For the time being, this paper completes our treatment of Sulawesi Nepomorpha. The set of papers Nieser & Chen (1991, 1996 and the present one) provides an identification guide to all Sulawesi Nepomorpha species. There is little doubt, however, that a number of undescribed species are still to be discovered in Sulawesi for several families of Nepomorpha.

**MATERIAL AND METHODS**

Measurements are in mm and are based on five specimens of each sex taken from the sample containing the holotype (if available). They are represented as the range of the sample with the sample mean in italics. Length and width refer to the maximum value of the specified body part oriented horizontally; if not specified they refer to body length and maximal body width. Body length is measured from anterior margin of vertex to apex of hemielytra. Extremities are measured with the ventral side upward, this is especially important in fore tibia of male *Micronecta*. The ocular index is computed as two times the synthlipsis (S) divided by the difference between width of head (D) and synthlipsis, in formula: 2S/(D-S). This measurement buffers against peaks in the ratio synthlipsis/width of eye, due to imperfect orientation of the head. Where necessary, other measurements will be discussed under the separate families.

The areas in Sulawesi used in indication of the localities are the administrative provinces. Some additional data on the localities sampled by Nieser in 1989 (with numbers N89xx) can be found in Nieser & Chen (1991). Pulau Sangir is a spice island belonging to Sulawesi Utara province. As it lies some 200 Km N. of the northern point of ‘mainland’ Sulawesi it is not on the map used in this paper (fig. 126). Remarks between braces {} after the locality data contain additional information not found on the labels.

Abbreviations: brach. = brachypterous, macr. = macropterous; lvIV, lvV = 4th and 5th instar larva respectively; L = length, W is width.

Specimens have been deposited in the following
collections registered according to Arnett, Samuelson & Nishida (1993): BMKB (Kota Baru, Brunei Darussalam); JTPC (Englewood, Co. U.S.A.); MBBJ (Bogor, Indonesia); MUDH (The Hague, The Netherlands); NHMW (Vienna, Austria); NMSC (Singapore); OXUM (Oxford, UK); RMNH (Leiden, The Netherlands); SEMC (Lawrence Ka. U.S.A.); UPPC (Laguna, Philippines); USCP (Cebu City, Philippines); ZMAN (Amsterdam, The Netherlands).

Unregistered collections: KKUC (Khon Kaen University Entomological Collection, Thailand); NCTN (N. Nieser collection, Til, The Netherlands); NPSC (Collections of National parks of Sabah, Lahad Datu); UMSK (Collections of the Universiti Malaysia Sabah Kota Kinabalu); ZC (G. Zimmermann collection, Marburg, Federal Republic of Germany); ZCWA (Personal collection of H. Zettel, Vienna, Austria).

Specimens not specified are divided between the collection of the collectors (see acknowledgements) and NCTN.

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SYSTEMATIC PART

Family Micronectidae Jaczewski, 1924

Until recently, the Micronectidae have mostly been considered a subfamily of Corixidae, although some authors have considered them in the past to constitute a separate family. This started with Douglas & Scott (1865) using the name Sigaridae. Jones (1930) was the first to propose Micronectidae as a separate family under that name. This was followed by some authors, notably Poisson 1928-1938 (e.g. Poisson 1938a), who later reduced this taxon, without explanation, again to subfamily (Poisson 1938b). After 1948 the classification presented by Hungerford (1948) was generally followed, but at present there is a tendency to give this taxon family status again. This will be substantiated by Jansson et al. (in preparation).

The width of an eye in Micronectidae is measured along the posterior margin of the head.

The family Micronectidae consists of small to very small Nepomorpha and is best represented in tropical and subtropical regions. There are at present three genera, Tenagobia Bergroth, 1899 in the New World; Micronecta Kirkaldy, 1897b and Synaptonecta Lundblad 1933 in the Old World. Of these Synaptonecta contains only a few species whereas Micronecta and Tenagobia (respectively Wróblewski 1968 and Nieser 1977) contain a considerable number of species divided over several subgenera. Many species come to light and, especially in tropical Asian Micronecta, the ecology of many species is virtually unknown as they are mainly known from light catches.

The micronectid fauna of Australia (Wróblewski 1970) is quite different from that of the Malesian Archipelago from Sulawesi westward, although some Australian species (e.g. M. virgata) reach Sulawesi. In addition there are some very widespread species (e.g. M. ludibunda, M. quadrirstrigata) which occur in both areas. The fauna of New Guinea is poorly known, but appears to be related to the Australian fauna. The micronectid fauna of the Moluccas is unknown. These practical restraints bring us to the following key to the Micronectidae from ‘West Indonesia’ covering the species of Indonesia from Sulawesi and Bali westward and including those of N. Borneo.

Key to males of Micronectidae from ‘West Indonesia’

1. Fore tibia and pala fused [S. India & Sri Lanka through Indochina to Jawa].............Synaptonecta issa (Distant, 1911).........................................................
   – Fore tibia and pala separated (Micronecta) ........ 2
2. Strigel absent ................................................... 3
   – Strigel present ............................................. 6
3. Small species, length less than 2 mm, hemielytra not distinctly striped but with irregular marks which may be indistinct, right paramere relatively broad but not widened apically (fig. 31, 40) .... 4
   – Larger species, length 2 mm or more ............... 5
4. Smaller species, length 1.1-1.3 mm, left paramere distinctly narrowing apically (fig. 33) [Jawa] M. acuta Lundblad, 1933
   – Larger species, length 1.7-1.8 mm, left paramere not narrowing apically (fig. 32) [Jawa] ..........
   ............................................. M. alexandri sp. n.
5. Length 2.0-2.1 (2.2-2.4), hemielytra dark with distinct longitudinal yellowish stripes which on corium are partly dissolved into yellow points, right paramere apically widened due to a thinner membranous triangular lobe on the convex margin of the shaft (fig. 41) [Jawa and Vietnam] M. guttatostrata Lundblad, 1933
   – Length 3 mm or more, hemielytral pattern indis-
tinct, right paramere of the common evenly curved apically tapering type, left paramere as in fig. 44 [India through Vietnam to Taiwan, W. Malaysia and Sumatera] *M. grisea* (Fieber, 1844)

6. Very small species, length about 0.8 mm, right paramere apically forked (fig. 42) [Java] .................. M. *pumilio* Lundblad, 1933

7. Hemelytra dark with purplish to black punctures [India and Sri Lanka through Indochina to Sumatera, Jawa and Bali] .................. M. *haliploides* (Horváth, 1904)

8. Hemelytral pattern with darker stripes or patches but not punctuate ............................................. 8

9. Larger, usually macropterous, species, length 2.9-3.4 mm, left paramere apically spinose or scaly ............................................. 10

10. Left paramere apically constricted (fig. 18) right paramere apically as broad as or slightly broader than middle part of shaft [Solomon Is. through N. Australia to Sulawesi] ...... M. *virgata* Hale, 1922

11. Free lobe of eighth abdominal tergite curved caudally in a sigmoid shape (fig. 5), right paramere slender, evenly curved (figs. 1, 43), length 2.2-3.1 mm .................................................. 12

12. Length 2.2-2.9, hemelytral pattern in Sulawesi specimens faintly reticulate, number of bristles on inner margin of right half of eighth abdominal tergite 20-25 mostly in one row [Iran through India and Indochina to Philippines and N. Australia] .................. M. *quadristrigata* Breddin, 1905

13. Mediocaudal margin of free lobe of eighth abdominal tergite with three indistinct projections (fig. 48), apex of left paramere curved sideward (fig. 49) [West Malaysia, Sumatera, Jawa, ? Borneo] .................. M. *decorata* Lundblad, 1933

14. Left paramere with a narrow shaft (fig. 17) ... 15

15. Left paramere dark, palar claw with a small semi-circular preapical incision but without subapical tooth (fig. 15) [Indochina, Sumatera, Jawa, Sulawesi] .................. M. *fugitans* Breddin, 1905

16. Smaller species, length 1.5-1.6 mm (♀ up to 1.7); palar claw not large or swollen (fig. 26); right paramere with a comparatively short and broad virtually straight shaft (fig. 24) [Sabah] ... .................. M. *skutalis* sp. n.

