966) recorded seven species in Singapore and Peninsular Malaysia, Fernando & Cheng (1974) raised the number to 10 and the present study counts 17 actually recorded species. Six of the seven additions are recently described (Nieser, 2000, 2002), which indicates that our knowledge of these small aquatic bugs in Southeast (SE) Asia is still far from complete.

Corixoidea are truly aquatic bugs and are found in stagnant waters or parts of streams with very little current. They are characterized by the rostrum, which

is broadly triangular in shape and not segmented although transverse grooves are present in most species (Fig. 29). The fore tarsi are one-segmented and widened in most genera, they are called palae (singular: pala). The palae of males show as a rule extra modifications. Another unique characteristic of the superfamily is the possession of a strigil in males of most species. This is a strongly sclerotized roundish or mushroom shaped organ, essentially consisting of one or more rows of tightly packed teeth, lying dorsally on the right side of the sixth abdominal tergite in Malayan species. In spite of its name, this organ has nothing to do with sound production but is, at least in Corixidae, used to maintain the subelytral gas store while surfacing during mating (Popham et al., 1984). The function of the strigil in Micronectidae has not yet been verified.

Most of the specimens used for this study have been collected over the years by various members of the National University of Singapore (NUS) and are deposited in the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research at the NUS. The material of *Micronecta* in this museum is quite impressive as it contains many samples collected in the field. Most previous studies of this genus have been based on material from light traps. Study of the material in ZRC resulted in the description of four new species (Nieser, 2002) and three first records for Singapore and West Malaysia

Table 1. Key characters distinguishing Micronectidae from Corixidae.

Micronectidae	Corixidae
1. Scutellum exposed	Scutellum covered by hemielytra
2. Female fore tibia and pala fused	Female fore tibia and pala separate
3. Male claw of pala modified and able to fold in the pala without pegs	Male palar claw not modified pala with pegs
4. Male right paramere at base usually with a field of ridges (for stridulation)	Male right paramere without such ridges
5. Stridulation in males only by movement of the genital capsule	Stridulation by rubbing peg fields on the anterior femur against the side of the head, females of some species also able to stridulate
6. Antennae three-segmented	Antennae four-segmented
7. Middle tibia shorter than tarsus	Middle tibia longer than tarsus.

[in this paper]. Additional specimens from the Nieser collection (NCTN) have also been included in this paper. The keys contain species actually collected in Singapore or Peninsular Malaysia, and a few species recorded from Sumatra and Thailand, which in all probability will occur in the area under consideration. Synonymy is abbreviated, references to *Micronecta* prior to 1968 can be found in Wróblewski (1968); references to Corixidae prior to 1940 in Hutchinson (1940).

SUPERFAMILY CORIXOIDEA

Corixidae and Micronectidae are closely related morphologically but are in some respects very different from other Heteroptera. Many authors consider them to be a single family Corixidae with several subfamilies of which Corixinae and Micronectinae are represented in Malaysia.

However there are many differences, which support the elevation to family rank of these taxa. The most important characteristics listed in Table 1.

The subfamily Micronectinae was erected by Jaczewski (1924). Based on these characters cited above I raise the subfamily Micronectinae to the family Micronectidae Jaczewski 1924. Further differences can be found in Mahner (1993), and on stridulation in Micronectidae (Jansson, 1989) and in Corixidae (Jansson, 1972). In addition, during mating, some Corixidae produce mounting signals by the male rubbing its middle femur against the edge of the hemielytron of the female (Jansson, 1975). Recently it was found that all nine species of *Micronecta* occurring near Melbourne, Australia can be distinguished by their sounds (King, 1999a). In some

species of *Micronecta* the most reliable specific differences are found in acoustic signals (King, 1997). Females of *Micronecta* are attracted to signals of conspecific males, in preference to signals of heterospecific males, and copulation only follows after a number of acoustic signals have been produced (King, 1999c).

The third corixoid family Diaprepocoridae, which is so far only known from Australia and New Zealand, also has the scutellum exposed. It differs from Micronectidae in having four segmented antennae and possessing ocelli. It is mentioned here since *Paranisops* (Notonectidae), hitherto endemic to Australia, was recently discovered in Thailand (Nieser & Zettel, 2001), so there is a small chance that a representative of the Diaprepocoridae may be found outside its known distributional area.

KEY TO FAMILIES AND GENERA OF CORIXOIDEA OF SINGAPORE AND PENINSULAR MALAYSIA

1. Scutellum exposed, small species, length 4 mm or less, antennae three-segmented, Micronectidae 2
- Scutellum covered by the pronotum (sometimes the apex visible), length rarely less than 4.5 mm, antennae four-segmented, Corixidae 3
2. Head dorsally between eyes with a shallow oval impression (Fig. 2), fore tibia and pala fused in both sexes *Synaptonecta*
- Head without impression dorsally between eyes, fore tibia and pala separate in males, fused in females *Micronecta*
3. Large and stout species, length 6.5-8.5, width 2.7-3.1 mm; hemielytra unicolorous hyaline *Agraptacorixa*
- Smaller and more slender species, length 4.5-5.5, width 1.7-2.5 mm; hemielytra brown with yellowish vermiculate markings *Sigara*

FAMILY MICRONECTIDAE

Micronectidae, commonly known as pygmy boatmen, are among the most common truly aquatic Heteroptera in Singapore and Peninsular Malaysia. However, due to their small size, they tend to be overlooked by the casual observer. Two of the three genera in the family are represented. *Synaptonecta* with one species *S. issa*. The remaining 15 recorded species belong to the genus *Micronecta*. At present there are six endemic species, four of which have recently been described (Nieser, 2002). Some species are only or predominantly known in the macropterous form while others are only or predominantly known in the brachypterous form. Some of the predominantly macropterous species are often found in stagnant, sometimes small, pools of water. A few of these are very widespread, e.g., *M. scutellaris*, which occurs in large parts of Africa, through Arabia, India, Sri Lanka and SE Asia to S. China, or *M. quadristrigata* which occurs from Iran through India, Sri Lanka, SE Asia and Indonesia to Hong Kong, Taiwan, the Philippines and N. Australia (Wróblewski, 1968). The predominantly brachypterous species tend to be associated with quiet parts of streams or larger stagnant water bodies.

