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GUIDE TO AQUATIC HETEROPTERA OF SINGAPORE AND PENINSULAR MALAYSIA
III. PLEIDAE AND NOTONECTIDAE

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***ABSTRACT.* –** This is the third guide to the aquatic Heteroptera of Singapore and West Malaysia, dealing with the families Pleidae and Notonectidae. Pleidae are represented by one genus comprising two widespread species. Notonectidae with four genera, including 11 species, are well represented. *Anisops kempi* is synonymized with *A. breddini*. *Anisops kuroiwae* and *A. nigrolineatus* are recorded for the first time from the Malay Peninsula. Keys to genera and species occurring in Singapore and West Malaysia, outline drawings of representatives of each genus and figures of structural details essential for identification are presented. For each species short diagnoses and distributional notes are given.

***KEY WORDS.* –** Notonectidae, Pleidae, Malay Peninsula, synonymy, new records, keys.

INTRODUCTION

The Pleidae and Notonectidae like the Helotrephidae swim with their belly up, hence their vernacular names "back-swimmers" for Notonectidae and "pygmy back-swimmers" for Pleidae. They belong to the infraorder Nepomorpha ("true aquatic bugs"), characterized by having the antennae shorter than the head and well developed eyes. In these two families the antennae are, in dorsal view, entirely concealed under the head. For identification to family see Cheng et al. (2001).

The Pleidae is a small cosmopolitan family (about 40 described species worldwide) of small yellowish to brownish insects of uniform structure. Their habitat requirements seem also to be quite uniform: they live nearly always in dense vegetation and are among the few Nepomorpha which often occur in waters covered by duckweed and similar floating plants. When scooped up in a net with vegetation, they tend not to move and are consequently often overlooked. The best way to collect them is to put a portion of the material scooped up in a large, white or lightly coloured, tray with some water and wait. After some time various kinds of small animals, among them Pleidae and Helotrephidae, will start to swim around and can then be picked up. The best is to have a very small net or tea strainer available for this latter purpose.

The Notonectidae is one of the larger Nepomorphan families with about 370 described species, well represented in both temperate and tropical areas of the World. They are much more variable in structure and habit than the Pleidae and will be discussed in some detail below. Unlike the Pleidae, the adults of most species avoid dense vegetation, so they can be collected with a normal pond net. Most species tend to hop around vigorously when caught in a net, and are then much more conspicuous than Pleidae.

The keys to species apply only to those actually recorded from Singapore and West Malaysia. Malayan in this paper refers to West Malaysia and Singapore (Fernando & Cheng, 1974). Malay Peninsula stands for West Malaysia and Singapore together. For clear differentiation West Malaysia is used in the text instead of Peninsular Malaysia. Comparative notes are added only if there are two or more similar Malayan species.

Most of the distributional data used in this study are based on specimens collected over the years by various members of the National University of Singapore (NUS) and deposited in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research there. Additional data from literature have been added. New record after the species name refers to new records for the entire Malay Peninsula. Synonymy is abbreviated, references to *Anisops* prior to 1951 can be found in Brooks (1951), and references to *Enithares* prior to 1968 in Lansbury (1968). All measurements are in mm.

TERMINOLOGY USED

(see also the introductions to *Anisops* and *Enithares*).

Aedeagus see genital capsule.

Cephalic projection (= cephalic horn) in some male *Anisops* the part of the interocular space extending in front of the eyes (Fig. 2).

Clavus proximal, inner, part of a hemielytron when folded over the back of the insect, laterally of the scutellum (Figs. 1, 36).

Claw see tarsus.
Colour the colour in the diagnoses is described in dorsal view.
Corium the middle part of a hemielytron (Fig. 36).
Coxa basal segment of a leg (Fig. 7).
Coxal plate (ventral metepisternal lobe) lateral lobe ventrally on metasternum at base of connexiva and covering the base of posterior coxa (Fig. 5).
Distal indicating the part of an extremity (leg, rostrum) removed from its attachment to the body, see proximal.
Femur the third leg segment (Fig. 7).
Fovea a large pit. **Foveate** pitted, in some genera of Notonectidae (*Aphelonecta*, *Enithares*, *Nychia*) the anterolateral angle of the pronotum has a fovea (Figs. 11, 29).
Frons the interocular space in frontal view plus the part between rostrum and lower edges of the eyes.
Genital capsule the male genitalia consisting of abdominal segment IX (pygophore) which is dorsally mostly open with its tergite usually forming a bridge. Segment X or proctiger lies as a lid on part of segment IX. Inside lies the aedeagus or phallus and attached to it laterally are the parameres (Fig. 31).
Hemielytra (also spelled hemelytra) the, somewhat hardened, anterior wings in rest covering most of the body dorsally behind the pronotum. Singular: hemielytron.
Hemielytral commissure the median seam between the hemielytra when these are folded over the back of the insect.
Holoptic means that the eyes touch each other. In a few species (*Nychia*, *Anisops breddini*) of Notonectidae this condition is found posteriorly on the head in dorsal view (Figs. 11, 25).
Humeral width of pronotum the maximal width of pronotum (measured over the "shoulders" or **humeri** near the posterior border).
Interocular space is the portion of the head capsule between the eyes.

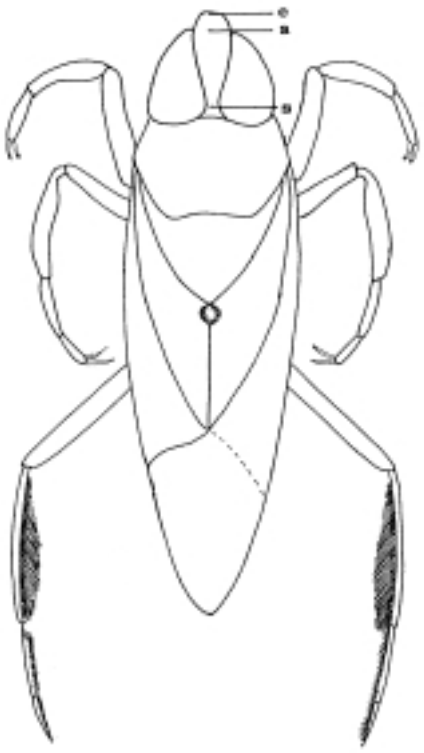


Fig. 2. *Anisops kuroiwae*, dorsal view of male, length 6.4 mm. a = anterior width of vertex; c = cephalic projection; s = synthlipsis

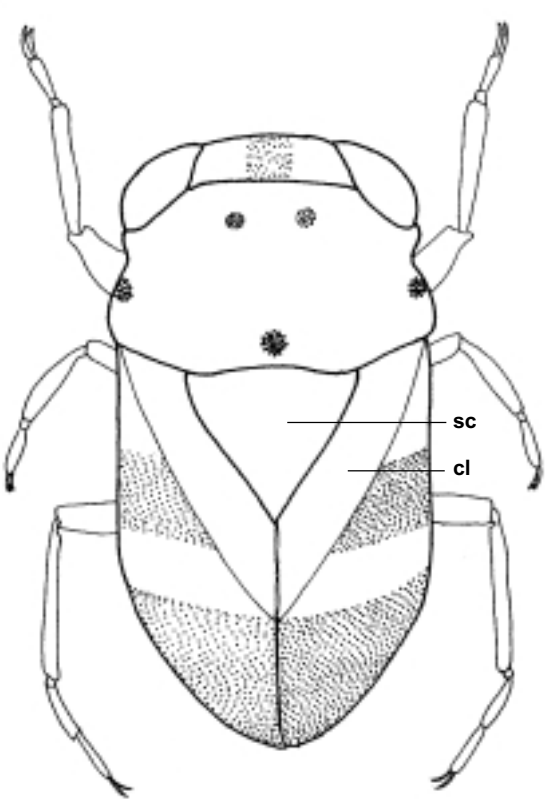


Fig. 1. *Paraplea liturata* length 1.5 mm (simplified from Chen et al., in prep.). cl = clavus; sc = scutellum.

Figs. 3-4. Base of foretibia of male Anisopinae. 3 *Anisops*, 4 *Walambiopsis*; p = stridulatory ridge.

Length without specification refers to body length, measured in dorsal view from anterior margin of vertex to posterior tip of the hemielytra with longitudinal and transverse axes horizontally.

Membranal suture the bordering line between corium and membrane.

Membrane the distal part of a hemielytron (Figs. 2, 36).

Metasternal xiphus median, more or less arrowhead-shaped projection just anteriorly of the hind legs on the metasternum (Fig. 34).

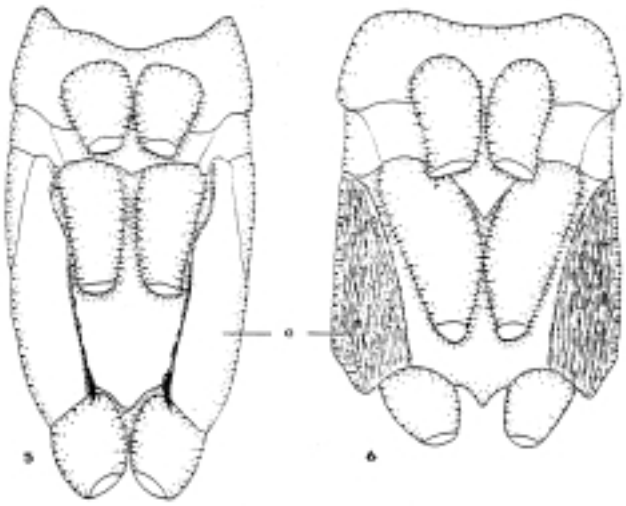
Parameres lateral hooks attached to the pygophore, see genital capsule.

Pronotum dorsal part of the first thoracic segment, in dorsal view directly behind the head.

Proximal indicating the part of an extremity close to its attachment to the body, see distal.

Pygophore see genital capsule.

Rostral prongs a pair of lateral strap-like outgrows of the third rostral segment in male *Anisops* (Fig. 12).



Figs. 5-6. Ventral view of thorax, legs distally of coxae removed. 5 *Anisops*, 6 *Paranisops*; c= coxal plate.

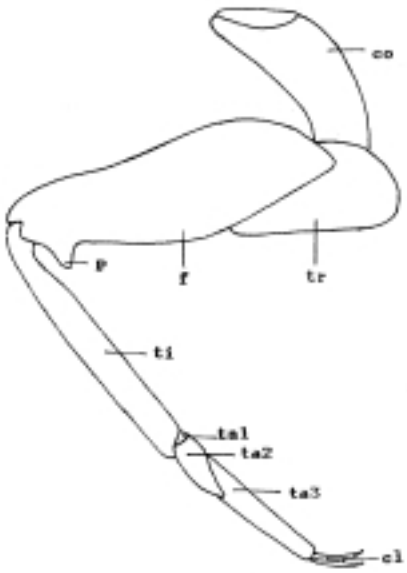


Fig. 7. Middle leg of male *Enithares ciliata*. cl = tarsal claws; co = coxa; f = femur; p = anteapical pointed protuberance of femur; ta1, ta2, ta3 = first, second and third tarsal segment; ti = tibia; tr = trochanter.