**Micronecta fugitans** Breddin (figs. 15, 17)

**Micronecta fugitans** Breddin, 1905a: 57.

**Micronecta fugitans** Breddin 1905b: 157; Lundblad 1933: 91-93 (redescription).

**Micronecta grisea** (Fieber)

(fig. 44)

Sigara *grisea* Fieber, 1844a: 14.

**Micronecta thyestes** Distant, 1911: 349.
**Micronecta thyesta**; Hutchinson 1940: 363-365 (redescription).
**Micronecta grisea**; Wróblewski 1968: 772-773, 775 (synonymy).

Material. – INDONESIA: Sumatera, Danau Toba, pond at YTP Arjuna Langakoti, 21. VII. 1994, leg. R. Thomas, 1♂ 1♀ macrop. First record for Sumatera. – C. Sumawesi, 33.7 km SE Palu, 01°08’ S 120°03’E, 800m, 19.xii.1994, lgt. Haft (4) 1♀ macr. (NHMW). males are needed to confirm the occurrence of this species in Sulawesi.


**Micronecta haliploides** (Horváth)

Sigara punctata Fieber, 1844a: 15. Preoccupied by Sigara punctata Illiger, 1807 (currently Corixa punctata).

**Micronecta haliploides** Horváth, 1904: 57.
**Micronecta haliploides**; Lundblad 1933: 104-109 (redescription).


**Micronecta ludibunda** Breddin (fig. 46)

**Micronecta ludibunda**; Breddin, 1905a: 57.
**Micronecta ludibunda**; Breddin 1905b: 157-158; Lundblad 1933: 95-96 (redescription); Wróblewski 1968: 765-767 (redescription).


Distribution. – India and Sri Lanka through SE Asia, Jawa and Sulawesi to New Guinea and Solomon Is.

**Micronecta quadririgata** Breddin (fig. 43)

**Micronecta quadririgata** Breddin, 1905a: 57.
**Micronecta quadririgata**; Breddin 1905b: 156-157; Lundblad 1933: 87-91 (redescription); Wróblewski 1972: 29-31 (redescription).


Distribution. – Widespread from Iran through S. and SE Asia to Hong Kong and Taiwan, through Indonesia to Philippines and New Guinea. Apart from always being macropterous, a contributing factor to its wide distribution (and frequent collection) is that this species thrives in village ponds and rice-fields.

Remarks. – Very similar to *M. kymatista* sp. n., see key for differences between males, Sulawesi specimens of *M. quadririgata* have a very slight tendency towards a reticulate hemelytral pattern lacking in *M. kymatista* which is also somewhat larger.

**Micronecta siva** (Kirkaldy) (fig. 45)

Sigara striata Fieber, 1844a: 292.

Sigara siva Kirkaldy, 1897a: 240.
Micronecta siva, Hutchinson 1940: 371-376 (redescription and synonymy).


Remarks. – The specimens from Musi River support the supposition of Hutchinson (1940) that ‘the shallow water of larger rivers’ might be an important habitat for this species.

Micronecta tarsalis L. C. Chen (fig. 16)

Micronecta tarsalis; Wróblewski 1972: 40 (additional description).


Remarks. – Males can be separated from M. figitans by the tarsal characteristic (see key) and the lack of pigmentation of left paramere, females of M. tarsalis are slightly smaller, length 2.0 mm, whereas females of M. figitans measure usually 2.1-2.2 mm.

Micronecta virgata Hale
(fig. 18)

Micronecta virgata Hale, 1922: 327.


Distribution. – Solomon Is., NE. Australia, Sulawesi.

Remarks. – Structural characteristics of the male and various measurements agree closely with M. virgata as interpreted by Wróblewski (1962, 1970), the only differences seem to be the metaxyphus which is relatively longer and more acute and the relative length of fore tibia and pala compared to fore femur, which are slightly less in the male of Sulawesi specimens compared to Australian ones. The relative length of the middle femur which is about 0.35 of body length in both sexes in Sulawesi specimens, whereas in Solomon Islands and Australian specimens this value is 0.41 and 0.38 respectively, so there may be a clinal variation in this ratio.

Micronecta kymatista sp. n.
(figs. 1-7)


Description

Macropterous specimens. Dimensions. Length ♂ 2.80-2.88-2.90, ♀ 2.92-3.06-3.12; width ♂ 1.25-1.30-1.32, ♀ 1.28-1.33-1.39; width of head ♂ 1.01-1.02-1.03, ♀ 1.04-1.08-1.11; synthlipsis ♂ 0.39-0.40-0.41, ♀ 0.41-0.41-0.42; width of an eye ♂ 0.30-0.33-0.35, ♀ 0.33-0.35-0.38; width of pronotum ♂ 0.98-1.00-1.01, ♀ 1.02-1.05-1.08.

Colour. Dorsally pale greyish brown, eyes darker grey, head, venter and legs yellowish with some fringes of bristles and claws of hind tarsi usually dark brown. Hemelytra with hyaline stripes at base of clavus and inner side of right corium as usual in genus; embolium yellowish. Dark pattern of hemelytra similar to other species of the M. quadristrigata-group especially M. altera Wróblewski; costal margin with two elongate dark patches, one at about basal third of corium, one halfway membrane of right hemelytron; left membrane hyaline with entire margin infuscate. Clavus with dark stripe along lateral margin and some smaller diffuse patches but pattern often indistinct; corium with four longitudinal stripes, the first (most lateral) and third long, second and fourth short, first caudally hooked.

Ratio length/width of body ♂ 2.1-2.2-2.3 ♀ 2.2-2.3-2.4. Head slightly wider than pronotum, synthlipsis distinctly wider than posterior width of an eye,
ocular index♂ 1.25-1.29-1.32♀ 1.17-1.24-1.30. Pronotum dorsally convex, about thrice as wide as long (W/L♂ 2.9-3.0♀ 2.6-2.8). Hemielytra with distinct scattered short spines. Lobes of abdominal tergite 4 with 10 bristles each. Spines laterally on abdominal segments: IV and V 2 short, 1 long; VI and VII 2 or 3 short, 1 longer; VIII 5 or 6 short, 1 long. Leg measurements summarized in table 1.

Male fore leg (fig. 4); femur with a pair of basal bristles, a central and an apical pair of small spines; tibia with an apical spine. Pala (fig. 3) with 5 long dorsal hairs, palm with about 15 bristles each in dorsal and ventral rows, claw broadly clavate, without ventral notch. Abdomen, prestrigilary flap poorly differentiated, strigil small, length 44-62µ, relatively broad, 1 comb with about 50 elongate teeth, median lobe of seventh abdominal sternite narrow with a rounded apex (fig. 6). Free lobe of left part of segment 8 as in fig. 5; plectrum on right part of segment 8 with 50-75 ribs, 28-35 marginal hairs along inner margin between plectrum and apex of right part of segment 8, anteriorly in one row posteriorly in a double to triple row. Right paramere (fig. 1) as in M. quadristrigata, in median view with the shaft more distinctly undulate, about 40 ribs on pars stridens process. Left paramere as in fig. 2.

Female fore leg with essentially the same pattern of spines and bristles as in male, the apical pair of tibial spines indicates the border between tibia and pala, the number of palar bristles in ventral row is somewhat lower, 10-12. Receptaculum seminis (fig. 7) simple, clavate.

Etymology
Kymatistas, Greek adjective meaning sinuous, referring to the sinuous free lobe and shaft of right paramere in inner view, typical for this and closely related species.

Comparative notes
(see also Wróblewski 1972)

The form of the free lobe of left part of abdominal segment VIII in males and the left paramere place this species in the M. quadristrigata-group. Size and the number of hairs on apical half of inner margin of right part of abdominal segment VIII with M. altera Wróblewski and M. quadristrigata f. minthe Distant from continental S. and SE. Asia. M. altera has the right paramere different with basal part of shaft slightly but distinctly swollen and a smaller number of plectral ribs (40-45). M. quadristrigata f. minthe of which the lectotype (Wróblewski 1972) was studied has the right paramere identical but the strigil is longer (72-85µ) with shorter teeth thus appearing distinctly more elongate and has more ribs (about 100) on the plectrum in addition in M. kymatista.