As new records and undescribed species are still to be expected in the area, users who come across material which clearly does not run in the key are kindly requested to send it for study to the author. Alcohol samples are much easier to deal with than dry prepared specimens. A sample should include at least three males.

**KEY TO MICRONECTIDAE OF WEST MALAYSIA AND SINGAPORE
IN MANY CASES ONLY MALES IDENTIFIABLE**

1. Vertex dorsally with a round or oval impression (Fig. 2); surface of hemielytra with a scaly microstructure; fore tibia and pala fused in both sexes*Synaptonecta issa*
- Vertex convex or, rarely, flattened, without impression; surface of hemielytra smooth; fore tibia and pala in males separate (*Micronecta*)2
2. Dark pattern of hemielytra punctuate (Fig. 5), large species, length 2.4-3.3 mm..... *M. haliploides*
- Dark pattern of hemielytra not punctuate, usually with more or less well defined stripes or reticulate, in some species hardly any pattern except for the hyaline stripes at base of clavus and inner margin of right membrane..3
3. Dark pattern on hemielytra with large irregular spots (Fig. 6), left paramere with a hood-shaped apical part (Fig. 23).....*M. maculata*
- Dark pattern on hemielytra without large irregular spots, left paramere of a different shape4
4. Dark pattern on corium consisting of four distinct solid, regular parallel bands (Fig. 8)5
- Dark pattern on corium streaky, irregularly linear or indistinct6
5. Larger species, length 2.8-3.4 mm, pronotum with a distinct dark transverse stripe in the middle (Fig. 3)
.....*M. siva*
- Smaller species, length 1.9-2.3 mm, pronotum a pair of subovaly curved darker stripes (Fig. 4, "spectacles frame" of Wróblewski, 1968, 1972) which may be indistinct or fragmented, no transverse stripe
.....*M. ludibunda*
6. Larger species length 2.4 mm or more7
- Smaller species length less than 2.4 mm.....10
7. Length 3.5 mm or more.....*M. scutellaris*
- Length up to 3.3 mm8
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- Longitudinal stripes on corium hardly discernible; male, free lobe of 8th abdominal tergite not sigmoid, tip of left paramere not sickle-shaped 9
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- Colour light to medium brownish grey, lateral margins of pronotum one third as long as median length of pronotum (0.1/0.3), width of pronotum three times its median length (1.0/0.3), males without a strigil, free lobe of left part of tergite 8 with a deeply incised distal margin resulting in a short finger-like projection usually pointing medially (Fig. 10) *M. grisea*
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..... *M. johorensis*
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.....*M. dentifera*
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17. Male lacking a strigil, right paramere apically swollen (Fig. 25); hemielytral pattern inverse, lighter stripes on dark background, lighter longitudinal lines on corium distally partly dissolved in small dots (Fig. 7)*M. guttatriata*
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19. Costal margin of hemielytra with a simple dark stripe, free lobe of eighth tergite of male apically rather narrow without a small median projection (Fig. 15); claw of male pala with a subapical tooth; length 1.6-2.1*M. tarsalis*
- Costal margin of hemielytra with distinct dark spots; free lobe of eighth tergite of male apically broad with a small median projection (Fig. 13); claw of male without subapical tooth; length 1.7-2.1 mm*M. decorata*

***Synptonecta issa* (Distant, 1910)**

Micronecta issa - Leong, 1964; Wróblewski, 1968; Fernando & Cheng, 1974.

Synptonecta issa - Nieser, 2000.

Diagnosis. - Length brachypterous 1.8-2.0, macropterous 1.9-2.4 mm. The brachypterous form is generally a small ovate somewhat greyish species with pointed hemielytral tips (Fig. 2). Head dorsally with a round to broadly oval depression. The hemielytra have a scaly microstructure and a spotted appearance which is, however, much less distinct than in *Micronecta haliploides* or *M. maculata*. In the brachypterous form the hemielytra are strongly reduced apically (Fig. 2). The pala and tibia are fused in both sexes.

Distribution. - A widespread predominantly brachypterous species, recorded from India and Sri Lanka, SE Asia and Java. Recorded from Singapore and Malaysia: Johor by Leong (1966) and Fernando & Cheng (1974). Usually scarce in collections but it is apparently common in Singapore, there are seven samples from Singapore containing this species in ZRC. In spite of being predominantly brachypterous

when collected in the field, Fernando & Cheng (1974) found it abundantly in light trap catches.

***Micronecta charakta* Nieser, 2002**

Diagnosis. - Length macropterous 1.7-2.0 mm. Dorsally generally somewhat greyish light brown; pronotum unicolorous; hemielytra with indistinct slightly darker patches and two medium brown patches at lateral margins. The easiest way to recognize this species is by the characteristic right paramere (Fig. 26) which is comparatively large and with some experience well visible in intact males, preferably in alcohol specimens.