Scutellum triangular structure seen in dorsal view medially behind the pronotum (Figs. 1, 2).

Stridulatory comb a ridge with teeth near the base of the fore tibia of male *Anisops* (Fig. 9).

Stridulatory ridge the expanded portion of the inner basal surface of the foretibia of male *Anisops* on which the stridulatory comb is placed (Fig. 3).

Synthlipsis the narrowest distance between the eyes just in front of the pronotum (Fig. 2).

Tarsus the part of the leg apically of the tibia, consists in the families under consideration of 1-3 segments and bears apically a pair of small hooks, the **claws** (Fig. 7).

Tibia the forth leg segment (Fig. 7).

Trochanter leg segment between coxa and femur (Fig. 7).

Tylus the area of the frons just above the rostrum (Figs. 12, 18).

Vertex the part of interocular space visible in dorsal view.

Width without specification refers to the maximum width of the insect body with closed wings in dorsal view, excluding the legs.

TAXONOMY

FAMILY PLEIDAE

***Remarks.* –** Pleidae are small, yellowish to light brownish, stoutly build insects; body length of Malaysian species up to 2.5 mm. All species in tropical Asia belong to the genus *Paraplea* Esaki & China, 1928, of which two widespread species have been recorded in Singapore and West Malaysia. Little is known of the biology of Pleidae although it is generally assumed that they are carnivorous preying on any small animals they can overcome. Benzie (1989) gives descriptions of the five larval instars and adults of both sexes of *Paraplea frontalis*. He also points out that characteristics used for identification of SE Asian *Paraplea* species are variable within the population he studied.

KEY TO MALAYAN SPECIES OF *PARAPLEA*

1. Small species, length 1.3-1.7, pronotum characteristically with five small round black dots, one at each humeral angle, a median one near posterior margin, and a pair more anteriorly near the median line. An additional ill defined pair medially of the humeral spots may be present. Hemielytra typically with brown transverse bands in the middle and posteriorly which, however, may be absent in pale specimens, head pattern typically with a median brown stripe only (Fig. 1) ..... *P. liturata*

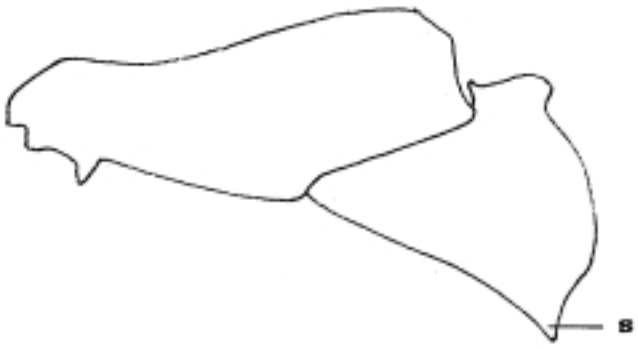


Fig. 8. *Enithares malayensis* middle femur and trochanter. s = spur at inner ventral margin of trochanter.

– Larger species, length 2.0-2.4, pronotum lacking the characteristic well defined dots at humeral angles and posterior margin, hemielytra without distinct transverse band and head pattern usually with one or two pairs small spots dorsally in addition to the median stripe ..... *P. frontalis*

Paraplea frontalis (Fieber, 1844)

Ploa frontalis Fieber, 1844.
Plea frontalis - Benzie, 1989 (redescription).
Plea quinquemaculata Lundblad, 1933; Fernando & Cheng, 1974 (new synonymy).

***Diagnosis.* –** The length (2.0-2.4), combined with the head pattern consisting of two pairs of dots dorsally of the median stripe characterize this species in specimens with typical coloration. However, the head pattern may be vague or, except for the median stripe, absent.

***Remarks.* –** I consider *P. quinquemaculata* as a form of *P. frontalis* with maximally developed frontal pattern since the male genitalia and the ventral carina fall within the variability of *P. frontalis* as described by Benzie (1989).

***Distribution.* –** India and Sri Lanka through SE Asia to Taiwan and the Moluccas. According to Fernando & Cheng (1974) this species has only been collected in Singapore. I have seen specimens from Sumatra (Nieser & Chen, 1999) and Thailand (unpublished) so it will doubtlessly occur in West Malaysia.

Paraplea liturata (Fieber, 1844)

Ploa liturata Fieber, 1844.
Plea liturata - Lundblad, 1933 (redescription); Fernando & Cheng, 1974.

***Diagnosis.* –** The small size (length 1.3-1.7 mm) combined with the typical small black dots on the pronotum (Fig. 1) make this species easily recognizable.

***Distribution.* –** India and SE Asia, through Java and Sulawesi to New Caledonia. In West Malaysia recorded from Johor, Melaka, Selangor, Perak and Penang (Fernando & Cheng, 1974).

FAMILY NOTONECTIDAE

***Remarks.* –** Notonectidae or backswimmers is a cosmopolitan family with about 370 species, of which 17 occur in the Malay Peninsula. There are two subfamilies which have different ways of life, to be discussed below. In the Old World the dominant genus of the subfamily Anisopinae is *Anisops* which has 11 species recorded from the area under consideration. A second genus of Anisopinae, *Paranisops*, recently discovered in Thailand (Nieser & Zettel, 2001; Chen et al., 2002) might occur also in the Malay Peninsula. The dominant genus of Notonectinae in tropical Asia is *Enithares* of which four species have been recorded from the Malay Peninsula. Two other genera: *Aphelonecta* and *Nychia*, each with one species, are represented in this area.

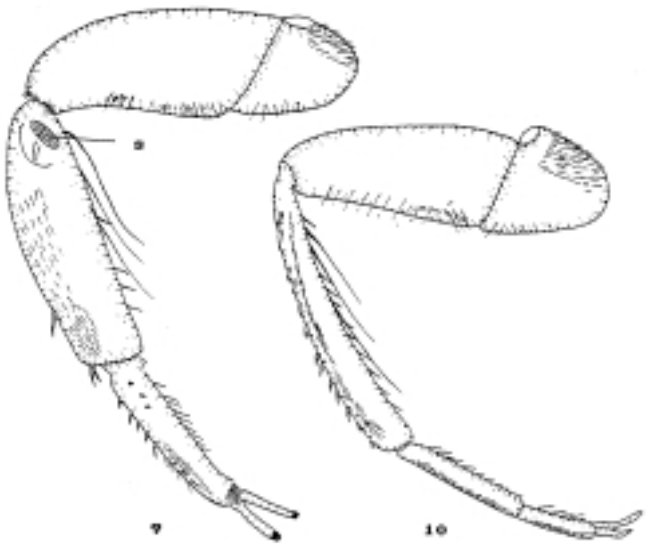
Most Malayan species of backswimmers are known only in the macropterous form. Only a few species are predominantly brachypterous, but even in those a considerable proportion of the population is able to fly and thereby colonize different kinds of stagnant waters including small pools and puddles and artificial ponds. However, especially in the tropics, some species are more restricted in their habitat choice e.g. most *Enithares* species and some *Anisops* are found nearly always in stagnant waters associated with streams or rivers. Fernando & Leong (1976) present locality records for the Malay Peninsula and some notes on habitats.

Notonectidae are strong predators, many species of Notonectinae show strong preference for mosquito larvae and pupae (Papácek, 2000, 2001). Anisopinae are less frequently reported to attack mosquitoes, perhaps because they usually hunt deeper in the water where they are less likely to encounter mosquito larvae. Several fish prey on backswimmers e.g. *Gambusia affinis* (Baird & Gerard) (Miura et al., 1979, 1984) which is sometimes used to control mosquito populations in rice-fields. Notonectidae are relatively scarce or absent from ponds with fish unless there is sufficient marginal vegetation to provide cover (personal observation). Older instars often prey on younger instars of their own species among vegetation, whereas adults tend to stay in the more open water. On the other hand backswimmers can reach considerable densities in cultured fish ponds, preying on the fry, as reported for at least two Malayan species: *Anisops bouvieri* (Gorai & Chaudhuri, 1962) and *A. breddini* (Leong, 1962).

KEY TO SUBFAMILIES AND GENERA OF NOTONECTIDAE OCCURRING IN INDOAUSTRALIA

1. Hemielytral commissure with a definite hair-lined pit at anterior end (Fig. 25) **Anisopinae** 2
– Hemielytral commissure without a definite hair-lined pit at anterior end **Notonectinae** 4
2. Coxal plates of hind legs bare (Fig. 5). Male front tibia proximally with a row of stridulatory pegs usually on a stridulatory ridge (Fig. 3) 3
– Coxal plates of hind legs covered with long black hairs (Fig. 6). Males without stridular teeth or pegs on front tibiae. [Australia and Thailand] ..... *Paranisops*
3. Antennae three-segmented. Male rostrum with a prominent lateral prong (Fig. 12), stridular teeth or pegs packed closely together proximally on a stridulatory ridge on foretibia (Fig. 3) [Palaeo-tropical and -subtropical] ..... *Anisops*
– Antennae two-segmented. Male rostrum without a lateral prong, stridular pegs clearly separate proximally on foretibia and not on a stridulatory ridge (Fig. 4) [Australian] ..... *Walambianisops*
4. Anterolateral margins of prothorax foveate (Fig. 11) 5
– Anterolateral margins of prothorax not foveate [Cosmopolitan, predominantly temperate and subtropical zones, not recorded from the Malay Peninsula] ..... *Notonecta*
5. Mid femur with a pointed protuberance near tip (Fig. 7) [Tropicopolitan] ..... *Enithares*
– Mid femur without a pointed protuberance 6

6. Eyes posteriorly holoptic, forming an ocular commissure (Fig. 11) [Palaeotropical] ..... *Nychia*
– Eyes basally widely spaced (Fig. 28) [SE Asia] ..... *Aphelonecta*



Figs. 9-10. Fore leg of *Anisops kuroiwae*. 9 male, 10 female; s= stridulatory comb.