M. minthe has nearly exclusively been found in ponds in cultivated or otherwise strongly disturbed areas whereas M. kymatista has been collected mostly in less disturbed areas.

Micronecta pachynychi sp. n. 
(figs. 8-14, 19)

Type Material. – Holotype, macropterous male: INDONESIA: Sulawesi Tengah, Batui River, SW of Luuwuk, Toptop Camp, 1°09'S, 122°31'30"E, 120m, 19 Oct. 1989, lowland rainforest, at light, J. P. Duf- fels, sample Sul.19 (ZMAN). – Paratypes, same data as holotype 3♀ 5♂ all macropterous, distributed as follows: 23♂ 48♀ (including allotype) ZMAN, 1♂ 2♀ MBBJ, 8♂ 8♀ NCTN, 1♂ 1♀ NHMW, 1♂ 1♀ RMNH.

Description
Macropterous specimens. Dimensions. Length♂ 1.92-1.98-2.03♀ 2.02-2.05-2.08; width♂ 0.92-0.94-0.95♀ 0.90-0.96-1.00; width of head♂ 0.66-0.70-0.71♀ 0.70-0.77-0.71; synthlipsis♂ 0.28-0.29-0.30♀ 0.29-0.30-0.31; width of an eye♂ 0.22-0.23-0.25♀ 0.20-0.22-0.23; width of pronotum♂ 0.72-0.74-0.75♀ 0.74-0.75-0.77.

Colour. Dorsally light to medium brown, eyes grey, head, legs, posterior margin of pronotum and embolium yellowish, ventral side medium to dark brown. Pronotum shining, unmarked except for lighter posterior margin and lateral angles, hemielytra shining, with usual hyaline stripes, darker marks indistinct or absent, left membrane smoky.

Ratio length/width of body♂ 2.0-2.1-2.2♀ 2.1-2.2-2.2. Head slightly narrower than pronotum, synthlipsis distinctly wider than posterior width of an eye, ocular index♂ 1.41-1.46-1.50♀ 1.35-1.48-1.55. Pronotum dorsally convex, about two and a half times as wide as long (W/L♂ 2.2-2.5). Hemielytra smooth without scattered short spines. Lobes of abdominal tergite 4 with 12-14 bristles each. Spines laterally on abdominal segments: IV and V 2 short, 1 long; VI and VII 2 or 3 short, 2 long; VIII 5 or 6 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 13); femur with a pair of basal bristles, a central and an apical pair of small spines; tibia with an apical spine. Pala with 5 long dorsal hairs, palm with 12-14 bristles in dorsal and about 17
in ventral row, claw very broad (fig. 14). Abdomen, prestrigilar flap with inner caudal angle rather narrow (fig. 19), strigil small, 1 comb with about 50 elongate teeth, median lobe of seventh abdominal sternite rather short (fig. 10). Free lobe of left part of segment 8 clavate with about ten apical bristles (fig. 9); plectrum on right part of segment 8 with about 50 ribs (very fine and difficult to count at magnification of 400×), 8 marginal hairs in one row along inner margin between plectrum and apex of right part of seg-

Figs. 12-23. Micronecta spp., details. – 12-14, M. pachynychi paratype male: 12, right paramere; 13, fore leg; 14, tarsal claw; 15, M. fugitans, tarsal claw of male; 16 M. tarsalis, ditto; 17, M. fugitans, left paramere; 18, M. virgata, ditto; 19, M. pachynychi, paratype, prestrigilar flap. – 20-23, M. skutalis, paratypes (male, 23 female): 20, prestrigilar flap; 21, outline of median lobe of abdominal sternite 7; 22, free lobe of abdominal tergite 8; 23, receptaculum seminis. – Scales 0.1 mm.
ment 8. Right paramere (fig. 12) with an evenly curved shaft, about 25 ribs on pars stridens. Left paramere with scale-like structures apically (fig. 11).

Female fore leg with essentially the same pattern of spines and bristles as in male, the apical pair of tibia indicates the border between tibia and pala, the number of palar bristles in dorsal row is somewhat lower, 10-12. Receptaculum seminis (fig. 8) simple, semiglobular.

Etymology
Pachynychi a composite Greek noun meaning ‘thick nail’ or ‘thick claw’ referring to the palar claw of the male.

Comparative notes
The thick palar claw in combination with the scaly left paramere is characteristic. Australian species with thick claws such as *M. annae* Hale and *M. gracilis* Hale and Asian species with scaly left paramere such as *M. sedula* Horváth and *M. orientalis* Wróblewski are larger, length about 3 mm (Wróblewski 1960, 1970).

*Micronecta aleksanderi* sp. n.
(figs. 31, 32, 34-39)


Description
Macropterous specimens. Dimensions. Length ♂ 1.70-1.81-1.82, ♀ 1.77-1.80-1.83; width ♂ 0.85-0.88-0.90, ♀ 0.90-0.91-0.92; width of head ♂ 0.63-0.65-0.70, ♀ 0.67-0.68-0.68; synthlipsis ♂ 0.30-0.31-0.31, ♀ 0.32-0.33-0.33; posterior width of an eye ♂ 0.18-0.19-0.20, ♀ 0.20-0.21-0.22; width of pronotum ♂ 0.68-0.70-0.71, ♀ 0.28-0.30-0.31. Colour dorsally generally light brown, eyes blackish, venter yellow, head, posterior margin of pronotum and legs pale yellow. Hemelytra apparently light brown with vague darker markings; two dark patches on embolium, a caudally hooked longitudinal stripe laterally on corium and an apical patch in caudal angle of clavus. Hyaline patches on hemelytra as usual in genus.

Head slightly narrower than pronotum, synthlipsis distinctly wider than posterior width of an eye, ocular index ♂ 1.50-1.79-2.00, ♀ 1.83-1.87-1.89, eyes relatively small. Lateral margin of pronotum well developed, caudally divergent. Hemelytra with numerous, evenly dispersed, very small spines. Lobes of abdominal tergite 4 with 10 bristles each. Spines laterally on abdominal segments: IV 1 short (and 1 longer bristle), V 2-3 short, 1 long; VI 2 short 2 long. VII 3 short 2 long; VIII 3 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 38); femur with two spines in basal part, one dorsally in apical third and two apically; tibia with three spines ventrally in distal third; pala (fig. 39) with four long dorsal hairs, palm with 15 short bristles in dorsal and 12 longer bristles in ventral row, claw large, simple, clavate. Abdomen, prestripigral lobe as in fig. 35, strigil absent, median lobe of seventh abdominal sternite short and acute (fig. 36). Free lobe of left part of segment 8 parallel-sided with outer angle accentuated and bearing 12 apical bristles (fig. 34); plectrum on right part of segment 8 with about 20 ridges; 6 marginal hairs in one row along inner margin between plectrum and apex of right part of segment 8, restricted to caudal part of margin. Right paramere (fig. 31) rather solid, pars stridens with 15 coarse ribs. Left paramere with a broad apex and a large ventral lobe (fig. 32).

Female fore leg with essentially the same pattern of spines and bristles as in male. Receptaculum seminis (fig. 37) simple, clavate.

Etymology
Dedicated to our colleague Prof. Aleksander Wróblewski, who recognized this species as undescribed but was unfortunately not able to prepare the description.

Comparative notes
Similar to *M. acuta* Lundblad (1934a) not only for lacking a strigil in the male but also agreeing in having small eyes, similar general shape, male fore leg and right paramere. Differences are in size, length of *M. acuta* 1.1-1.3 mm and the form of left paramere which in *M. acuta* has a distinctly tapering apex (fig. 33). There may be an ecological difference too as *M. acuta* has been found among plants and *M. aleksanderi* in pools without vegetation and a coarse sand bottom.

Remarks
Three males and three females from the same sample as the holotype and one male and female from sample N8360, were being studied by Prof. Wróblewski when he had to stop working due to his illness. They have not been found when the material
was requested back and are probably still somewhere in the collection of the Zoological Institute in Poznán.