Distribution. - Described from Malaysia: Perak and Trengganu and so far not recorded elsewhere. Only known in the macropterous form.

***Micronecta decorata* Lundblad, 1933**

Micronecta decorata - Fernando & Cheng, 1974; Nieser, 2000.

Diagnosis. - Length macropterous 1.7-2.1 mm. Generally a small, light brown, elongate species. Pronotum unicolorous, corium with poorly contrasting, brown, broken longitudinal stripes. Lateral margins of the hemielytra usually with two large dark spots in anterior half and a third one at the base of the membrane. Similar to *M. tarsalis* see under that species. The large free lobe of eighth tergite of the male (Fig. 13) is characteristic.

Distribution. - A species with a rather restricted distribution: Sumatra and the Malay Peninsula. Fernando & Cheng (1974) recorded it from Malaysia: Perak. In the ZRC there are samples from the following states: Johor, Kelantan, Pahang, and Trengganu. There are also several samples containing this species from Singapore, new record. Only known in the macropterous form.

***Micronecta dentifera* Nieser, 2002**

Diagnosis. - Length brachypterous 1.2-1.3 mm. Generally a yellowish to pale brown, very small, ovate species. Pronotum unicolorous yellowish; hemielytra with an irregular little contrasting light brown reticulate pattern and four dark patches at lateral margins of which the second is the largest. Similar to *M. johorensis* which is larger. The left parameres of these species are somewhat similar but the right

paramere of *M. dentifera* is long and slender without longitudinal striae, that of *M. johorensis* is distinctly stouter and shows longitudinal striae (Figs. 27, 28).

Distribution. - Described from Singapore and so far not recorded elsewhere, only known in the brachypterous form.

***Micronecta fugitans* Breddin, 1905**

Micronecta fugitans - Wróblewski, 1968; Fernando & Cheng, 1974; Nieser, 2000.

Diagnosis. - Length macropterous 1.8-2.2 mm. Generally a small to medium sized elongate light brown species. The hemielytral pattern is similar to that of *M. quadristrigata* but often indistinct. Lateral margins of the hemielytra with three elongate brown patches which tend to form a more or less continuous stripe. The left paramere with its rod-like dark brown shaft is characteristic.

Distribution. - A widespread species, from Thailand through the Malay Peninsula and Sumatra to Java and Sulawesi (Nieser & Chen, 1999). Recorded only once from W. Malaysia: Johor (Fernando & Cheng, 1974). Only known in the macropterous form. This species has been found regularly in light catches.

***Micronecta grisea* (Fieber, 1844)**

Micronecta grisea - Wróblewski, 1968; Fernando & Cheng, 1974; Nieser, 2000.

Micronecta thyesta Distant, 1910; Leong, 1966.

Diagnosis. - Length macropterous 2.6-3.2 mm. Generally a large greyish brown species. Corium with two strongly broken longitudinal stripes which may be indistinct. Lateral margins of hemielytra with three elongate brown patches of which the middle one is the largest. The lack of a strigil and the peculiar form of the free lobe of left part of eighth tergite (Fig. 10) are characteristic.

Distribution. - A widespread species, from India and Sri Lanka through SE Asia to Sumatra, Java, Taiwan and possibly Sulawesi (Nieser & Chen, 1999). Recorded from Malaysia: Johor and Melaka (Leong, 1966; Fernando & Cheng, 1974). There are also some specimens from Selangor and Perak in ZRC. Only known in the macropterous form. *M. grisea* occurs in both stagnant and running waters and has also been found in light catches.

***Micronecta guttatostrata* Lundblad, 1933**

Micronecta guttatostrata - Nieser, 2000.

Diagnosis. - Length macropterous 2.0-2.4 mm. Generally a medium sized, rather short and broad, dark species. Pronotum with two thick transverse dark stripes. Hemielytra with and inverse pattern, dark with light longitudinal stripes which on corium are apically broken up in small dots (Fig. 7). This hemielytral pattern is characteristic. In addition the male lacks a strigil.

Distribution. - Described from Java and found in a few isolated localities in Vietnam (Wróblewski, 1967) and Thailand (Nieser, 2000). In ZRC there are 1 male and 4 females from Malaysia: Selangor, Ulu Gombak, Sungai Gombak, 14 Nov.1995, coll. C.M. Yang et al. First record from Malaysia, not recorded from Singapore. Only known in the macropterous form.

***Micronecta haliploides* Horváth, 1904**

Micronecta haliploides - Nieser, 2000.

Micronecta punctata (Fieber, 1844); Leong, 1966; Wróblewski, 1968; Fernando & Cheng, 1974.

Diagnosis. - Length brachypterous 2.4-2.9, macropterous 2.6-3.3 mm. A large elongate oval to elongate species, immediately recognizable by the yellowish hemielytra marked with distinct dark dots (Fig. 5).

Distribution. - A widespread species, predominantly brachypterous but macropters are not uncommon in field collections and the species is found regularly in light trap catches. Recorded from India, Sri Lanka, SE Asia, Sumatra, Java and Bali (Nieser & Chen, 1999). Recorded from Singapore, Johor, Melaka, Negri Sembilan, Penang and Selangor by Leong (1966) and from Kahang by Fernando & Cheng (1974). There are also two specimens from Trengganu in ZRC.

***Micronecta johorensis* Fernando, 1964**

Micronecta johorensis - Wróblewski, 1968; Fernando & Cheng, 1974; Nieser, 2000.