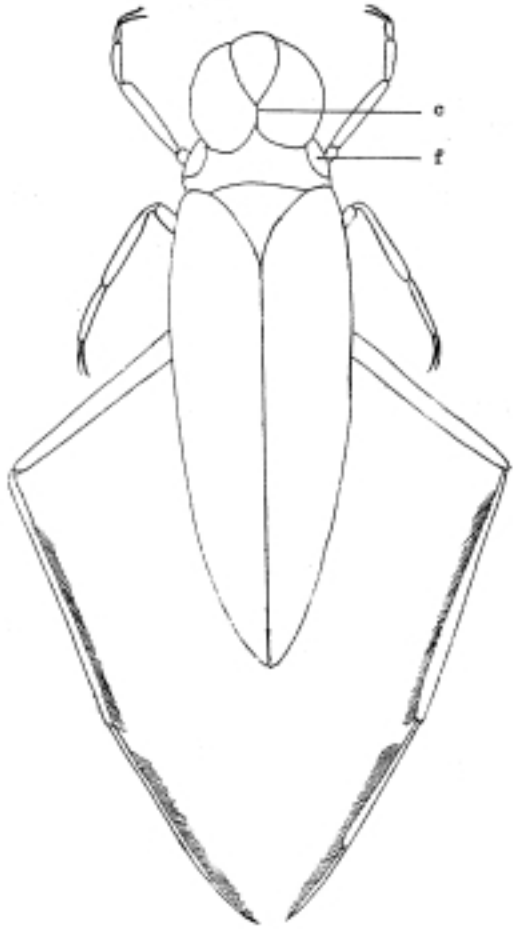


Fig. 11. *Nychia sappho*, brachypterous male in dorsal view, body length 3.7 mm. c = ocular commissure; f = pronotal fovea.

SUBFAMILY ANISOPINAE

***Remarks.* –** The Anisopinae Hutchinson are represented in the Malay Peninsula by the genus *Anisops*. The genus *Paranisops* Hale which until recently was considered to be an Australian endemism, has been found in Thailand (Nieser & Zettel, 2001; Chen et al., 2002) but so far not elsewhere in SE Asia.

Anisops Spinola, 1837

***Remarks.* –** This genus has been revised by Brooks (1951) who provides a key to species for males. Since then many species have been added including one described from Melaka (Leong, 1963). In addition the distributional areas of many species are much greater than was suggested by Brooks.

There are 11 species actually known from the Malay Peninsula. They are remarkable for having haemoglobin cells anteriorly in their abdomen (Bare, 1928). In these haemoglobin cells they store the reserve oxygen during a dive (Miller, 1964). The amount of air they take with them under water on the outside of the body can be regulated and so that they can obtain neutral buoyancy which makes them belong to the few really planktonic insects. They usually live in ponds or pools, including virtually stagnant parts of streams, with few or no fish. However, some fish ponds may occasionally be infested with *Anisops* and other Notonectidae, preying on the fry. Some species which live in farmponds are widely distributed, e.g. *A. bouvieri*, *A. breddini* and *A. kuroiwae*.

Definite identification is usually possible only for males, which have several distinguishing secondary sexual characteristics. The front tarsi are one-segmented in males but two-segmented in females (Figs. 9, 10). In Malayan species, the most important identification characteristics are to be found on the head of the male, notably the length and place of origin of the **rostral prongs** is diagnostic (Figs. 12-17). The **tylus**, may be swollen or posses a median groove (Fig. 18) and the shape of the **cephalic projection** (Fig. 2), is diagnostic of several Malayan species. Other important identification characters include the fore leg of the male, notably the **stridulatory comb** (Fig. 9). The number and shape of the teeth in the stridulatory comb are very important for specific identification in some species. The apex of the comb is towards the posterior (i. e. the concave, flexor) margin of the tibia. In addition the shape of the forefemur, especially wether its apex is narrow or broad, and the general shape of the tibia; the number and position of spines on the tibia and the presence or absence of small spines on the tarsus are important characters. Other characters used in keys are various ratios. Important is the ratio between the **synthlipsis** and the **anterior width of the vertex**, which is the width between the eyes anteriorly in dorsal view (Fig. 2). Except for tylus which was introduced by Truxal (1953) most of the above terminology was introduced or redefined by Brooks (1951). The colour of *Anisops* is, apart from a few exceptions, rather uniform and tends to fade in specimens killed or stored in alcohol. So it is usually ignored in the treatment of the genus below.

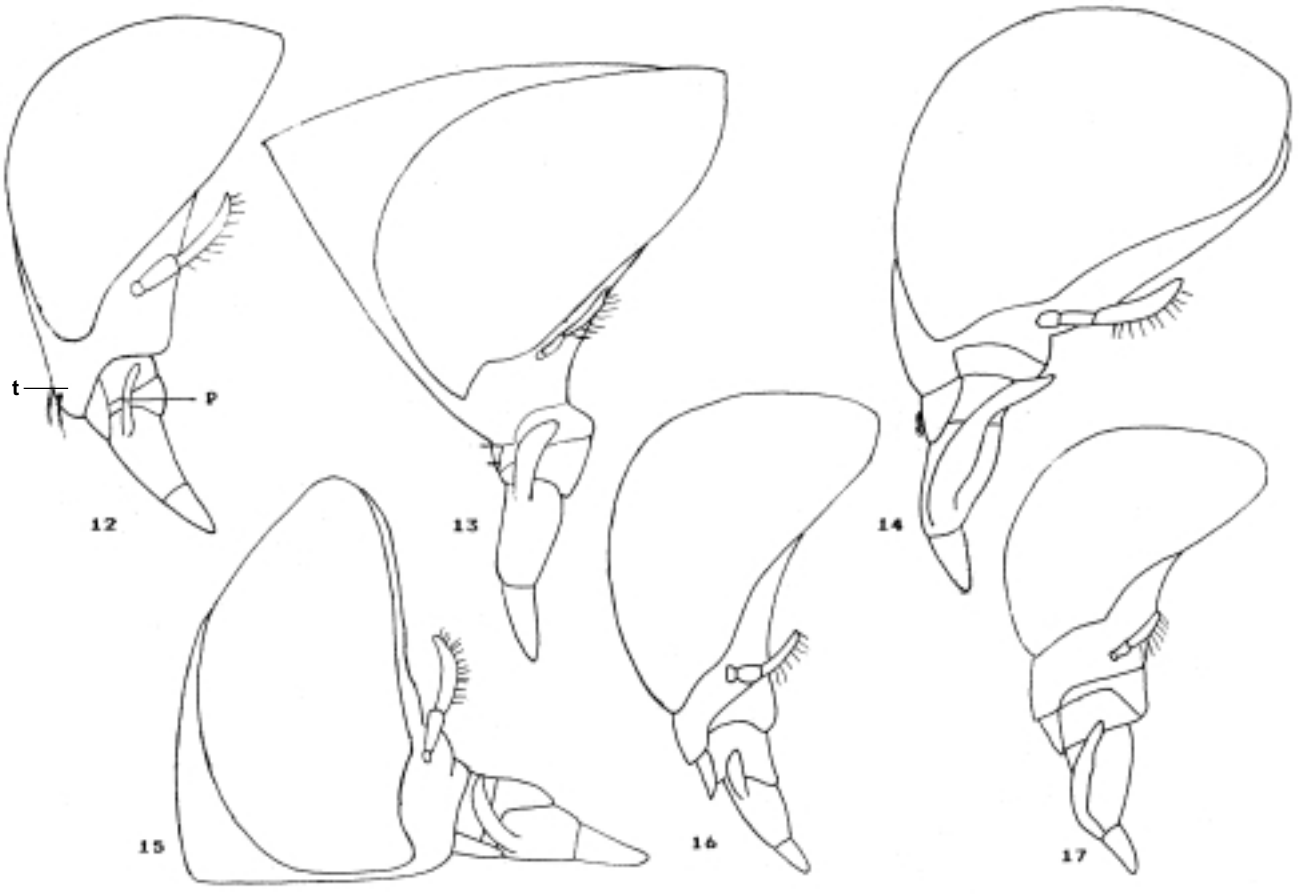
KEY TO MALES OF *ANISOPS* SPECIES IN WEST MALAYSIA AND SINGAPORE

1. Interocular space anteriorly produced into a cephalic projection (Figs. 2, 13, 15) 2
– Interocular space anteriorly not produced into a cephalic projection 4
2. Cephalic projection in dorsal view rounded at apex, in lateral view extending in front of eye less than half the total length of the frons (Fig. 15) 3
– Cephalic projection in dorsal view more or less acuminate at apex, in lateral view extending in front of eye half or more the total length of the frons (Fig. 13) ..... *A. bouvieri*
3. In frontal view, frons diverging ventrally and with a lateral carina over its entire length (Fig. 19) ..... *A.kuroiwae*
– In frontal view frons narrowest halfway between the eyes, with a weak carina in its dorsal part only (Fig. 20) ..... *A. nasutus*
4. In dorsal view eyes holoptic in posterior half (Figs. 25, 26) ..... *A. breddini*
– In dorsal view eyes not holoptic 5
5. Tylus medially excavate (Fig. 18) ..... *A. niveus*
– Tylus flat or somewhat swollen, not medially excavate 6
6. Rostral prong shorter than third rostral segment (Fig. 16), originating in its proximal third 7
– Rostral prong longer than third rostral segment, originating in its distal third (Fig. 17); length up to 5.6 mm .... *A. lansburyi*
7. Synthlipsis one fifth or less the anterior width of vertex, length up to 4.8 mm ..... *A. exiguus*
– Synthlipsis about one third or more the anterior width of vertex, length over 5.0 mm 8
8. Length over 6.6 mm 9
– Length up to 6.5 mm 10
9. Length 8.5 mm or more; tylus swollen, with a pair of tufts of bristles which reach the base of the labrum (Fig. 12) ..... *A. barbatus*
– Length up to 8.3 mm; tylus flat or slightly swollen, without tufts of bristles ..... *A. occipitalis*
10. Along the median longitudinal axis the head is less than one half the length of the pronotum; tylus and frons not carinate, in lateral view frons extending in front of the eyes; stridulatory comb on foretibia with about 22 teeth 14 apical ones distinctly longer than the 8 basal ones which are differently orientated (Fig. 22) ..... *A.nigrolineatus*
– Along median longitudinal axis the head is more than one half the length of the pronotum; tylus and adjacent part of the frons carinate, in lateral view dorsal half of frons not extending in front of eyes (Fig. 14); stridulatory comb of about 25 to 32 teeth which decrease in width from base to apex (Fig. 23) ..... *A. tahitiensis*

Anisops barbatus Brooks, 1951

Anisops barbata Brooks, 1951; Lansbury, 1964; Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** The largest species occurring in the Malay Peninsula, although some of the largest females of *A. occipitalis* overlap in size with small females of *A. barbatus*. Length, male 8.5-9.3, female 8.0-9.1; greatest width, male



Figs. 12-17. *Anisops* male, head in lateral view. 12 *A. barbatus*; 13 *A. bouvieri*; 14 *A.tahitiensis*; 15 *A.kuroiwae*; 16 *A. exiguus*; 17 *A. lansburyi*. p = rostral prong; t = tylus.