**Micronecta skutalis** sp. n. (figs. 20-26)

Type Material. – Holotype, macropterous male (RMNH), EAST MALAYSIA, Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre at junction Sg. Segama and Sg. Palum Tambun, bridge of Segama, 4°58’N 117°48’E, 750 m, edge of untouched lowland rain forest, 14. march 1987, at light, 18.20-22.30h, leg. van Tol & Huisman. – Paratypes: 23♂/H20040 39♀/H20038: same data as holotype, 16♂/H20040 15♀/H20038 including allotype ♂/H20038 (3♂/H20040 3♀/H20038 NCTN, 1♂/H20040 1♀/H20038 ZMAN); same locality, clearing near E trail, edge of untouched lowland rain forest, 21. III. 1987, at light, 18.30-22.30h, leg. van Tol & Huisman, 5♂/H20040 12♀ (1♂/H20040 NCTN). Sabah, 60 km W of Lahad Datu, Danum Valley Field Centre Sg. Palum Tambuni, 117.48E 4.58N, 150m asl., 9. IX. 1986, UV-light, 2♂/H20040 12♀, leg. J. Huisman. All macropterous, in RMNH unless otherwise indicated.

**Description**

Macropterous specimens. Dimensions. Length ♂ 1.46-1.52-1.56, ♀ 1.50-1.61-1.67; width ♂ 0.59-0.62-0.65, ♀ 0.63-0.94-0.68; width of head ♂ 0.51-0.52-0.53, ♀ 0.53-0.55-0.56; synthlipsis ♂ 0.20-0.22-0.24, ♀ 0.22-0.23-0.25; width of an eye ♂ 0.15-0.17-0.19, ♀ 0.16-0.18-0.21; width of pronotum ♂ 0.54-0.58-0.60, ♀ 0.56-0.58-0.60.

Colour. Dorsally light to medium brown, eyes grey, head, legs, posterior margin of pronotum and outer margin of embolium yellowish, ventral side medium to dark brown. Pronotum shining, unmarked except for lighter posterior margin and lateral angles, hemelytra shining, with usual hyaline stripes, darker marks indistinctly arranged in three interrupted longitudinal stripes, left membrane hyaline with outer half smoky.

Ratio length/width of body ♂ 2.3-2.4-2.6 ♀ 2.3-2.5-2.6. Head slightly narrower than pronotum, synthlipsis distinctly wider than posterior width of an eye, ocular index ♂ 1.29-1.44-1.71 ♀ 1.42-1.52-1.71. Pronotum dorsally convex, two to two and a half times as wide as long (W/L ♂ 2.1-2.7). Hemelytra with short spines which are arranged in longitudinal rows and along the membranal suture. Lobes of abdominal tergite 4 with 5-6 bristles each. Spines laterally on abdominal segments: IV 1 short 1 longer, V 2 short, 1 long; VI 2 short 1-2 longer, VII 2 short 2 long; VIII 5 short, 2 very long, hair-like. Leg measurements summarized in table 1.

Male, fore leg (fig. 26); femur in basal part with 2 and apically with 2-3 small spines; tibia with 2-3 small spines near distal margin; pala with 3 long dor-
sal hairs, palm with 15–19 bristles in dorsal and 14–17 in ventral row, claw simple, clavate. Abdomen, presterigilar lobe as in fig. 20, strigil small, 1 comb with about 60 long and narrow teeth, median lobe of seventh abdominal sternite rather short (fig. 21). Free lobe of left part of segment 8 clavate with about ten apical bristles (fig. 22); plectrum on right part of segment 8 without ribs (at least not visible at magnification of 400×), 10–14 marginal hairs in one row along inner margin between plectrum and apex of right part of segment 8. Right paramere (fig. 24) with a rather broad, nearly straight shaft, ribs on pars stridens not visible at a magnification of 400×. Left paramere with scale-like structures along one side (fig. 25).

Female fore leg with essentially the same pattern of spines and bristles as in male. Receptaculum seminis (fig. 23) simple, clavate.

**Etymology**

Skutalis, Greek noun meaning baton, referring to the rod-like appearance of the right paramere.

**Comparative notes**

The left paramere is similar to that of *M. daedala* Distant (1911), *M. hummeli* Lundblad (1934a) and *M. poci* Wróblewski (1967). Of these *M. poci* has a very aberrant apex of the right paramere (fig. 46). *M. daedala* and *M. hummeli*, which are closely related, are somewhat larger (length 1.8–2.0 mm) and have the apex of the right paramere geniculate apically.

**Family Corixidae** Leach, 1815

The Corixidae s. str. are very poorly represented in our study area, in fact in all true tropical regions. The latter with the exception of the halophilous species of the neotropical genus *Trichocorixa*. One of the reasons for this difference in distribution between Corixidae and Micronectidae may be that Corixidae, due to their larger size, are more prone to fish predation and various kinds of small water bodies in the tropics are much more often infested by fish. Negative correlation between occurrence of fish and Corixidae is well known (e.g. Bendell & McNicol 1995).

Only two genera are so far known to occur in the Malesian Region. They can be easily separated by the following key:
1. Pronotum and hemielytra unicolorous, hyaline brownish .............. Agraptacorixa Kirkaldy, 1898

– Pronotum and usually hemielytra marked with transverse alternating yellow and dark bands (which may be fragmented or vermiculate) ....

................................. Sigara Fabricius, 1775

So far only two species of Sigara found in Indonesia. Sigara (Tropocorixa) connexa Lundblad (1933) is known from Indochina, Sumatera and Jawa (Jaczewski 1962). Sigara (Tropocorixa) insulana Lundblad, 1933 has been described from mountainous areas in Jawa and Sumatera and never been recorded again.

Agraptacorixa hyalinipennis (Fabricius) (figs. 50, 51)

Sigara hyalinipennis Fabricius, 1803: 105

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Figs. 31-39. Micronecta spp., details. – 31, 32, M. aleksanderi, paratype; 31, right paramere; 32, left paramere; 33, M. acuta, left paramere (after Lundblad 1933, not on scale). – 34-39, Micronecta aleksanderi, paratype male, paratype female (37). – 34, free lobe of abdominal tergite 8; 35, prestrigilar flap; 36, outline of median lobe of abdominal sternite 7; 37, receptaculum seminis; 38, fore leg; 39, pala and palar claw. – Scales 31-32, 34-39: 0.1 mm.

1. Pronotum and hemielytra unicolorous, hyaline brownish .......... Agraptacorixa Kirkaldy, 1898

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Agraptacorixa hyalinipennis (Fabricius) (figs. 50, 51)

Sigara hyalinipennis Fabricius, 1803: 105

Material. – INDONESIA: Maluku, Bacan, Wayaua, ca. 50m asl., logged forest & camp, hand col., 05-16.viii.1985, 1♂, leg. J. Huijbregts (RMNH). First records from the Moluccas. – PHILIPPINES: Mindanao, Lake Sebu area, barangay Bakdolong, pools on banks of stream, 3.xii.1993, N9365, 1♀, leg. N. Nieser (NCTN); to be entirely sure the record has to be confirmed by male specimens from the area. First record from the Philippines.

Distribution. – India, Myanmar, Taiwan, Indonesia (Sumatera, Jawa, Maluku), Philippines (Mindanao) and Papua New Guinea.

Remarks. – In view of its distribution this species might turn up in Sulawesi. It is smaller than its Asian congeners, which measure over 8.5 mm. In the Australian fauna there are several species of approximately the same size (6.5-8 mm); these all have distinctly different right paramere and strigil (figs. 50, 51), notably A. macrops Hungerford which occurs also in New Guinea has a small strigil which is not on a stalk (Knowles 1974). So far Australian species are not known to occur West of New Guinea.

Family Ochteridae Kirkaldy, 1906

The Ochteridae form a small family with at present three genera of which Ochterus Latreille occurs worldwide in tropical and subtropical regions. The other genera contain few species and are restricted to Australia and S. America. S. America and the Australian Region are relatively rich in species, elsewhere the number of species is low (Baehr 1990b, Kormilev
However, recently Gapud (1981, 1995) and Gapud & San Valentin (1977) found several undescribed species in the Philippines, so the low number of species in some areas may be due to insufficient collecting. Sulawesi is with five species intermediate between the species-poor African-Continental Asian area and the rich Australian area.