Diagnosis. - Length brachypterous 1.5-1.8 mm. Generally a small ovate, yellowish to light brown species, pronotum with a pair of solid transverse brown patches, which may be poorly contrasting, on

each side of the midline near posterior margin. Hemielytral pattern reticulate. Lateral margins with five dark patches of which the first and last are small. Head as wide as pronotum which is about six times as wide as long. Hemielytra with strongly reduced membranes, ending in acute tips. Due to the hemielytral pattern at first similar to *M. malayana* which is slightly larger and has distinct open roundish patches on the pronotum (as in Fig. 4). In *M. johorensis* the pronotal patches are less distinct, solid and placed more near the posterior margin of the pronotum. In addition *M. malayana* has the apices of the hemielytra somewhat less reduced and has a very different left paramere (Figs. 18, 20).

Distribution. - Described from Malaysia: Johor. In the ZRC there are apart from specimens from several other localities in Johor, also specimens from Singapore. New record for Singapore. Only known in the brachypterous form. Found in quiet parts of streams and in stagnant waters.

***Micronecta lemnae* Nieser, 2000**

Diagnosis. - Length brachypterous form 1.2-1.3 mm. Generally a small ovate pale yellow species. Hemielytra yellowish with relatively large but poorly contrasting brown patches of which two are at lateral margins. Head distinctly wider than the pronotum and covering the lateral margins of the pronotum entirely. In Malaysia this is the smallest species, the right paramere (Fig. 24) is characteristic.

Distribution. - Described from Thailand. Numerous specimens from Malaysia: Pahang, Sungai Balat, 26 km from Kantuan, 15 May.1995 coll. B. Tan & Sumita (ZRC) in addition some specimens from Johor and Kelantan. New record for Malaysia, not recorded from Singapore. Only known in the brachypterous form.

***Micronecta leongi* Nieser, 2002**

Diagnosis. - Length macropterous 1.8-2.1 mm. Generally a medium sized, pale, somewhat brownish elongate species. Hemielytra with poorly contrasting broken longitudinal stripes. Three brown patches along lateral margins of the hemielytra also poorly contrasting. Recognizable by the apically broadly rounded free lobe of left part of eighth tergite of the male (Fig. 14). In case of doubt the left paramere with a denticulate groove on the apical part of the shaft is diagnostic (Fig. 21).

Distribution. - Described from Malaysia: Trengganu and Selangor and so far not recorded elsewhere. Only known in the macropterous form.

***Micronecta ludibunda* Breddin, 1905**

Micronecta albifrons - Leong, 1966 (not Motschulsky, misidentification)

Micronecta ludibunda - Fernando & Cheng, 1974.

Micronecta ludibunda ludibunda - Wróblewski, 1968; Nieser 2000.

Diagnosis. - Length brachypterous 1.8-2.1, macropterous 1.9-2.3 mm. A medium sized species usually with distinct stripes on the hemielytra (somewhat like Fig. 8). Pronotum with a pair of open somewhat roundish patches (Fig. 4). Lateral margins of the hemielytra with five brown patches of which the basal two are often connected. However, the hemielytral pattern may be broken or rather indistinct but is never reticulate as in Fig. 9. The brachypterous form is elongate oval and has the hemielytra only slightly reduced, the main difference, part from the development of the hind wings, is in the lateral margin of the hemielytra which in the brachypterous form is somewhat convex along corium and in the macropterous form this part is straight, resulting in a more elongate general body form. The pronotal pattern (Fig. 4) in combination with the striped hemielytra is diagnostic. In case of doubt the apex of the left paramere in *M. malayana* which is the only other species with a similar pronotal pattern has a narrower lobe than in *M. ludibunda* (Figs. 19, 20). In practice the difference in hemielytral pattern (Figs. 8, 9) will be sufficient to separate these species. See also under *M. malayana*.

Distribution. - A very widespread species: From India and Sri Lanka through SE Asia and Indonesia to New Guinea and the Solomon Islands (Wróblewski, 1968). Recorded from Malaysia: Johor and Melaka (Leong, 1966; Fernando & Cheng, 1974) and Singapore. In addition there is a sample from Pahang in ZRC.

***Micronecta maculata* Nieser, 2002**

Diagnosis. - Length brachypterous 1.2-1.3, macropterous 1.4-1.6 mm. The brachypterous form is broadly ovate with pointed hemielytra. Macropterous specimens are more elongate and have the hemielytra with well developed membranes. Fully coloured specimens are yellowish with extensive dark marks on the hemielytra (Fig. 6). However some specimens are lacking the distinct hemielytral marks, in that case the left paramere (Fig. 23) is characteristic.

Distribution. - Described from Malaysia: Trengganu and Johor and so far not recorded elsewhere. The brachypterous form is much more common than the macropterous form.

***Micronecta malayana* Leong, 1966**

Micronecta malayana - Fernando & Cheng, 1974.

Micronecta ludibunda malayana - Wróblewski, 1968; Nieser, 2000.

Diagnosis. - Length brachypterous 2.0-2.2, macropterous 2.1-2.4 mm. A medium sized light brown species with a reticulate hemielytral pattern (Fig. 9). Lateral margins of the hemielytra with three brown patches. The brachypterous form is elongate oval and has the hemielytra only slightly reduced, the main difference, apart from the development of the hind wings, is in the lateral margin of the hemielytra which in the brachypterous form is somewhat convex along corium and in the macropterous form this part is straight, resulting in a more elongate general body form. The pronotal pattern (Fig. 4) in combination with the reticulate hemielytra is diagnostic. In case of doubt the apex of the left paramere in *M. ludibunda* which is the only other species with a similar pronotal pattern has a broader lobe than in *M. malayana* (Figs. 19, 20). The hemielytral pattern is very similar to that of *M. johorensis* see under that species.