2.7-3.0, female 2.8-3.1. Synthlipsis at least two thirds the anterior width of vertex; width of head 0.8-0.9 times the humeral width of pronotum.
Male. In dorsal view, anterior margin of head truncate; width of head seven to eight times the anterior width of vertex; rostral prong slightly shorter than third rostral segment, originating in the proximal third of third rostral segment (Fig. 12). Tylus somewhat swollen, with a pair of tufts of bristles which reach the base of the labrum (Fig. 12). Forefemur narrowed at apex; stridulatory comb on foretibia consisting of 20-25 comparatively broad teeth.
Female. Width of head five to six times the anterior width of vertex. Tylus slightly swollen, without tufts of hairs.
Brachypterous form not known.

Distribution. **–** A widespread species recorded from India through SE Asia to Sumatra, Java and China (Brooks, 1951; Lansbury, 1964). It has not been collected recently in the Malay Peninsula but Lansbury (1964), Fernando & Cheng (1974) and Fernando & Leong (1976) report specimens from Perak and Singapore in the British Museum of Natural History.

Anisops bouvieri Kirkaldy, 1904

Anisops bouvieri Kirkaldy, 1904; Brooks, 1951 (redescription); Fernando & Cheng, 1974; Fernando & Leong 1976.

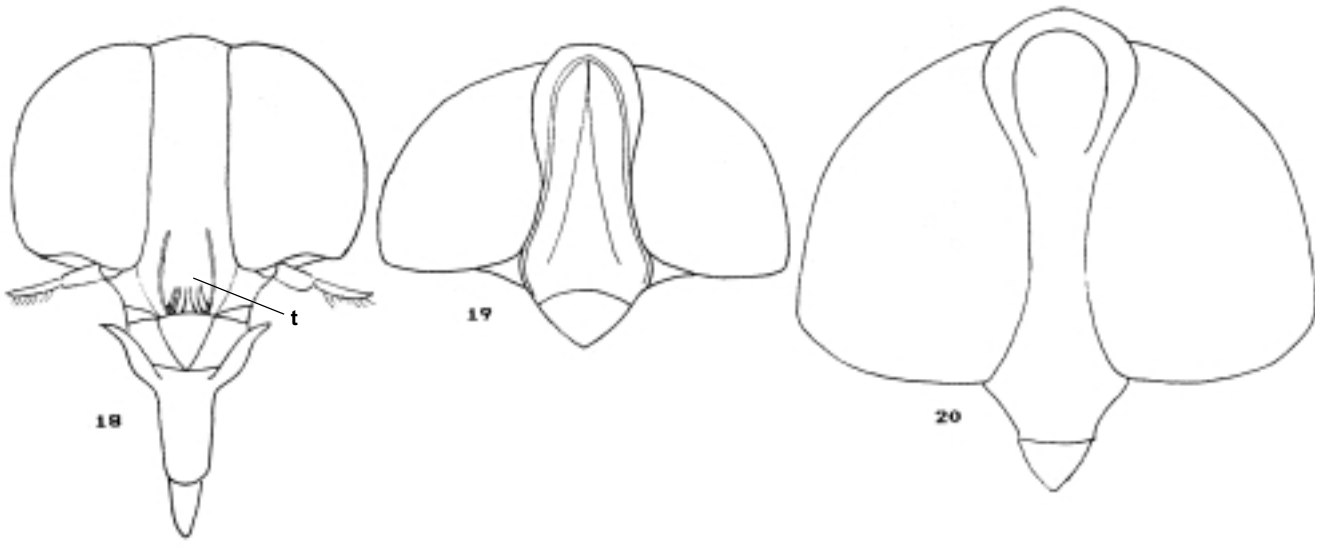
Diagnosis. **–** Males are distinguished by the long cephalic projection (Fig. 13). Length, male 6.0-6.3, female 5.7-6.0; greatest width, male 1.5-1.8, female 1.7-1.8. Width of head about 0.9 times the humeral width of pronotum.
Male. In dorsal view the head has a rather long cephalic projection with an acute apex; in lateral view extending about half the total length of the frons anteriorly of eyes (Fig. 13). Synthlipsis narrow, 0.20-0.25 times the anterior width of vertex. Tylus medially deeply excavated, the lateral rims also grooved, these grooves running upward to the apex of the cephalic projection. Labrum with three narrow tufts of hairs, one at each basal angle and one at the apex; rostral prong slightly shorter than third rostral segment, originating in the proximal third of third rostral segment (Fig. 13). Forefemur narrowed at apex. Stridulatory comb on foretibia with about 12 teeth, which become shorter towards apex; distally of the stridulatory comb four to five normal (not clavate) bristles.
Female. In dorsal view the head is rounded anteriorly with the vertex very slightly produced. Tylus somewhat swollen. Labrum with some short hairs, not united into tufts as in the male. Synthlipsis wide, about half the anterior width of the vertex. Females are very similar to those of *A. kuroiwae* which occasionally have been found in the same locality.
Brachypterous form not known.

Distribution. **–** A widespread species recorded from India through SE Asia to China and in New Guinea. Fernando & Cheng (1974) and Fernando & Leong (1976) recorded it from Melaka, Johor and Singapore. I have seen one more sample each from Johor and Singapore in ZRC.

Anisops breddini Kirkaldy, 1901

Anisops breddini Kirkaldy, 1901; Fernando & Cheng, 1974; Fernando & Leong, 1976.
Anisops breddeni - Brooks, 1951 (misspelling, redescription).
Anisops kempi Brooks, 1951 (new synonymy).

Diagnosis. **–** This species is distinguished by the posteriorly holoptic eyes (Figs. 25, 26). Moreover, it is the only Malayan species which is predominantly brachypterous.
Brachypterous form. Length, male 5.7-6.6, female 5.4-6.8; greatest width, male 1.2-1.6, female 1.2-1.7.
In dorsal view lateral margins of eyes only slightly convex giving the head a somewhat conical appearance; eyes holoptic posteriorly (Fig. 25). Vertex projecting slightly beyond the anterior margins of eyes. Width of head about equal to width of pronotum and five to six times the anterior width of vertex. Tylus smoothly convex. Lateral margins of pronotum parallel (Fig. 25). Scutellum with its basal width 1.2 times its median



Figs. 18-20. *Anisops* male, head in frontal view; 19-20 rostrum removed. 18 *A. niveus*; 19 *A. kuroiwae*; 20 *A. nasutus*. t = tylus.

length (W/L 1.0/0.8) and 0.6-0.7 times the posterior width of the pronotum. Hemielytra with reduced membranes. Hind wings reduced to club-shaped elongate straps.
Male. Rostral prong slightly longer than third rostral segment originating in proximal third of third rostral segment, second rostral segment with a distal outgrowth posteriorly, which reaches the tip of the rostrum. Forefemur strongly swollen. Stridulatory comb on foretibia consisting of a few irregular teeth.
Female. Second rostral segment with a short distal outgrowth posteriorly which does not reach halfway the third rostral segment.
Macropterous form. Length, male 5.7-6.6, female 5.4-6.7; greatest width, male 1.3-1.6, female 1.4-1.7.
In dorsal view the lateral margins of the eyes are somewhat more convex than in the brachypterous form, giving the head a slightly rounded appearance (Fig. 26). Vertex not or hardly projecting beyond anterior margins of eyes. Lateral margins of pronotum slightly diverging posteriorly; humeral width of pronotum somewhat larger than width of head (Fig. 26). Basal width of scutellum 1.2 times its median length (W/L 1.3/1.1) and about 0.9 times the humeral width of pronotum. Hemielytra with fully developed membranes. Hind wings fully developed. Other structural characteristics, including secondary sexual characteristics of male and female, as in brachypterous form.

***Remarks.* –** Brooks (1951) described *A. kempi* from India and Thailand. Some of his paratypes were taken at light. In his comparative notes he remarks that *A. kempi* "... appears very similar to *A. breddeni* Kirkaldy. However, the pronotal lateral margins of *A. kempi* diverge whereas in *A. breddeni* they are almost parallel. Also the head of the latter is more or less conical with the vertex extending beyond the anterior margins of the eyes, while in *A. kempi* the outline of the head is rounded. Also the latter species has a much larger scutellum which has a basal with one and one third its median length, whereas in *A. breddeni* the scutellum is small with its basal width only slightly more than its median length." These are precisely the characteristics in which the macropterous form differs from the brachypterous form, so *A. kempi* is to be considered the macropterous form of *A. breddini* and is herewith synonymized.

***Distribution.* –** A widespread species recorded from India and Sri Lanka through Indochina to Java and Sulawesi (Nieser & Chen, 1991). In the Malay Peninsula this is the commonest species occurring in ponds in wild and agricultural areas. Fernando & Cheng (1974) and Fernando & Leong (1976) recorded it from Kedah, Melaka, Johor and Singapore. In the ZRC there are additional samples from Melaka, Johor, Singapore, Negeri Sembilan, Pahang, Perak and Selangor.

Anisops exiguus Horváth, 1919

Anisops exigua Horváth, 1919.
Anisops exigera - Brooks, 1951 (misspelling, redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** Generally a small, sordid white, shiny species. Greatest width at pronotal humeri. Lateral margins of abdomen with hemielytra, anteriorly parallel, posteriorly converging.
Length, male 4.3-4.8, female 4.3-5.2; width, male and female 1.2-1.4.
In dorsal view the head is anteriorly truncate with vertex slightly indented. Width of head 0.8-0.9 times the humeral width of pronotum and about six times anterior width of vertex. Synthlipsis very narrow, one fifth to one eighth the anterior width of vertex. Labrum without specialized bristles.
Male. Tylus slightly swollen with a smooth surface. Rostral prong slightly shorter than third rostral segment, originating in its proximal third (Fig. 16). Forefemur apically narrowed. Stridulatory comb on foretibia with 9-11 teeth which are longest in the middle.
Female. Tylus flat.
Brachypterous form unknown.

***Remarks.* –** *Anisops exiguus* is very similar to *A. lansburyi*. Males can be recognized by the rostral prong, which is short in *A. exiguus* and long in *A. lansburyi* (Figs. 16, 17). In addition the stridulary comb on the foretibia although similar in the number and structure of its teeth, lacks the one or two small teeth present apically in *A. lansburyi* (Fig. 21). Females of *A. exiguus* are comparatively broader than those of *A. lansburyi* but these species are difficult to distinguish in the female sex. (See also under *A. niveus*).

***Distribution.* –** A widespread species, recorded from Papua New Guinea, Malaysia, Vietnam and India (Brooks, 1951; Lansbury 1964). Fernando & Cheng (1974) and Fernando & Leong (1976) recorded it from Kedah and Johor. In ZRC there are samples from Melaka, Selangor, Johor and Bukit Timah Nature Reserve, (13 Dec.1996, coll. T. Wong, H. K. Lua et al.), first record for Singapore. The species is apparently widespread in the Malay Peninsula but has been collected infrequently, and with only a few specimens in each sample.