Species of *Ochterus* are usually reported to live at the edge of water mostly on open spaces and as a rule at exposed sunny places. However, this is partly due to the fact that most reports refer to the widespread species *O. marginatus*. At least in the tropics, several species occur regularly on shaded sandy banks of streams in forests. They are agile insects which fly quickly when disturbed. As Jaczewski (1935) observed their habitat boosts the possibility that they escape the collecting activities of most hydrobiologists and also the students of terrestrial fauna.

Not only is the fauna of New Guinea and Australia richer than that of more western parts of Asia, the actual species composition is also different. Even the very widespread *O. marginatus* is not known to reach New Guinea. Due to this difference in fauna the key below refers to the species known from Indonesia excluding Irian Jaya but, for the sake of geographical continuity, including N. Borneo. The fauna of New Guinea is treated in Baehr (1990b).

**Key to West Indonesian species of *Ochterus***

1. Large species, length (♀) 5.0 – (♂) 5.5, costal margin of hemielytra narrowly yellowish without broader more or less square patches, appendages of right paramere rather broad with pointed tips (fig. 57) [Sulawesi Tenggara] .......................... ............................ *O. grandiusculus* Nieser & Chen, 1992
– Smaller species, length up to (♂) 4.8 – (♀) 5.2, eventual larger specimens with some square yellow patches along costal margin and appendages of right paramere long, apically indented (fig. 56) ................................................................. 2

2. Pronotum scutellum and basal half of hemielytra covered with long (0.10-0.15 mm) erect hairs [Sulawesi Selatan] ............... *O. trichotos* sp. n.

– Body at most with much shorter appressed hairs ............................................................................. 3

3. Dark species, colour pattern variable but nearly always hemielytra dark grey to blackish, costal margin of hemielytra narrowly yellowish with proximal part of embolium and 2-3 square patches on corium broader yellowish, posterior margin of pronotum narrowly yellowish, appendages of right paramere approximately symmetrical, slender, apically indented and usually rather long (fig. 56) [widespread] ...................... *O. marginatus* (Latreille)

– Hemielytra brown to blackish without the square yellowish patches along costal margin of corium, lighter mark on median part of posterior margin of pronotum as a rule not distinctly wider than the more lateral yellowish stripe on posterior margin .................................................. 4

4. Proximal segments 1 and 2 of rostrum dark brown to black ...................................................... 5

– Proximal segments 1 and 2 of rostrum yellowish to light brown .................................................. 6

5. Smaller species, length 4-4.5 mm, apical part of shaft of right paramere swollen (fig. 58) [Sumatera, Jawa, Bali] .......... *O. thienemanni* Jazcewski, 1935

– Larger species, length 4.2-4.8 mm, apical part of shaft of right paramere not swollen (fig. 61) [Sulawesi Tengah and S. Utara] ....... *O. homorofos* sp. n.

6. Hemielytra light to medium brown; right paramere with distinctly asymmetrical appendages of which the right one is distinctly incised apically (fig. 60) [Jawa, Sulawesi] ...... *O. noualhieri* Baehr

– Hemielytra dark brown to blackish; appendages of right paramere virtually symmetrical with slightly rounded (not incised) apices (fig. 59) [Sabah] ............... *O. xustos* Nieser & Chen, 1992

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**Ochterus marginatus** (Latreille)  
(fig. 56)  
*Ochterus marginatus* Latreille 1807: 143.  
*Ochterus marginatus marginatus* Jazcewski 1934: 602-605 (redescription & synonymy).  

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Distribution. – A very widespread species, from the Mediterranean and N. part of Africa through India, SE Asia and China to Japan, Taiwan, Philippines, Sulawesi and Jawa.

Remarks. – The first definite record for Sulawesi. However, the two female specimens identified as *O. thienemanni* by Nieser & Chen (1992) from Sulawesi Tenggara turned out to be *O. marginatus*.

**Ochterus noualhieri** Baehr  
(figs. 52, 60)

*Ochterus noualhieri* Baehr, 1990a: 91-93.


Distribution: Jawa, Sulawesi and ? Bali.

**Ochterus homorofos** sp. n.  
(figs. 54, 61)

Description
Dimensions (of holotype mentioned first). Length ♂ 4.2-4.4-4.7, ♀ 4.5-4.7-4.8; width of head ♂ 1.28-1.31-1.40, ♀ 1.28-1.30-1.33; posterior width of pronotum ♂ 2.13-2.29-2.37, ♀ 2.39-2.43-2.50; maximal width (at level of caudal point hemielytral commissure) ♂ 2.30-2.47-2.58, ♀ 2.55-2.67-2.79. Colour, generally dark brown to blackish. Posterior half of pronotum and hemielytra dark brown, head behind ocelli, anterior part of pronotum and scutellum dull black. Head anteriorly of ocelli shining bronze, anterior part of clypeus, labrum and segments 3 and 4 of rostrum yellowish to light castaneous; basal antennal segments dirty yellowish, apicals brownish, eyes castaneous marbled with pale brownish. Lateral margin of pronotum with a yellow spot on explanate part anterolaterally, posteriorly continuing as a narrow line; posterior margin with a narrow, little contrasting medium reddish brown line. Narrow band along costal margin of hemielytra and patch at caudal end of claval commissure yellowish. Legs yellowish, coxae and apices of femurs infuscated. Thoracic ventral black except explanate anterolateral area of prothorax yellowish and segmental sutures light brown. Abdominal venter blackish medially, medium brown laterally.

Median carina of head only developed in posterior (upper) half, anterior transverse ridges interrupted to form a shallow V-shaped groove diverging anteriorly. Ridges in median part along anterior half of carina irregular, more laterally roughly parallel converging anteriorly, in posterior part more or less transverse but rather short. Clypeus in profile straight (without transverse depression); rostrum just reaching caudal margin of hind coxae. Anterior width of frons between eyes subequal to slightly narrower than the width of an eye (W frons/W eye 0.38/0.42 and 0.41/0.42). Length of antennal segments I:II:III:IV 0.11:0.15:0.20:0.33. Pronotum, posterior width over twice median length (2.13/0.87 and 2.37/1.00); anterior width 1.10-115; lateral margins softly but evenly convex, strongly diverging posteriorly; punctures distinct, moderately dense and regularly spaced in posterior half, anteriorly somewhat smaller and less deep in a single row along median line, double row along anterior margin and covering non explanate lateral quarters; posterior margin trisinuate. Scutellum, basal width nearly twice the median length (1.21/0.75 and 1.50/0.82). Hemielytra with lateral margins along embolium nearly straight, converging posteriorly; embolium, bases of clavus a double row along each side of claval suture and a field of about 0.25mm= on corium at caudal apex of embolium punctate, remainder smooth; membranes surpassing the apex of abdomen. Male genitalia, pygophore with a broad apex (fig. 54). Shaft of right paramere not noticeably thickened apically; capitulum of paramere obtusely pointed, appendages highly asymmetrical and comparatively broad (fig. 61).

Etymology
Homoros (‘omorphos’) Greek adjective meaning beautiful, referring to the dorsal pattern of this species.

Comparative notes
The apex of paramere especially the broad inner (smaller) appendage differs from all other species in Sulawesi and Philippines (Gapud 1981, 1995, Gapud & San Valentin 1977), except for O. grandiusculus which is, however much larger (L 5.3-5.5).