Remarks. - Wróblewski (1968) considered this a subspecies of *M. ludibunda*. There are, however, two samples in ZRC which contain both *M. ludibunda* and *M. malayana* (Johor, Sungai Salangi, 22 Sep.1992, coll. Yeo & Yi; and Selangor, Peat swamp, 18 Nov.1991, coll. H. K. Lua). As there have not been found specimens with intermediate hemielytral pattern and the apices of the left parameres differ these are to be considered full species.

Distribution. - Described from Malaysia: Johore and Selangor (Leong, 1966). In ZRC there are additional samples from these states, from Pahang and several from Singapore, new record for Singapore. Both brachypterous and macropterous forms have been collected. Localities are about evenly divided between stagnant waters and streams.

***Micronecta polhemusi* Nieser, 2000**

Diagnosis. - Length macropterous 2.3-2.9 mm. A dark grey elongate species. Head light brown, eyes grey, frons with a distinct castaneous mark extending

onto clypeus and rostrum. Hemielytra grey, embolium and an ill-defined transverse band on corium darker brown, these darker marks little contrasting, well visible with light shining through the hemielytra only. The castaneous mark on the frons and the dark colour of the hemielytra without longitudinal stripes are characteristic.

Distribution. - Described from Thailand and Vietnam. There are two samples from Singapore: Pulau Ubin, 28 May. 1997, K.L. Yeo et al. in ZRC, new record for Singapore. In view of the general distribution the species will also occur in West Malaysia. Only known in the macropterous form.

***Micronecta quadristrigata* Breddin, 1905**

Micronecta quadristrigata - Fernando & Leong, 1964; Leong, 1966; Wróblewski, 1968; Fernando & Cheng, 1974; Nieser, 2000.

Diagnosis. - Length macropterous 2.2-3.0 mm. A rather large light brown elongate species. Hemielytra with broken longitudinal stripes which are rarely virtually absent. Lateral margins of the hemielytra with four dark patches of which the basal one is largest and elongate. Leong (1966) gives the maximal length of females as 3.4 mm but I have not seen such large specimens. Within the fauna of the Malay Peninsula the sigmoid shape of the free lobe of the left part of the eighth tergite (Fig. 12) is characteristic.

Distribution. - A widespread species, from Iran through India, Sri Lanka, SE Asia, Hong Kong, Taiwan, Indonesia and the Philippines to N. Australia (Wróblewski, 1968). Recorded from Malaysia: Johor, Melaka, Perak, Penang, Selangor and Singapore (Leong, 1966; Fernando & Cheng, 1974). Only known in the macropterous form. Very common and abundant in light catches. In the field in various kinds of stagnant waters including those in agricultural fields. Fernando & Leong (1964) presented notes on its life history.

***Micronecta scutellaris* (Stål, 1858)**

Micronecta scutellaris - Leong, 1966; Wróblewski, 1968; Fernando & Cheng, 1974; Nieser, 2000.

Diagnosis. - Length macropterous 3.6-4.4 mm. A large, greyish brown, elongate species, hemielytra with darker longitudinal stripes which vary from distinct unbroken stripes to broken stripes which may

be virtually absent. Lateral margins of the hemielytra with four brown patches which are also variable from nearly confluent in the form with unbroken stripes to quite indistinct in poorly marked specimens. The form with distinct unbroken stripes was described by Hutchinson (1940) from India. In NCTN there is a specimen from this rare form from S. Vietnam so it occurs in SE Asia too. This species is at once recognizable by its size. The only species getting near the lower size limit of *M. scutellaris* is *M. grisea* of which males do not possess a strigil.

Distribution. - A very widespread species from Africa through Israel, Arabia India and Sri Lanka to SE Asia and China (Wróblewski, 1968). Recorded from Malaysia: Johor, Melaka and Singapore (Leong, 1966; Fernando & Cheng, 1974). Only known in the macropterous form. Often found together with *M. quadristrigata* in stagnant water in agricultural fields. It is in Malaysia much less common than *M. quadristrigata*.

***Micronecta siva* (Kirkaldy, 1897)**

Micronecta siva - Wróblewski, 1968; Nieser, 2000.

Diagnosis. - Length brachypterous 2.8-3.0, macropterous 2.7-3.4 mm. The macropterous form is a large elongate species with very distinct solid longitudinal stripes on the hemielytra and three transverse dark stripes on the pronotum (Figs. 3, 8). Lateral margins of the hemielytra with an unbroken brown stripe. *M. ludibunda* may have a similar hemielytral pattern but this species is smaller, the hemielytral pattern is less solid (in some specimens even broken) and the pronotum has a pair of open roundish patches (Fig. 4). The brachypterous form is smaller on average and has a more ovate body shape but can be recognized by the same hemielytral pattern as in the macropterous form.

Distribution. - A widespread species, from India and Sri Lanka through SE Asia to Sumatra. This species has not yet been recorded from West Malaysia or Singapore but in view of its distribution (Burma, Thailand, Vietnam and Sumatra, Nieser & Chen, 1999) it should occur there. There are some indications that it is associated with larger rivers. The brachypterous form is rare in collections.

***Micronecta tarsalis* Chen, 1960**

Micronecta tarsalis - Wróblewski, 1968; Nieser, 2000.