Anisops kuroiwae Matsumura, 1915 (new record)

Anisops kuroiwae Matsumura, 1915.
Anisops batillifrons - Lundblad, 1933; Brooks 1951 (redescription).
Anisops kuroiwai - Miyamoto, 1964 (synonymy, unjustified emendation of name).

***Diagnosis.* –** Males are easily recognized by the structure of the cephalic projection and the frons. Generally a medium-sized, fusiform species with its maximal width just in front of its middle. Length male, 5.6-6.4, female 5.4-6.3; width, male 1.5-1.6, female 1.3-1.8. Head width 0.8-0.9 times the humeral width of pronotum and four to five times the anterior width of vertex. Labrum in both sexes without specialized hairs or bristles.
Male. Cephalic projection in dorsal view with a rounded apex; in lateral view extending less than half the total length of the frons anteriorly of eyes (Fig. 15). In frontal view, tylus and frons are excavate with two carinae on each side of which the inner ones meet in the anterior sixth of the frons (Fig.

19). Synthlipsis about one-fourth or less the anterior width of vertex. Rostral prong subequal to slightly longer than third rostral segment, originating in its proximal third (Fig. 15). Forefemur apically narrowed. Stridulatory comb on foretibia with about 13 teeth, of which the basal six are much longer than the apical seven.
Female. In dorsal view the head is rounded anteriorly. The syntlipsis is slightly less than one third the anterior width of vertex. Tylus flat, not swollen. Females are virtually indistinguishable from those of *A. bouvieri*, with which this species has sometimes been found together. (See also under *A. nasutus*).
Brachypterous form unknown.

***Distribution.* –** A widespread species from India through SE Asia to southern China, Iriomote (off Japan) and the Philippines. In the ZRC there is a sample from Melaka, Batu Berendam (fishponds, 3 Oct.1960, 23 males 36 females). Not recorded from Singapore.

Anisops lansburyi Leong, 1963

Anisops lansburyi Leong, 1963; Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** Generally a pale, small, broadly fusiform species with its maximum width at the level of the apex of scutellum. Length, male 4.5-5.6, female 4.6-5.9; width, male 1.1-1.4, female 1.1-1.5. Width of head 0.93 times to almost equal to the humeral width of pronotum and about six times the anterior width of vertex.
Male. In dorsal view the head is rounded with anterior margin truncate and vertex very slightly indented. Synthlipsis narrow, one tenth to one seventh the anterior width of vertex. Rostral prong longer than third rostral segment, originating near its apex (Fig. 17). Tylus somewhat swollen, smoothly convex. Tylus and labrum with a few short scattered hairs. Forefemur narrowed at apex. Tibial comb with eight to nine rather large teeth of subequal length and one or two very small teeth at its apex (Fig. 21).
Female. Except for the sexual characteristics females of this species are very similar to males. They are on average slightly larger and the synthlipsis is slightly wider than in males: one seventh to one fourth the anterior width of vertex.
Brachypterous form unknown.

***Remarks.* –** See under *A. exiguus* and *A. niveus*.

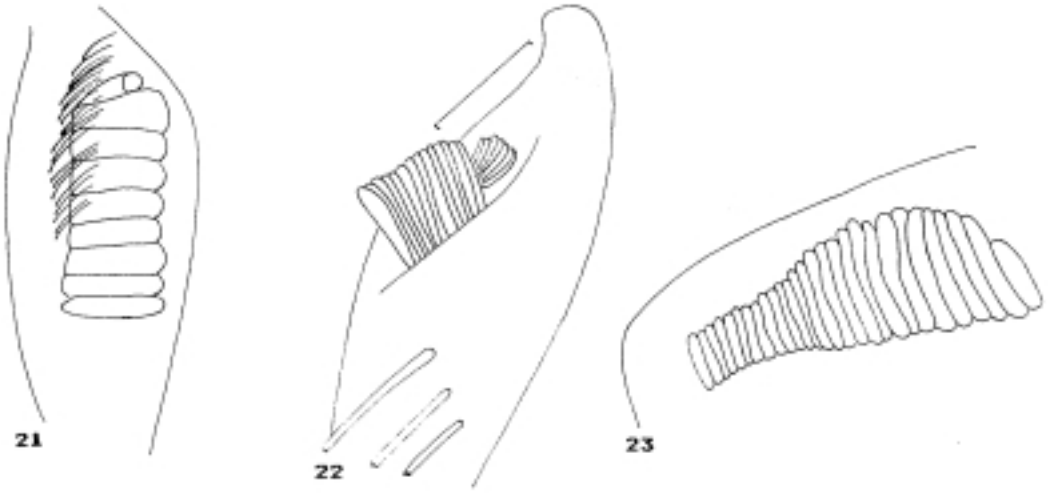
***Distribution.* –** Described from the Malay Peninsula (Melaka and Singapore, Leong 1963; Fernando & Cheng, 1974; Fernando & Leong, 1976). I have seen only one additional male from Singapore (ZRC.6.9393-9396) in ZRC.

Anisops nasutus Fieber, 1851

Anisops nasuta Fieber, 1851; Brooks, 1951 (redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** Stramineous to greyish, slender, anteriorly nearly parallel-sided, posteriorly converging, widest just in front of the apex of scutellum.
Length, male 6.0-7.8, female 6.0-7.0; width, male 1.3-1.8, female 1.4-1.9.
Male. In dorsal view the head has a cephalic projection with a broadly indented apex, in lateral view less than half the total length of the frons anteriorly of eyes. In frontal view the tylus has a wide median depression appearing almost flat; the frons is narrowed in the middle and has dorsally a median oval depression bordered by a carina (Fig. 20). Synthlipsis about one quarter the anterior width of vertex. Rostral prong slightly shorter than third rostral segment, originating near its proximal margin. Forefemur apically narrowed. Stridulatory comb on foretibia with about 14 teeth which are longest in the middle.
Female. In dorsal view the head is rounded anteriorly; the synthlipsis is one quarter to one third the anterior width of vertex. Tylus flat.
Brachypterous form unknown.

***Remarks.* –** Males are easily recognized by the structure of



Figs. 21-23. *Anisops*, male, stridular comb. 21 *A. lansburyi*; 22 *A. nigrolineatus*; 23 *A. tahitiensis*.

the cephalic projection and the frons. Females are very similar to those of *A. bouvieri* and *A kuroiwae* although they are usually larger (length of females of *A. nasutus* 6.0-7.0, of *A. bouvieri* and *A. kuroiwae* 5.4-6.3).

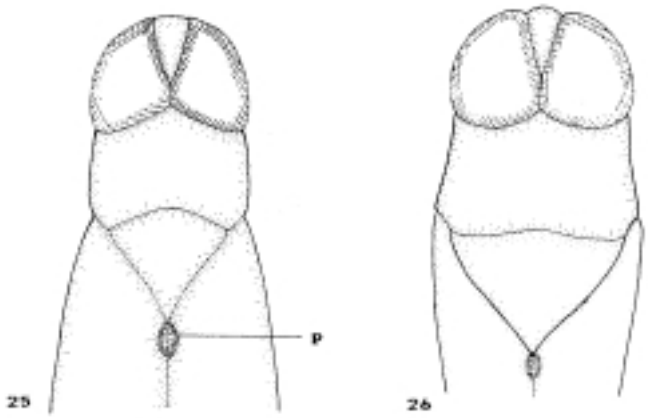
Distribution. **–** Widespread from India through West Malaysia to southern China, and through Indonesia to Australia and Pacific islands (Nieser & Chen, 1991). Fernando & Cheng (1974) and Fernando & Leong (1976) recorded it from Melaka and Singapore. I have not seen additional Malayan specimens.

Anisops nigrolineatus Lundblad, new record

Anisops nigrolineata Lundblad, 1933; Brooks 1951 (redescription).

Diagnosis. **–** Macropterous form blackish, rather slender, fusiform, greatest width at level of apex of scutellum.

Fig. 24. *Anisops tahitiensis* male, fore leg.



Figs. 25-26. *Anisops breddini*, male, anterior part of body in dorsal view. 25 brachypterous form; 26 macropterous form. p = ciliated pit at base of hemielytral commissure.

Length, male and female 5.4-6.6; width, male and female 1.5-1.8. Colour generally black. Width of head four to five times the anterior width of vertex. Tylus flat, somewhat laterally expanded. Synthlipsis wide, about one half anterior width of vertex. Labrum without specialized hairs. Pronotum relatively long, its humeral width about 1.5 times its median length which is twice the median length of head.

Male. The vertex protrudes in front of the eyes, both in dorsal (Fig. 27) and lateral view. Rostral prong longer than third rostral segment originating near its base. Forefemur strongly narrowed apically. Tibial comb with about 22 teeth of which the apical 14 are slender and long, more than twice the length of the basal eight which are oriented in a different direction (Fig. 22).

Female. Vertex not protruding anteriorly of eyes. Tylus slightly swollen.

Brachypterous form, Brooks (1951) recorded a pale form. This may be either the brachypterous form or specimens which have been for a long time in alcohol. So far no brachypters have been examined by the author.

Remarks. **–** Males characterized by the stridulatory comb (Fig. 22). Females similar to those of *A. tahitiensis* which have, however, head and pronotum of subequal length.

Distribution. **–** Widespread, described from Java and recorded from The Philippines, Thailand, Burma and India where it seems to have its main distribution (Brooks, 1951). In the ZRC are three samples with this species: Two from Selangor [Ulu Gombak, Sungai Gombak, 14 Nov.1995, coll. C. M. Yang et al. 3 males 2 females and Ulu Gombak, upland pond nr. Sendlo ridge, 16 Nov.1995, coll. Yang et al. 4 males 2 females] and one from Pahang [Kuala Lipis, pool by mud brook, 12 Apr.1997, coll. K. L. Yeo, 1 female]. Not recorded from Singapore.

Anisops niveus (Fabricius, 1775)

Notonecta nivea Fabricius, 1775.
Anisops nivea - Brooks, 1951 (redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976.

Diagnosis. **–** Pale to dark, spindle shaped, greatest width about halfway the body.

Length, male 4.8-5.1, female 4.8-5.4; width, male 1.2-1.4, female 1.3-1.8. Head width 0.9 times the humeral width of pronotum and four to five times the anterior width of vertex.