Ochterus trichotos sp.n.
(figs. 55, 62 )


Description
Dimensions. Length ♂ 4.5-4.6-4.6, ♀ 4.6-4.8; width of head ♂ 1.22-1.28-1.33, ♀ 1.25-1.25; posterior width of pronotum ♂ 2.33-2.40-2.48, ♀ 2.44-2.44; maximal width (at level of caudal point hemielytral commissure) ♂ 2.44-2.49-2.60, ♀ 2.61-2.77. Colour, generally dark grey to black, hemielytra laterally with a dark grey-brown tinge. Eyes mottled brown and blackish, ocelli castaneous, head anteriorly of ocelli shining black, anterior part of clypeus, labrum and segments 3 and 4 of rostrum yellowish to light castaneous; antennae entirely dirty grey-brown. Lateral margin of pronotum with a yellow spot on anterolateral explanate part, not continuing posteriorly; posterior margin concolorous with disk of pronotum. Costal margin at embolium broadly (0.1 mm), posteriorly more narrowly yellowish. Thoracic ventral black except explanate anterolateral area of prosternum, yellowish. Legs dirty yellowish, coxae and apices of femurs infuscated. Abdominal venter blackish brown. Dorso bluish pruinosus patches: anterolaterally on pronotum continuing along inner sides of explanate areas; clavus except for a patch in the middle; small proximal and larger halfway and distally on embolium; six irregular patches on corium and irregular anastomosing patches on membrane.

Median carina continuous over total length of head in front of ocelli, at level of anterior half of eyes somewhat less distinct. Laterally at level of anterior half of
eyes a pair of broad shallow grooves. Transverse ridges in anterior half regular, pointing only slightly anteriad; irregular from midway to posterior quarter and regular but short in posterior quarter. Clypeus in profile straight; rostrum reaching distinctly beyond caudal margin of hind coxae. Anterior width of frons between eyes subequal to the width of an eye (W frons/W eye 0.40/0.42). Length of antennal segments I:II:III:IV 0.11:0.13:0.30:0.30. Pronotum, scutellum, clavus and corium beset with long (0.10-0.15 mm) erect bristles. Pronotum, humeral width two and a half times its median length (2.48/0.99); anterior width 1.10; lateral margins softly but evenly convex, strongly diverging posteriorly; posterior margin trisinuate. Punctures on pronotum and scutellum rather small but distinct, quite densely and regularly spaced, erect hairs originating in the punctures. Scutellum basal width nearly twice the median length (1.21/0.75 and 1.50/0.82), punctures as on posterior half of pronotum. Hemelytra with lateral margins along embolium nearly straight, converging in posterior part. Hemelytral punctures, a double row along inner margin of clavus and a single row along each side of claval suture, evenly dispersed over embolium and corium; membranes surpassing the apex of abdomen. Male genitalia, apex of pygophore fig. 55. Shaft of right paramere not noticeably thickened apically, capitulum somewhat pointed, appendages highly asymmetrical and comparatively broad (fig. 62).

Etymology

Trichotos, Greek adjective meaning hairy, referring to the distinct dorsal pilosity.

Comparative notes

The right paramere reminds somewhat of O. polhemus Gapud from the Philippines (Luzon, Mindoro, Leyte, Mindanao), which has, however, a hooded capitulum and brown hemelytra. O. trichotos is distinguished from all Sulawesi and Mindanao species by the hirsute dorsum.

Ochterus pardalos sp. n.

(figs. 53, 63)

Type Material. – Holotype male (NCTN), PHILIPPINES: Mindanao, Lake Sebu area, trickle of water fed by seepage from ‘Cold River’, 8 Dec. 1993, N9376, leg. N. Nieser. – Paratypes: 1 ♂, Lake Sebu area, at foot of a large waterfall (locally called ‘second waterfall’) about 30m high causing a lot of fine spray, Ochterus on wet rock just outside the spray area, 6.xii.1993, N9368, N. Nieser, 2 ♀ (one marked allotype, NCTN); Lake Sebu area, Seven Falls, 19.vii.1985, 1 ♂, leg. J.T. & D.A. Polhemus (JTPC).

Description

Dimensions (the larger ♂ is the holotype). Length ♂ 4.05-4.28, ♀ 4.33-4.55-4.77; width of head ♂ 1.28-1.30, ♀ 1.28-1.30; posterior width of pronotum ♂ 2.22-2.23, ♀ 2.33-2.37-2.40; maximal width (at level of caudal point hemelytral commissure) ♂ 2.32-2.33, ♀ 2.35-2.43-2.55. Colour, generally dark grey to blackish, hemelytra in females becoming dark brownish distally; abdominal venter castaneous. Head except behind eyes, smooth, shining, between eyes and posterior part of clypeus with metallic bronze tinge, anterior part of clypeus and labrum castaneous, base of rostrum blackish, distally castaneous becoming lighter near tip; basal antennal segments dirty yellowish, apicals brownish, eyes castaneous. Posterior part of head and pronotum dull dark grey, lateral margin of pronotum with a yellow spot anterolaterally, posteriorly continuing as a narrow line; posterior margin with a narrow, little contrasting medium brown line. Scutellum dark grey with bluish-grey spots. Hemelytra dull, dark grey with numerous bluish-grey spots, embolium with narrow yellowish margin, nodal furrow with an indistinct yellowish spot, hemelytral commissure also with a lighter spot. Legs yellowish, anterior coxae and apices of all femurs brownish.

Frons with a median carina interrupted halfway between eyes, anterior transverse ridges parallel, V-shaped with point anteriorly; posterior ridges irregular. Clypeus in profile straight (without transverse depression); rostrum distinctly surpassing hind coxae. Width of frons between eyes subequal to slightly larger than the width of an eye (W frons/W eye ♂ 0.48/0.40, ♂ 0.43/0.43). Length of antennal segments I:II:III:IV 0.10:0.13:0.26:0.29. Pronotum, posterior width over twice median length (2.2/0.9); anterior width ♂ 1.15 ♂ 1.20; lateral margins strongly diverging posteriorly; punctures moderately dense, regularly spaced, anteriorly somewhat smaller and less deep; posterior margin trisinuate. Scutellum, basal width twice the median length (1.4/0.8), punctures as on pronotum. Hemelytra with lateral margin along embolium nearly straight; embolium, bases of clavus and corium and a row along each side of claval suture punctate, remainder smooth; membranes just surpassing the apex of abdomen. Male genitalia, pygophore with a rather broad apex (fig. 53). Shaft of right paramere not noticeably thickened apically, capitulum somewhat pointed, appendages highly asymmetrical (fig. 63).

Etymology

Pardalos, Greek adjective meaning spotted, referring to the strong pattern of bluish-grey pruinose patches on scutellum and hemelytra which are striking in the living animal, especially when it sits in the sunshine.
Comparative notes
(see key)
The paramere is very similar to that of *O. nonalbi*er* (figs. 56, 59) but *O. pardalo* is distinctly darker and larger with body more parallel-sided and lateral margins of pronotum more strongly divergent posteriorly; finally the apex of pygophore is broader (figs. 60, 61). *O. suriga*eta* Gapud (1995) from a similar habitat in the N. of Mindadanao as the 2♂ paratypes from second waterfall, is relatively more slender, brownish, has the capitulum of the paramere with a small projection over the base of the appendages and the appendages relatively longer and of different shape.

Remarks
Both localities have a slightly cooler microclimate compared to the surrounding area generally. In the more open area of Bakdolong valley *O.marginatus* was collected.

Family Gelastocoridae Kirkaldy, 1897
An essentially tropicopolitan family extending into temperate America and Australia, represented in the Old World by the single but large genus *Nerthra* Say, 1832. Rich in species in Central and S. America, Australia and New Guinea (Todd 1961).

Three species have been recorded from Sulawesi: *N. macrothorax* *N. lurida*, and *N. occidua* (Montrouzier 1855, Todd 1959). *N. macrothorax* is a widespread species occurring from Tonga Islands and Australia north to Kyushu and west to the Comores. It is supposed to be distributed (over sea) on floating (plant) debris (Todd 1959, 1960). The other two are only known by their single types.

In the Moluccas there are two species: *N. recta* and *N. toxopeusi* both described by Todd (1959). Likewise only 2 species each have been recorded from Sumatera, Borneo and Philippines so species density seems to be really low in most of the Malesian Archipelago. A few species may still be found as most *Nerthra* species are active during the night and hide in daytime in soft mud or under plant debris and they are only very rarely recorded from light catches, so they are easily overlooked by collectors. Most species live near water bodies but some have been found in or on wet forest floor at places remote from open water.