Diagnosis. - Length macropterous 1.8-2.1 mm. A small, light brown, elongate species. Some poorly contrasting darker brown marks consisting mainly of a transverse stripe on pronotum and broken longitudinal lines on corium. The darker spots along costal margin tend to connect forming a more or less unbroken stripe. The claw of the male has a subapical tooth which is characteristic. Similar to *M. decorata* which has the dark spots along costal margin not continuous and the males have different free lobes of the eighth tergite (Figs. 13, 15).

Distribution. - A widespread species, from S. India and Sri Lanka through SE Asia to Sulawesi. This species has not been recorded from Malaysia or Singapore but in view of its distribution will probably occur there. Only known in the macropterous form.

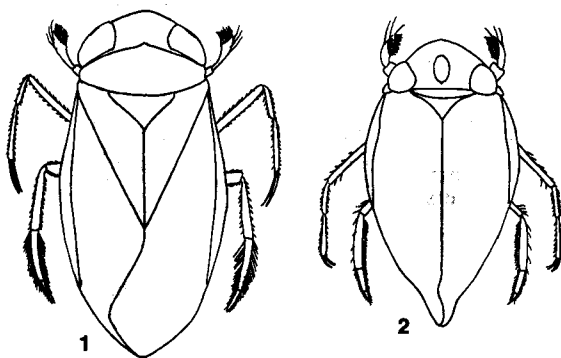
FAMILY CORIXIDAE

Corixidae or water boatmen are exceptional in Nepomorpha as they reach their greatest abundance and diversity in temperate areas. In tropical areas they are apparently replaced by the smaller Micronectidae. The number of recorded species in the Malay Peninsula is two with a possible third occurring, based on a record from Sumatra which has to be confirmed.

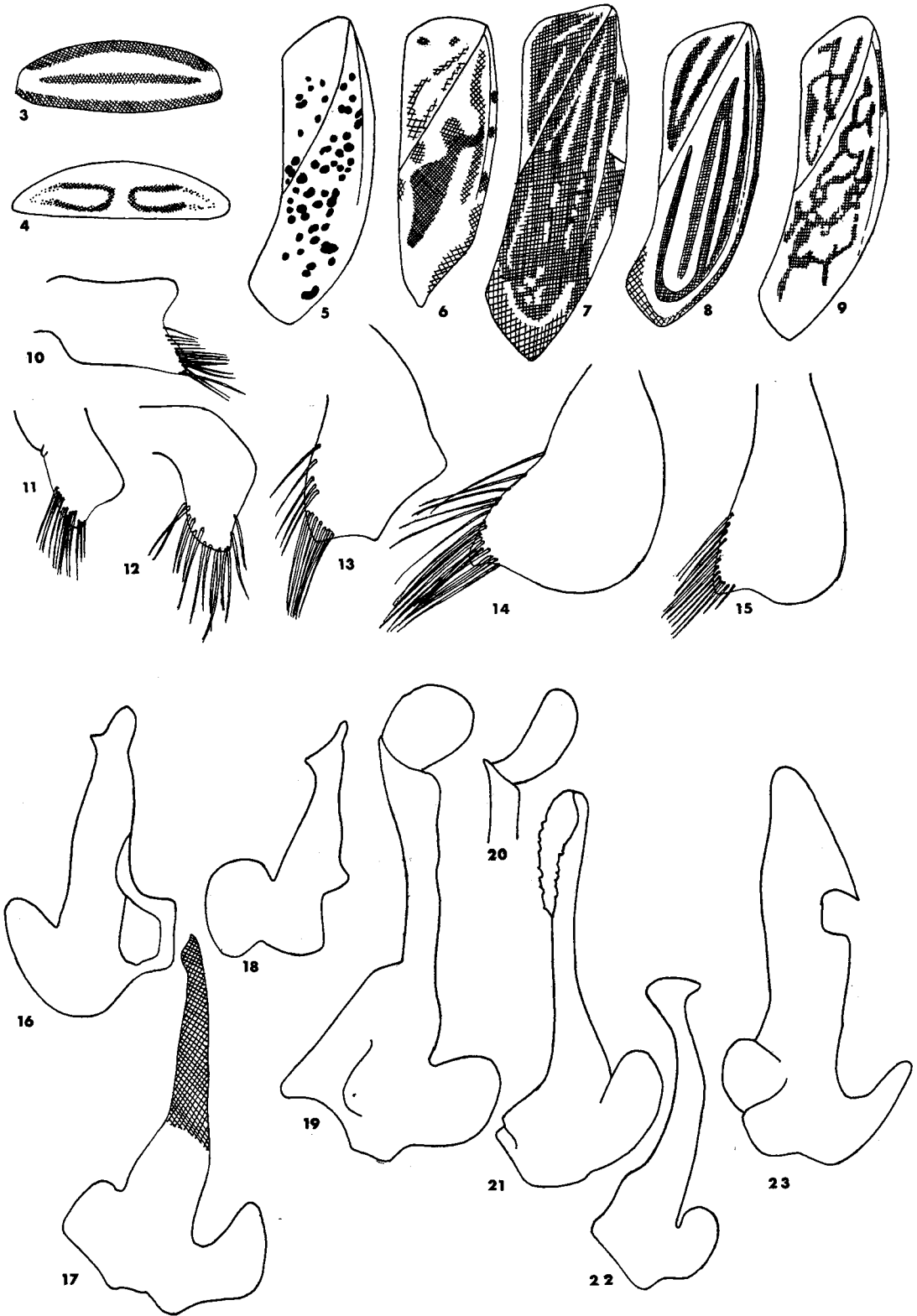
***Agraptacorixa hyalinipennis* (Fabricius, 1803)**

Agraptacorixa hyalinipennis - Fernando & Leong, 1964; Leong, 1966; Fernando & Cheng, 1974.