Male. In dorsal view the head is anteriorly truncate with the vertex very slightly indented. Synthlipsis about one third the anterior width of vertex. In frontal view tylus and frons are excavate with two lateral carinae on each side. The median groove runs up to halfway between the eyes where the outer carinae meet in an acuminate apex (Fig. 18). Rostral prong shorter than third rostral segment, originating near its proximal margin. Labrum with rather long hairs at base, the lateral ones forming two tufts which curve upwards along the carinae of the tylus excavation; the middle hairs often united into a small tuft which points downward over the apex of labrum. Forefemur apically somewhat narrowed. Foretibia stout, stridulatory comb with about 13 teeth of equal length.

Female. In dorsal view the head is nearly truncate anteriorly with the vertex slightly extending in front of eyes; the syntlipsis is over one third to nearly half the anterior width of vertex. Tylus flat, not swollen.
Brachypterous form not known.

***Remarks.* –** Males clearly recognized by the structure of the frons. Females are of about the same length as *A. lansburyi* and only slightly larger than *A. exiguus* females. Both of these species have a relatively narrower body and a distinctly narrower synthlipsis.

***Distribution.* –** India through SE Asia to Sumatra (Brooks, 1951). Fernando & Cheng (1974) and Fernando & Leong (1976) recorded it from Singapore and Johor. In addition there are specimens in three samples from Melaka in the ZRC.

Anisops occipitalis Breddin, 1905

Anisops occipitalis Breddin, 1905; Brooks, 1951; (redescription); Lansbury, 1965; Fernando & Cheng, 1974.

***Diagnosis.* –** Macropterous, pale yellowish to grey, somewhat fusiform, greatest width at the level of apex of scutellum. Length, male 6.6-8.1, female 6.6-8.3; width, male 1.6-2.2 female 1.6-2.4. Width of head 0.8-0.9 times the humeral width of pronotum and 5-6.5 times the anterior width of vertex.
Male. In dorsal view, head anteriorly truncate to slightly rounded, vertex level with anterior margin of eyes. Synthlipsis wide, 0.4-0.5 times the anterior width of vertex. Rostral prong longer than third rostral segment, originating near its distal margin. Tylus slightly swollen, labrum covered with short hairs. Forefemur broadly rounded apically, dorsal margin with a wide shallow indentation in apical third. Tibial comb with about 20-25 teeth decreasing in width from base to apex.
Female. In dorsal view, head anteriorly truncate, vertex level with anterior margin of the eyes. Synthlipsis 0.5-0.7 times the anterior width of vertex. Tylus flat, labrum bare.
Brachypterous form, not recorded from Malaysia, Sumatra and Java. However, Lansbury (1965) suggested that *A. leucotheca* Esaki, occurring from the Solomon Isles to Samoa, may represent the brachypterous form of this species.

***Remarks.* –** Usually recognizable by its length, intermediate between *A. barbatus* which is larger and the other species which are smaller. [Small females of *A. barbatus* may be of the same length as large females of *A. occipitalis* but they are broader, width 2.8 or more, whereas *A. occipitalis* females have a maximum width of 2.4. Females of the smaller species have a narrower synthlipsis].

***Distribution.* –** From West Malaysia through Indonesia to Australia (Lansbury, 1965). Fernando & Cheng (1974) and Fernando & Leong (1976) recorded this species colonizing ponds from Johor. In the ZRC there is a sample from Singapore [Bukit Timah Nature Reserve, 13 Dec.1996, coll. T. Wong, H. K. Lua et al., 3 males 3 females and a single female Singapore at light May 1992], first record for Singapore. In addition specimens from Johor, Melaka, Pahang and Perak.

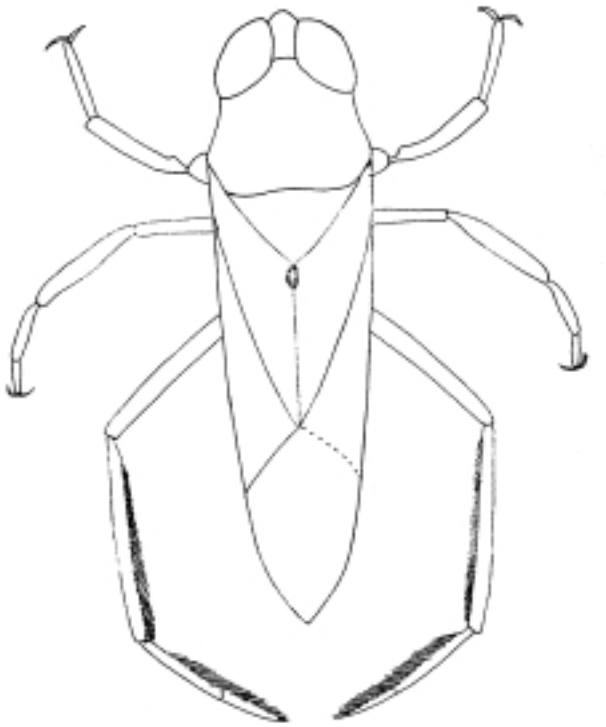


Fig. 27. *Anisops nigrolineatus*, male, habitus in dorsal view, length 6.3 mm.

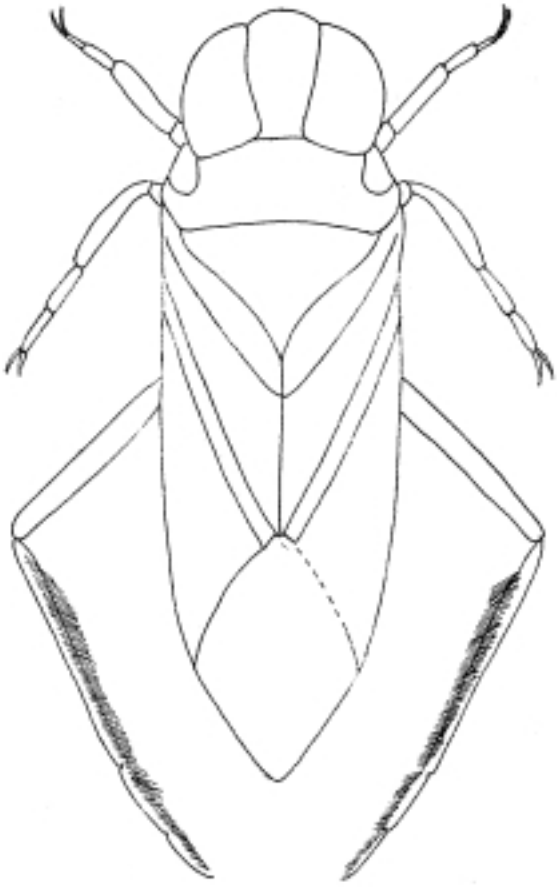


Fig. 28. *Aphelonecta gavini*, male, habitus in dorsal view, length 6.7 mm.

Anisops tahitiensis Lundblad, 1934

Anisops tahitiensis Lundblad, 1934; Brooks, 1951 (redescription); Lansbury, 1964; Fernando & Cheng, 1974; Fernando & Leong, 1976; Kovac & Yang, 1990; Yang & Kovac, 1995; Yang et al. 1999.

***Diagnosis.* –** Sordid white to yellowish somewhat spindle shaped with blackish apex of abdomen and widest in the middle of the body.

Length, male 5.1-6.0, female 5.1-6.3; width, male 1.3-1.5 female 1.3-1.6. Head width 0.9 times the humeral width of pronotum and five to seven times the anterior width of vertex.

Male. In dorsal view the head is anteriorly truncate.

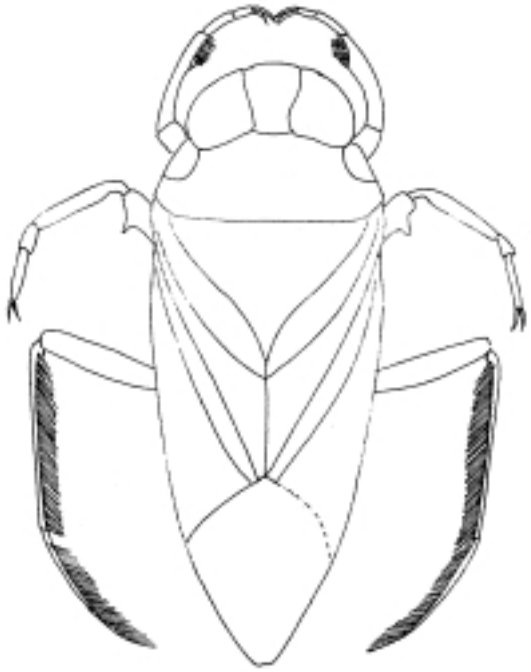


Fig. 29. *Enithares ciliata*, male, habitus in dorsal view, length 7.2 mm.

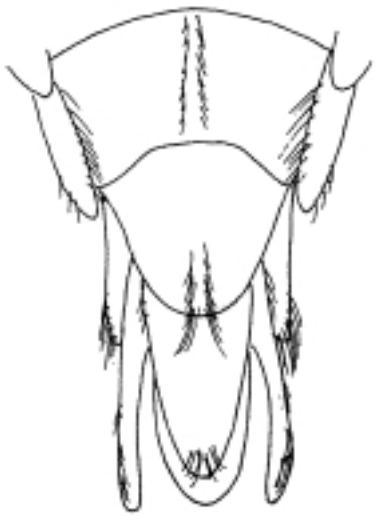


Fig. 30. Apex of abdomen of male *Enithares*, ventral view, semidiagrammatic.

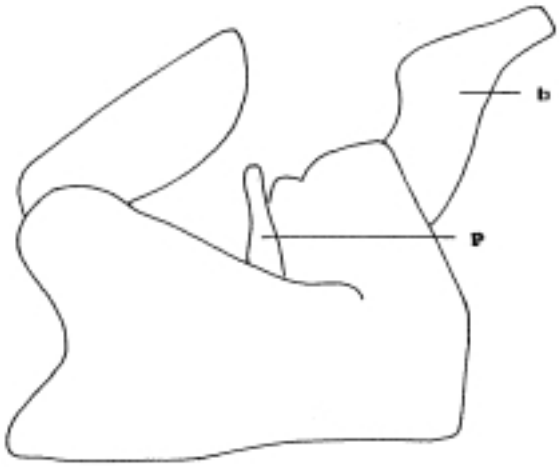


Fig. 31. Genital capsule of male *Enithares metallica*, lateral view. b = basal plate of aedeagus, p = paramere.

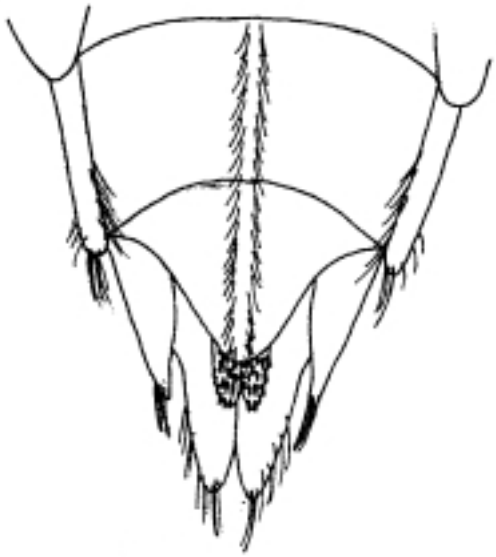


Fig. 32. Apex of abdomen of female *Enithares*, ventral view, semidiagrammatic.