Key to Sulawesi species of *Nerthra*
(adapted from Todd 1959)

1. Hemelytra entirely coriaceous and fused together; ocelli absent ............................................................... 2
   2. Hemelytra with membrane well developed; ocelli present ............................................................................... 2
2. Width of head equal to the combined length of pronotum and scutellum; scutellum depressed medially at base .......... *N. occidua* Todd, 1955
   1. Width of head less than the combined length of pronotum and scutellum; entire scutellum strongly elevated above hemelytra ............. ......................................................... *N. lurida* Todd, 1959

Family Belostomatidae Leach, 1815
We have seen only one species of Belostomatidae from Sulawesi: *Diplonychus rusticu* (Fabricius). This species has a very wide distribution and it is quite variable in size and colour. The Sulawesi specimens have been compared with specimens from Sri Lanka, Thailand, Viet-Nam, SW China, Brunei and Mindanao but no structural differences to split this material up in two or more taxa have been found. A second species: *Lethocerus indicu* (Lepeletier & Servelle, 1825) occurs in Sulawesi Utara (Danau Mooat area, J. Polhemus in litt.) but so far we have not personally seen specimens from Sulawesi.

*Diplonychus rusticu* (Fabricius)
*Nepa rustica* Fabricius, 1781: 333

Remark. – J. Polhemus (1994) discussed the nomenclatorial problems connected with this name. A proposal to conserve the name for this species was submitted to the ICZN by Polhemus & Kerzhner (1995), and later approved by the ICZN, (1996)

Distribution. – Widespread, from India through SE Asia and China to Japan and Sulawesi.

**Family Pleidae** Fieber, 1851

A family of small, morphologically very uniform Nepomorpha containing three genera which are mainly differentiated in the numbers of tarsal segments.

Only one genus, *Paraplea* Esaki & China (1928), with two widespread species, is represented in the area of study. An important characteristic used to separate species apart from colour has been the form of the thoracic and abdominal carina. Unfortunately Benzie (1989) has shown in a study of a large population that this characteristic is much more variable within a species than formerly supposed.

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**Figs. 64-73.** Pleidae and Helotrephidae. – 64-67, *Paraplea frontalis* 64, right paramere (dorsolateral view); 65, genital capsule; 66, left paramere; 67, ovipositor; 68-72, *Hydrotrephes viriosus*, male (68-70), female (71, 72); 68, dorsal paramere; 69, apex of aedeagus; 70, ventral paramere; 71, ventral abdominal carinae II; III; 72, subgenital plate; 73, *Hydrotrephes kamara*, dorsal paramere; after a sketch by J.T. Polhemus. – Scales 63-70: 0.1 mm, 71, 72: 0.5 mm.

95
Key to Sulawesi species of *Paraplea*

1. Small species, length 1.3-1.7, pronotum characteristically with three pairs of small round black dots, one pair at humeral angles and one medially near posterior margin, in addition a pair more anteriorly near the median line and a pair more ill-defined medially of the humeral spots may be present. Hemelytra typically with a brown transverse band in the middle, which, however, may be absent in pale specimens, head pattern typically with a median brown stripe only .................

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

*P. liturata* (Fieber, 1844)

*P. frontalis* (Fieber, 1844)

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**Paraplea frontalis** (Fieber)

(figs. 64-67)

*Ploa frontalis* Fieber, 1844b: 18, pl. 1 figs. 36-39.


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**Paraplea liturata** (Fieber)

*Ploa liturata* Fieber, 1844b: 19, pl.2 figs. 4-6


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Material. – INDONESIA: Sulawesi Utara, Pulau Sangir, small roadside pond at last bridge on Sungai Lainte from Naha, soft sand bottom, floating plant debris, 17. XI. 1994, N9455a, 4° 8′; Sungai Lainte at last bridge from Naha, lowland aspect of small stream, about 8m wide, 0.5m deep, slow current, water with a faint whitish shimmer (probably a small roadside pond at last bridge on Sungai Lainte, 22. X. 1985, 1°; Base Camp, Stau, Teiche {weir, ponds}, 22. X. 1985, 1°; same 24.x.1985, 1°; Base camp, Tümpel am Labor (pool at laboratory), 26. X. 1985, 1°; Base Camp, Lichtfang (at light), 4.xi.1985, 1°; Same Lakes, Kleiner See, Fischteich {small lake, fish pond}, 16. XI. 1985, 1°; Base Camp, Lichtfang (at light), 4.xi.1985, 1°; all leg. G. Zimmermann.

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Material. – INDONESIA: Sulawesi Utara, Dumoga Bone N.P., Tumpah, at light, 28. X. 1985, 16° 24′; D.B.N.P., Base Camp, Stau, Teiche {weir, ponds}, 22. X. 1985, 1°; same 24.x.1985, 1°; same Lakes, Kleiner See, Fischteich {small lake, fish pond}, 16. XI. 1985, 1°; Sulawesi West of Tungoi, 18.xi.1985, 4° 3′; Leg. G. Zimmermann (ZC). – Sulawesi Tenggara, K. Wawotobi, Wawonggole, Sungai Anggoro, 20. II. 1989, quietly flowing stream in open woodland, depth up to 1m, water dark brown, vegetation hanging from the banks in the water, N8901, 1°; Sulawesi Tenggara, 20 km S. of Pomalaa, pond at edge of marsh forest, 2. III. 1989, Nymphaea, Juncus, N8929, 1°; Leg. N. Nieser. – PHILIPPINES: Mindanao, Sarangani prov. Lake Sebu village, village pond next to market, ring-shaped eutrophic pond used e.g. for bathing water buffalo, diameter c 100m, width of moat 5-10m mostly shallow, many Poaceae and Cyperaceae, further water plants of the *Potamogeton gramineus*-group and a *Callitriche* lookalike, 7. XII. 1993, N9374, 2°, leg. N. Nieser. All macropterus.

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Distribution. – India and SE Asia through SE Asia to Taiwan and the Moluccas.

Remarks. – The head pattern figured by both Fieber (1844b) and Lundblad (1933) shows the longitudinal stripe between eyes and a pair of comma-shaped spots at the level of the dorsal margins of eyes in addition a second pair of spots more dorsally on vertex may be present. Already Lundblad (1933) remarks that these four additional spots are usually indistinct or absent. In our material only some specimens from the fishpond west of Tungoi show the comma-shaped spots and the series from Maluku has a rather dark frontal pattern with the most dorsal spots prominent and the comma-shaped ones present but ill-defined. Structurally there is little variation in parameres especially the right one which folds over the genital capsule and is (in latero-dorsal view, fig. 64) longer than usually depicted e.g. Lundblad (1933), in strictly lateral view. The ventral keel varies somewhat and there are differences in average size between populations. Notably the specimens from Sulawesi Tenggara (L 2.05-2.35) are somewhat smaller than those from Sulawesi Utara (L 2.15-2.42) and those from Bacan (L 2.20-2.41). However, we have not been able to find consistent differences between the samples mentioned and some additional specimens from Sumatera and Thailand.
Family Helotrephidae Esaki & China 1927

A family of small Nepomorpha which, although united with the Pleidae in the superfamily Pleoidea, is quite diverse morphologically with 16 genera divided over four subfamilies. Greatest diversity is found in continental and insular SE Asia with 10 genera and about 40 species of which Hydrotrephes with over 25 species is by far the largest. In our study area five genera are represented (J. Polhemus 1990; Zettel 1994, 1995a, b).

In this section the seventh abdominal sternite of female is referred to as subgenital plate. The length of an eye in Helotrephidae is measured along its longest axis more or less dorso-ventrally, its width is measured in lateral view perpendicular on the hind margin. In Pleoidea the legs have specialised ‘spatulate’ hairs which, however, do not seem to be useful for species discrimination. The macropterus form has a well-developed claval suture and an additional small antero-ventral (in closed wings) suture. The small anter-ventral area cut off by this suture has been called clavulus (China 1930); it does not seem to have diagnostic value. Brachypters lack these sutures and have the hind wings reduced to small stumps. Zettel (1995a, b) uses the term ‘Hinterflügelmikropt’ (hind wing micropt) for these. We use brachypter referring to the condition of the hemelytra (Nieser & Chen 1996). In this family the membranes are reduced in both macropterus and brachypterus forms, they form a callous ridge and a groove which serve as a coupling mechanism to keep the wings closed in rest and has been named pseudomembrane (J. Polhemus 1990).