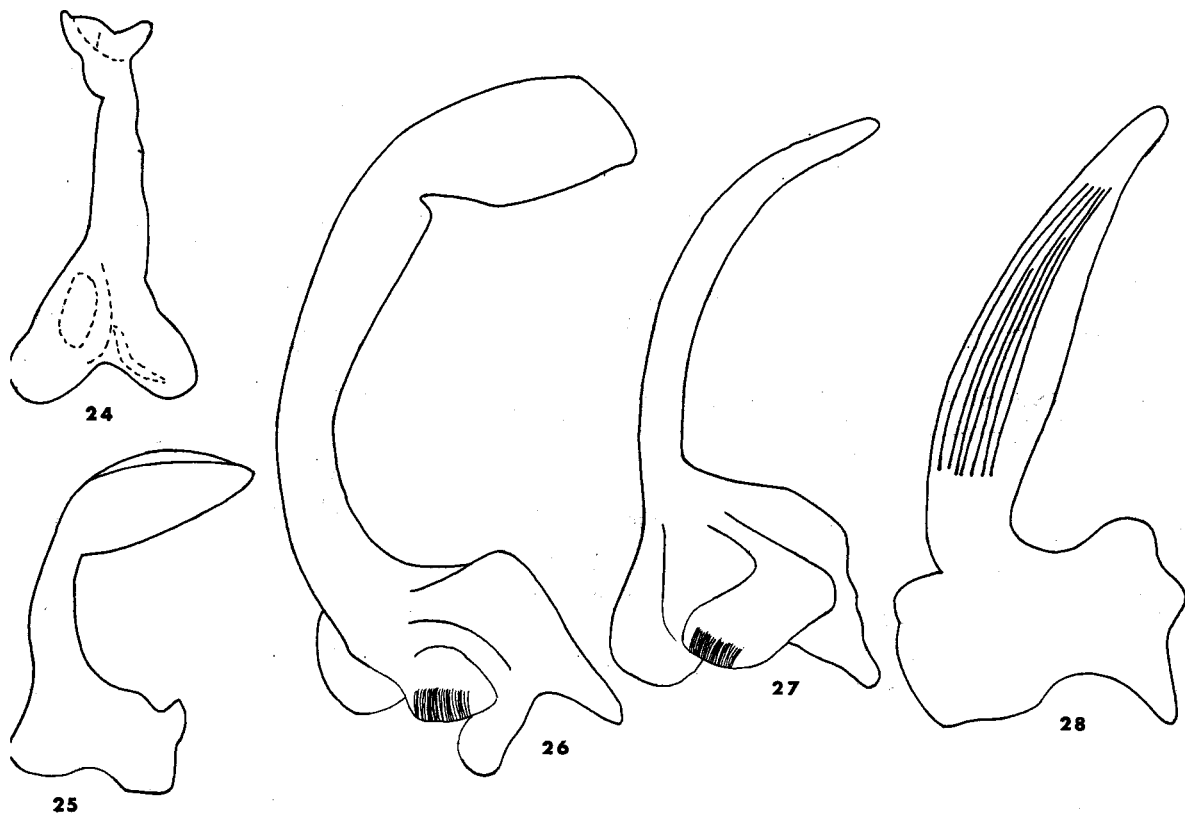
Diagnosis. - Length 6.5-8.5, width 2.7-3.1 mm (Fig. 34), pronotum and hemielytra without yellowish transverse marks on a brown background. Within the fauna of the Malay Peninsula this species can be recognized at once by these characteristics.



Figs. 1-2. Habitus of Micronectidae. 1 *Micronecta quadristrigata* female; 2 *Synaptonecta issa* male.



Figs. 3-4. Pronotum of *Micronecta* spp. 3 *M. siva*; 4 *M. ludibunda*. 5-9. Right hemelytron of *Micronecta* spp. 5 *M. haliploides*; 6 *M. maculata*; 7 *M. guttatostrigata*; 8 *M. siva*; 9 *M. malayana*. 10-15. Free lobe of left part of tergite VIII of male *Micronecta* spp. 10 *M. grisea*; 11 *M. polhemusi*; 12 *M. quadristrigata*; 13 *M. decorata*; 14 *M. leongi*; 15 *M. tarsalis*. 16-23. Left paramere of *Micronecta* spp. 16 *M. dentifera*; 17 *M. fugitans*; 18 *M. johorensis*; 19 *M. ludibunda*; 20 *M. malayana*, apex of paramere; 21 *M. leongi*; 22 *M. quadristrigata*; 23 *M. maculata*.



Figs. 24-28. Right paramere of *Micronecta* spp. 24 *M. lemnae*; 25 *M. gutattostriata*; 26 *M. charakta*; 27 *M. dentifera*; 28 *M. johorensis*.

Distribution. - A widespread species, from India to S. China and through SE Asia to Indonesia (Moluccas) and the Philippines (Mindanao) (Nieser & Chen, 1999). There is only one record from Singapore by Fernando & Leong (1964) who present also some data on the life history of this species. Not recorded from W. Malaysia.

Diagnosis. - Length 5.0-5.5, width of head 1.7 mm. Pronotum with six unbroken transverse lines distinctly narrower than the intervening spaces. Hemielytra with strongly broken vermiculate transverse lines. This species can be distinguished from all other *Sigara* subgenus *Tropocorixa* by the cleft and lobe ventrally in the left paramere (Fig. 33).