Fig. 33. *Enithares* apices of female ovipositors, ventral view.

Synthlipsis about one third the anterior width of vertex. In frontal view tylus swollen and laterally compressed forming a low, rather blunt carina which runs to basal half to two thirds of the frons, anteriorly the carina usually has a narrow slit on the tylus. Rostral prong longer than third rostral segment, originating near its distal (Fig. 14). Labrum without specialized hairs. Forefemur distally somewhat broadly truncate. Stridulatory comb on foretibia with about 23-34 teeth increasing in length towards apex (Fig. 23).
Female. In dorsal view the head is nearly truncate anteriorly; syntlipsis is about 0.3-0.5 times the anterior width of vertex. Tylus slightly convex, not swollen, frons without carina. Brachypterous form not known.

"Comparative notes" has not been used in this paper, they have been included under "remarks". The part with a red line in the margin under *Anisops tahitiensis* should read:

***Remarks.* –** Similar to *A. nigrolineatus*, see under that species.

Brooks (1951) gives as body length for both sexes 5.1-5.5, although Lundblad (1934) stated that the length of a male is about 6.0 and of female 6.7. Specimens from West Malaysia had a body length of male 5.3-6.0 female 5.5-6.3 (pers. observ.). The figure of the stridulatory comb given by Lansbury (1964) gives the impression that the width of the teeth increases from base to apex. Lundblad (1934) states the opposite, confirmed by my observations (Figs. 23, 24).

As already observed by Lansbury (1964), with Brooks (1951) SE Asian males of this species tend to key out to *A. fijiensis* Brooks , because the head is less than seven times as wide as synthlipsis (5.0-6.5 times in specimens from W. Malaysia studied). However, *A. fijiensis* males have the apex of the forefemur distinctly narrowed.

***Distribution.* –** From Andaman Islands and Vietnam through Malesia to Australia, Tahiti, Guadalcanal and Okinawa (Lansbury, 1964). This species has been recorded from Johor, Pahang, Perak, Selangor and Singapore (Fernando & Cheng, 1974; Fernando & Leong, 1976; Kovac & Yang, 1990; Yang & Kovac, 1995; Yang et al. 1999). There is a also sample from Trengganu in ZRC. This species inhabits stagnant waters (lakes, ponds and pools, swamps) confirming the observation that it is not found in running water (Yang & Kovac, 1995).

SUBFAMILY NOTONECTINAE LATREILLE

***Remarks.* –** Apart from various external morphological features, Notonectinae differ from Anisopinae by the lack of haemoglobin cells. During a dive they carry a large external air store under the hemielytra and in the ventral abdominal channels closed ventrally by hair fringes. In addition there is, at least in *Notonecta*, a film of air on the outside of the hemielytra which functions as a physical gill. Unlike Anisopinae, Notonectinae cannot regulate their air store, so they tend to float upward when not actively swimming. Some species cling to objects under water to stay submerged, other species simply float against the underside of the surface film while waiting for prey (e.g. *Nychia sappho* and some species of *Enithares)*. With their large eyes they detect eventual prey beneath them. In addition they have sensory organs on their legs with which they can locate prey that has fallen in the water by the waves such struggling animals cause in the surface film.

Aphelonecta Lansbury, 1965

***Remarks.* –** A key to all six described species was provided by Zettel (1995). There is only one Malayan species:

Aphelonecta gavini Lansbury, 1966

Aphelonecta gavini Lansbury, 1966; Zettel, 1995; Kovac & Yang, 1990.

***Diagnosis.* –** Length male 6.2-6.9 female 6.3-6.9; width male & female 2.1-2.3. Colour in dorsal view, eyes reddish brown, often flecked with black; vertex yellow often tinged with reddish brown; anterior half of pronotum and most of scutellum pale yellowish. Posterior half of pronotum translucent, appearing black due to the underlying black basal part of scutellum. Hind wings black, shining through the translucent hemielytra. Legs yellowish to light brown. In dorsal view, vertex slightly protruding in front of eyes, greatest width of head about three times the anterior width of vertex. Anterior width of vertex twice the synthlipsis. Dorsal margin of pronotal fovea directed straight caudad before turning laterad. Nodal furrow straight, directed dorsad, less than its own length removed from membranal suture.

***Remarks.* –** About the same size as and somewhat similar to *Enithares mandalayensis*, but darker. The lack of a subapical tooth of the middle femur distinguishes this genus from *Enithares*.

***Distribution.* –** Continental SE Asia. Recorded from Pahang by Kovac & Yang (1990). A common species in the Malay Peninsula, in ZRC represented in many samples from Johor, Terengganu and one from Singapore (ZRC.6.9392 3A, 30 Oct.1968, 1 female), new record for Singapore. Mainly found in virtually stagnant parts of streams.

Enithares Spinola, 1837

***Remarks.* -** The genus *Enithares* has been revised for Asian and Australian species by Lansbury (1968) who provides keys to males and females. Since then several other species have been described but these are nearly all restricted to Insular Asia (Liu & Zheng, 1991; Nieser & Chen, 1991, 1996; Nieser & Zettel, 1999; Zettel, 2003).

Four species are actually known from the Malay Peninsula. Most live in virtually stagnant bays of streams or ponds associated with streams. An exception is *E. mandalayensis* which can be found in ponds and marshes away from streams. In smaller pools there may be only one or two adult

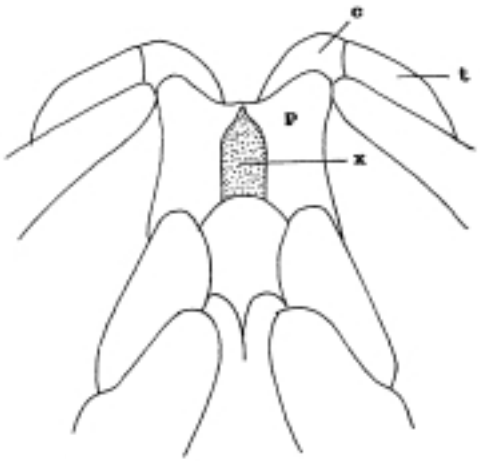


Fig. 34. *Enithares* metasternum, semidiagrammatical ventral view, caudad upwards. c = hind coxa, p = coxal plate, t = hind trochanter, x = metasternal xiphus (dotted).

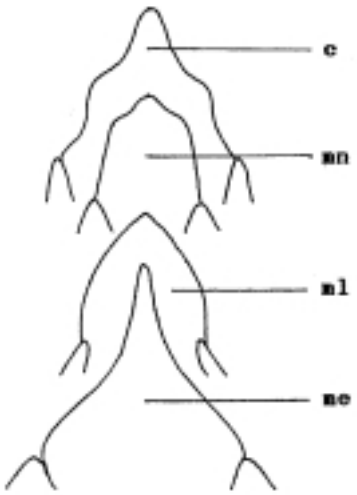


Fig. 35. *Enithares* species, metasternal xiphus. c = *E. ciliata*, mn = *E. mandalayensis*, ml = *E. malayensis*, me = *E. metallica*.

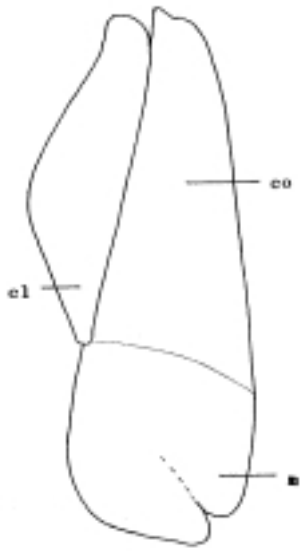


Fig. 36. *Enithares* right hemielytron, semidiagrammatic. cl = clavus, co = corium, m = membrane.

specimens. Like many Notonectinae they usually float against the underside of the surface film when resting or awaiting prey. Most species are easily disturbed and then hide under water. Most species have a dark coloured and a pale form.

Both males and females can be identified although males show more characteristics their identification is consequently more reliable. Males and females can be distinguished by differences in the caudal abdominal sternites but unfortunately the characteristic sternite VIII, which in the males is more elongate, is usually hidden inside the apex of abdomen. The easiest way to separate males and females is to lift the caudal sternites of the abdomen in fresh or relaxed specimens to reveal the male genital capsule (Figs. 30, 31) or the paired short and blunt ovipositors (first gonapophyses) which are strongly sclerotized and beset with stout spines (Figs. 32, 33). Dry specimens can be relaxed in the vapour of acetic acid, see introduction. Males of many species have modified tibiae and tarsi on fore- and or middlelegs (Fig. 38). The shape of the **metasternal xiphus** is the most important non sexual character used for identification (Figs. 34, 35). Some males have various leg segments modified (Figs. 8, 37, 38). The **genital capsule** or **pygophore** (Fig. 31) also provides specific characteristics. In *Enithares* it is laterally cleft, the symmetrical **parameres** lie at the base of the cleft (Fig. 31). Behind the cleft lies the **posterior lobe**, which is dorsally open and encloses the aedeagus. The **basal plate** (Fig. 31) aids in specific identification in some species. In order to expose the aedeagus the capsule can be softened by soaking the capsule for a few hours in 10% potassium hydroxide

Fig. 37. *Enithares mandalayensis* male, tarsus of middle leg. Thickened and bent inner claw dotted.

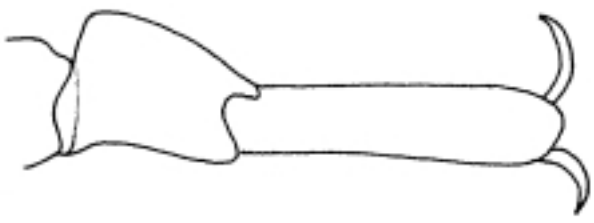


Fig. 38. *Enithares ciliata* male, tarsus of middle leg.

(KOH) at room temperature, or boil for some minutes. Females do not show specialized external characters.