KEY TO MALES OF SIGARA POSSIBLY OCCURRING IN WEST MALAYSIA AND SINGAPORE.

- 1. Pala comparatively short and high (Fig. 30); left paramere without a cleft in its ventral margin (Fig. 32) *S. paivai*
- Pala elongate (Fig. 31); left paramere with a thin lobe ventrally separated from the main body of the paramere by a cleft (Fig. 33) *S. distorta*

***Sigara (Tropocorixa) distorta* (Distant, 1910)**

Corixa affinis Distant, not Leach; Bueno, 1927.
Corixa distorta - Hutchinson, 1940; Jaczewski, 1962.

Distribution. - A widespread species from Pakistan, Nepal and India through Vietnam to SW China. It has been reported by Bueno (1927) from Sumatra, this record needs confirmation.

***Sigara (Tropocorixa) paivai* Lundblad, 1928**

Sigara paivai Lundblad, 1928 (new name for *Corixa dubia* Paiva); Jansson, 1995.
Sigara connexa Lundblad, 1933; Jaczewski, 1962; Fernando & Leong, 1964; Fernando & Cheng, 1974.

Diagnosis. - Length 4.5-5.0, width of head 1.6-1.8 mm (Fig. 35). Pronotum with five to six transverse lines equally broad to slightly narrower than the intervening

dark spaces. Hemielytra with vermiculate transverse lines broken one or two times each. This species can be distinguished by its small size in combination with the comparatively short and high male pala (Fig. 30) and the right paramere which has a broad rounded lump in the middle of the shaft, other species have a spur near the apex of the shaft. Jansson (1995) confirmed the long suspected synonymy of *S. connexa* and *S. paivai*.

Distribution. - A widespread species, from India through SE Asia to Sumatra, Java and Korea. It has been recorded from Johor, Melaka and Negri Sembilan (Fernando & Cheng, 1974), not yet recorded from Singapore.

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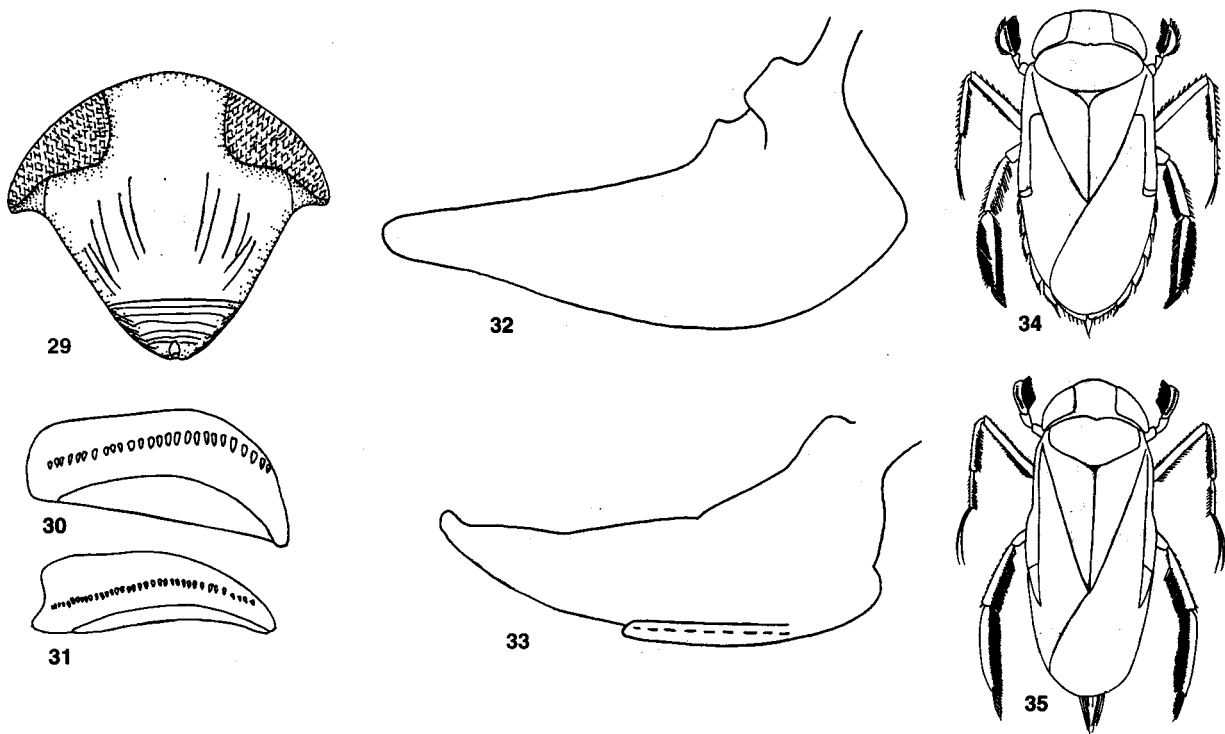


Fig. 29. Head of *Sigara paivai*, frontal view. 30-31. Outline and stridulatory pegs of pale pala. 30 *Sigara paivai*; 31 *S. distorta*. 32-33. Left paramere. 32 *Sigara paivai*; 33 *S. distorta*. 34. *Agraptacorixa hyalinipennis*, habitus. 35. *Sigara paivai*, habitus. Fig. 31 and 33 adapted from Hutchinson, 1940; Fig. 32 adapted from Lundblad, 1933.

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