KEY TO *ENITHARES* SPECIES OF WEST MALAYSIA AND SINGAPORE

1. Males 2
– Females 5
2. Mesotrochanter forming a distinct spur at inner ventral margin (Fig. 8) ..... *E. malayensis*
– Mesotrochanter rounded or bluntly angulate 3
3. Small species, length up to 7; outer claw of mid-tarsus conspicuously thickened and bent inwards (Fig. 37) ..... *E. mandalayensis*
– Larger species length 8 or more 4
4. Length 8.5-9.6, second segment of intermediate tarsus widened, about as wide as long (Fig. 38) (in lateral view the first tarsal segment is largely to entirely hidden by the tibia so the actual second segment is apparently the first, see Fig. 7) ... *E. ciliata*
– Length 10.2-12, second segment of intermediate tarsus not widened, twice as wide as long ..... *E. metallica*
5. Length 7.0-8.0; metaxiphus as fig 35mn ..... *E. mandalayensis*
– Length over 8.5 6
6. Length less than 10.0, metasternal xiphus with convex lateral margins or with small blunt subapical projections, apex blunt (Figs. 35c, 35ml) 7
– Length over 10.5, metasternal xiphus with concave lateral margins and a long acute apex (Fig. 35me) .... *E. metallica*
7. Metasternal xiphus with smoothly convex lateral margins (Fig. 35ml) ..... *E. malayensis*
– Metasternal xiphus with small blunt subapical projections and blunt apex (Fig. 35c) ..... *E. ciliata*

Enithares ciliata (Fabricius, 1798)

Notonecta ciliata Fabricius, 1798.
Enithares ciliata - Lansbury, 1968 (redescription); Fernando & Leong, 1976.

Diagnosis. – Length, male 8.5-9.6, female 9.0-9.6; width, male and female 3.0-3.6. Pale form can be entirely pale yellowish brown (Lansbury, 1968). Dark form is generally blackish in dorsal view, with dark brown eyes; vertex yellowish; anterior half to two thirds of pronotum yellowish with variable brown markings; remainder translucent with blackish underlying parts showing through. Lateral margins of scutellum in living specimens with a greenish fluorescent stripe, which becomes yellow in dead specimens; abdomen black; basal part of hemielytra and caudal lobe of membrane translucent.

Head in dorsal view rounded anteriorly, its width about 2.75 times anterior width of vertex. Anterior width of vertex more than twice the synthlipsis (vertex 2.1-2.2x synthlipsis). Dorsal margin of pronotal fovea directed straight caudad before turning laterad. Mesotrochanter rounded. Metasternal xiphus as in Fig. 35c.

Male. Foretibia on its inner side with a wide indentation halfway its length apically of this indentation the tibia is widened into a triangular projection. Second segment of middle tarsus short and wide, about a wide as long (Figs. 7, 38).

Remarks. – Males can be easily recognized by the middle tarsus and also the foretibia. Females are distinguished by the shape of the metasternal xiphus combined with their size.

Distribution. – Widespread, Mauritius, Bhutan, India, Sri Lanka, continental SE Asia, SE China and Indonesia: Sumatra (Lansbury, 1968, Polhemus et al., 1995). Also recorded from Kedah: Pulau Langkawi by Lansbury (1968). In addition specimens have been studied from Johor and Perak (ZRC), not recorded from Singapore. Apparently distributed throughout most of the Malay Peninsula but rare. Usually found still parts of streams and in ponds and pools associated with streams.

Enithares malayensis Brooks, 1948

Enithares malayensis Brooks, 1948; Lansbury, 1968 (redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976; Kovac & Yang, 1990.

Diagnosis. – Length, male and female 9.0-9.4; width, male and female 3.2-3.6.

Eyes reddish brown to grey, vertex and anterior one third of pronotum brown. Middle third of pronotum yellowish, posteriorly hyaline but appearing darker due to scutellar colour showing through. Scutellum black with a yellowish "V"-shaped area. Hemielytra and hind wings translucent, appearing black over most of dorsum of abdomen, proximal part of membrane black.

Head in dorsal view rounded anteriorly, width of head three times or more anterior width of vertex. Anterior width of vertex twice the synthlipsis. Dorsal margin of pronotal fovea directed straight caudad before turning laterad. Metasternal xiphus as in Fig. 35ml.

Male. Foretibia curved forward, concave on anterior surface and convex on posterior surface. Inner ventral angle of mesotrochanter with a spur-like projection (Fig. 8). Middle tibia weakly convex along dorsal surface and expanded distally.

Remarks. – Males are distinguished by the spur-like projection of mesotrochanter (Fig. 8). Females should be recognizable by the shape of the metasternal xiphus combined with size.

Distribution. – Recorded from the Malay Peninsula: Johor, Kedah, Pahang, Perak, Selangor, Singapore and Indonesia: Riau Archipelago (Fernando & Cheng, 1974; Lansbury, 1968; Kovac & Yang, 1990). In the ZRC there are also samples from Kelantan, Pahang and Terengganu. One male from Pulau Tioman, Ziming, 27 Jul.1996 is an addition to the checklist from this island (Yang et al., 1999). This seems to be the commonest Malayan species. Equally common in streams as in stagnant ponds.

Enithares mandalayensis Distant, 1910

Enithares mandalayensis Distant, 1910; Lansbury, 1968 (redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** Length, male 6.6-6.9, female 7.0-8.0; width, male and female 2.2-2.8. Generally pale, eyes reddish, vertex, pronotum and scutellum pale yellowish in some specimens with a dark transverse band anteriorly on pronotum. Hemielytra and hind wings translucent, dorsum of abdomen brown to grey, legs yellowish with blackish spines and bristles and sparse dark markings.
Head in dorsal view rounded anteriorly, vertex slightly protruding; width of head about 2.5-2.8 times anterior width of vertex. Anterior width of vertex 2.3-2.5 times the synthlipsis. Dorsal margin of pronotal fovea directed straight caudad before turning laterad. Mesotrochanter rounded. Metasternal xiphus as in Fig. 35mn.
Male. Fore leg, tibia distally and first tarsal segment with shallow indentations. Outer claw of middle tarsus curved and widened (Fig. 37).

***Remarks.* –** Males can be distinguished by the outer claw of middle tarsus in combination with their size. Females are distinguished by the shape of the metasternal xiphus and their smaller size. Lansbury (1968) states that the width of head in 60% of his specimens examined is less than two times the anterior width of vertex. The range of this ratio cited in the diagnosis above is based on Malayan specimens.

***Distribution.* –** Burma, Thailand, Vietnam, West Malaysia. In Malaysia it has been recorded from Johor, Melaka, Negeri Sembilan (Fernando & Cheng, 1974; Lansbury, 1968). In ZRC there are also some specimens from Singapore (Nee Soon swamp forest), new record for Singapore and samples from Kelantan, Selangor and Terengganu.

Enithares metallica Brooks, 1948

Enithares metallica Brooks, 1948; Lansbury, 1968 (redescription); Fernando & Cheng, 1974; Fernando & Leong, 1976.

***Diagnosis.* –** Length, male and female 10.2-12.0, width, male and female 3.9-5.5. Pale form (after Lansbury, 1968), vertex, pronotum and scutellum yellowish brown. Clavus and corium translucent appearing grey to black due to underlying dorsal pigmentation. Opaque zone of membrane greyish yellow, remainder of membrane smoky brown.
Dark form, eyes castaneous, remainder of head yellowish, frons and tylus each with a pair of reddish brown spots. Pronotum anteriorly pale yellow with foveae black, posteriorly translucent but appearing dark brown due to underlying pigmentation. Scutellum black with variable yellowish markings along lateral margins. Clavus, corium and membrane largely blackish with a slightly metallic sheen, basal parts of clavus and corium and apical part of membrane translucent.
Head in dorsal view rounded anteriorly, width of head about 2.5-2.8 times anterior width of vertex. Anterior width of vertex 1.7-1.9 times the synthlipsis. Dorsal margin of pronotal fovea directed obliquely caudad before turning laterad. Mesotrochanter rounded. Metasternal xiphus as in Fig. 35me.
Male. Middle leg, femur with a shallow depression covered with long hairs ventrally on inner surface. Genital capsule with lateral arms of basal plate caudally with a comparatively narrow projection (Fig. 31).

***Remarks.* –** This is the largest Malayan species distinguished by the acute tip of metaxiphus.

***Distribution.* –** Thailand, Vietnam and West Malaysia (Lansbury, 1968). Recorded from Kedah, Perak and Selangor (Fernando & Cheng, 1974; Fernando & Leong, 1976; Lansbury, 1968). In ZRC there is also a sample from Pahang. Notably from mountainous areas.

Nychia sappho Kirkaldy, 1901

Nychia marshalli var. *sappho* - Kirkaldy, 1901.
Nychia malayana - Lundblad, 1933; Fernando & Cheng, 1974; Fernando & Leong, 1976.
Nychia sappho - Lansbury 1985 (redescription, synonymy); Kovac & Yang, 1990; Yang et al., 1999.

***Diagnosis.* –** This species is distinguished by the holoptic eyes and the foveate pronotum (Fig. 11).
Brachypterous form. Length, male 3.6-3.9, female 4.2-4.8; width, male 1.0-1.3, female 1.2-1.4.
Eyes reddish, pronotum and scutellum whitish, middle of scutellum somewhat translucent. Hemielytra largely translucent, whitish back of abdomen shining through. Hemielytra along costal margin with a broad pruinose band variably infuscated, base of hemielytra also pruinose, in females extending caudally to a white to brownish pruinose band running about one third the length of hemielytron about midway between costal and inner margins; some females with two variable brown spots across hemielytral commissure.
Vertex somewhat protruding in front of eyes; eyes holoptic posteriorly. Width of pronotum, male 0.9-1.0, female 1.0-1.1; pronotum laterally with a pair of foveae. Basal width of scutellum, male & female 0.4-0.7; median length 0.5-0.8. Hemielytra without claval suture, membrane reduced; hind wings absent. Male fore tarsi two-segmented, female fore tarsi one-segmented.
Macropterous form. Length, male 3.9-4.6, female 4.4-4.7; width, male 1.2-1.4, female 1.3-1.4. Colour as in brachypterous form except for hemielytra: clavus largely translucent; corium and membrane pruinose; corium with a narrow longitudinal median translucent stripe, pruinose areas light to medium brown; membrane whitish. Hind wings translucent with a vague whitish hue.
Structurally essentially as brachypterous form except for the scutellum which is much more strongly developed, basal width 0.9-1.2, median length 0.9-1.1. Hemielytra with claval suture present. Membrane and hind wings fully developed.

***Distribution.* –** Widespread, recorded from N Australia and New Guinea through Indonesia, the Philippines and continental SE Asia to Burma (Lansbury, 1985; Nieser, 1998). Recorded from Johor, Pahang, Perak and Singapore (Fernando & Cheng, 1974; Fernando & Leong, 1976; Kovac & Yang, 1990; Yang et al., 1999). In the ZRC there are also samples from Selangor and Terengganu. The commonest species in the samples of ZRC, which is partly due to the fact

that larvae are identifiable to species. Found in virtually stagnant parts of streams and in ponds not connected with streams.

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