Key to Malesian genera of Helotrephidae

1. Small species, length up to 1.6 mm .............. 2
   – Larger species length over 2 mm, usually over 2.5 mm ................................................. 4
2. Ventrolateral carina of cephalonotum continuing over the eyes (so the eye is split in a ventral and a dorsal portion) .................................................. 3
   – Ventrolateral carina of cephalonotum not continuing over the eyes [Vietnam, Thailand, W. Malaysia, Sumatera, Sarawak] ..........................................
   ........................................................................... Idiotrephes Lundblad
3. Anterior and intermediate tarsi 2-segmented (first segment very small) [China, Vietnam & N. Borneo] .................. Distotrephes J. Polhemus
   – All tarsi 3-segmented (first segment very small) [W. Malaysia, Sarawak] .... Fischerotrephes Zettel
4. Abdominal sternites 4-6 without median carina [Sri Lanka, Indonesia, Philippines] ..........................................
   ........................................................................... Hydrotrephes China
   – Abdominal sternites 4-6 with a median carina [China (incl. Taiwan), Vietnam, Thailand, Malaysia] .................... Helotrephes Stål

For the three species of Distotrephes found in Sabah and Sarawak and the two species of Fischerotrephes found in W. Malaysia and Sarawak, the reader is referred to Zettel (1994, 1995b), Idiotrephes is in our area represented by an undescribed species from Sarawak (Zettel, 1995b).

Until 1997 six species of Hydrotrephes were known, five of them from Indonesia and Philippines, including one, the type species H. bouvieri from Sulawesi (J. Polhemus 1990). So it is somewhat surprising that now 11 species are known from Sulawesi alone. Apparently Sulawesi is a special centre of differentiation for this taxon although the occurrence of two new species in a restricted area of Mindanao and a number of undescribed species from various islands reported to be in the JTPC (J. Polhemus 1997) indicates that specific collection might show that there are many more species in the Melanesian area.

J. Polhemus (1997) refrained from presenting a key to Sulawesi species of Hydrotrephes as identification is mainly possible by checking the head pattern and male genitalia of specimens to be identified. In order to sort out specimens more quickly we present a key for Sulawesi species here. As there is little doubt that more species are to be found, identification is to be checked by comparing with the complete description of the species in J. Polhemus (1997) and this paper.

Key to males of Hydrotrephes of Sulawesi

1. Large species, length over 3.25 mm ............... 2
   – Smaller, length less than 3.25 mm, usually less than 3 mm ................................................ 4
2. Dark frontal pattern dorsally between eyes nearly reaching inner margins of eyes; acute projection on inner side of dorsal (smaller) paramere at apical third of paramere (fig. 73); length 2.9-3.4 mm. [Sulawesi Tengah & S. Utara] ............................ H. kamara J. Polhemus, 1997
   – Dark frontal pattern leaving a relatively broad light stripe along inner margin of eyes; acute projection on inner side of dorsal paramere at apical fourth of paramere (figs. 68, 74); length 3.4-3.8 mm. ...................................................... H. meixon sp. n.
3. Apex of aedeagus with a small ‘head’, distance between tip and knob about 0.15 mm (fig. 75); length 3.5-3.8 mm [Sulawesi Tengah]...
   ........................................................................... H. meixon sp. n.
   – Apex of aedeagus with larger head, distance between tip and knob 0.3 mm (fig. 69); length 3.4-
   – Larger, length 2.5 mm or more .................. 5
5. Apex of aedeagus with a distinct spur as in fig. 94 ........................................10
   – Apex of aedeagus with a knob only, length 2.9-3.4 mm, frontal pattern entirely dark between
   eyes, a narrower band and a pair of spots under the eyes between eyes and rostrum [Sulawesi
   Tengah & S. Utara] ........................................10
   – Pattern between eyes not reaching inner margins of eyes, in case of doubt (H. taweli which may be
   very similar) the dorsal paramere is apically rounded (fig.114) .......................... 7
7. Dorsal paramere with a broad tooth-like projection apically (fig. 98) .............. 8
   – Dorsal paramere with inner margin smooth .... 9
8. Dark frontal pattern with irregular lateral margins, continuous from posterior head suture to
   anteclypeus; apical part of ventral paramere narrow, total length of paramere ten times its width
   in apical part, length 3.0-3.1 mm ........................................ 7
   – Dark frontal pattern divided in a broader posterior
   or separate narrower anterior part with more or less straight lateral margins; apical part of
   ventral paramere more solid, total length of paramere eight times its width in apical part, length 2.5-2.8
   mm [Sangir Is.] ....................... *H. zetteli* sp.n. ............................
9. Dark frontal pattern divided in partly anastomosing
   small patches, consequently lateral margins strongly irregular; ventral paramere with narrower
   apical part relatively short, about one third of total length of paramere (fig. 117), length 2.5-2.6
   mm [Sulawesi Selatan] ........................................ 9
   – Dark frontal pattern more solid with more or less
   straight lateral margins; narrower apical part of ventral paramere about half the total length of
   paramere (fig. 116) ........................................10
10. Frontal pattern between eyes consisting of a pair of oblong patches separated by a light median
    line, anterior part of dark pattern separated from posterior part, indistinct; dorsal paramere parallel-sided in
    middle part (fig. 115), length 2.6-2.8 mm [Sulawesi Utara] ............................
   – Frontal pattern between eyes solid and continuous
    with distinct anterior part; dorsal paramere gradually widening in apical half, length 2.5-2.7
    mm [Sulawesi Tengah & S. Utara] ............................
   – Pattern between eyes solid brown to black reaching laterally unto margin of eyes and anteriorly
    halfway eyes or more anteriorly, a narrower band running to labrum may be connected to or
    separate from dark area between eyes, dorsal paramere truncate (not rounded) apically (fig. 113),
    length 2.4-3.0 mm [Sulawesi Utara] ........................................ 5

Hydrotrephes bouvieri Kirkaldy
(fig. 115, 126-1)

Hydrotrephes bouvieri Kirkaldy, 1904: 129.

Hydrotrephes bouvieri J. Polhemus 1997: 45 (redescription).


Hydrotrephes celebensis J. Polhemus
(fig. 126-2)

Hydrotrephes celebensis J. Polhemus, 1997: 45-47.


Hydrotrephes marana J. Polhemus
(fig. 126-2)


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Hydrotrephes nieseri J. Polhemus
(fig. 113, 126-2)


Hydrotrephes taweli J. Polhemus
(figs. 114, 116, 126-1)


Hydrotrephes viriosus J. Polhemus
(figs. 68-72, 80, 91, 126-1)


Redescription

As the original description is based on a single female, we give an additional description based the specimens cited above.

Dimensions, length ♂ 3.38, ♀ 3.5; width across eyes ♂ 1.80, ♀ 1.88; posterior width of cephalonotum ♂ 2.55, ♀ 2.60; height at base of hemielytra ♂, ♀ 1.60.

Colour, generally dark brown-grey with yellow, eyes dark grey. Holotype male anterior part of cephalonotum predominantly brown-grey, pattern between eyes ill-defined (fig. 80), posterior part yellow, scutellum brownish yellow with ill-defined brown patches, base of hemielytra and pseudomembrane brown-grey; remainder of hemielytra yellow. Allotype female dorsally darker, cephalonotum dark between eyes only with a distinct pattern, in frontal view a broadly bifid dark mark dorsally and a separate rectangular spot at base of rostrum, laterally near eyes lighter, posterior part dark grey with a transverse yellowish band behind middle. Scutellum and basal part of hemielytra dark grey, apical three quarters of hemielytra sordid yellow with ill defined darker mottling. Both specimens with rostrum dark castaneous to blackish, venter medium brown to dark grey, legs pale brownish.

Cephalonotum, scutellum and hemielytra densely beset with alveolar punctures, somewhat less deep and less dense between eyes, clypeus transversely ridged. In dorsal view cephalonotum broader than long (2.6/2.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina with one tip (fig. 91). Eye two times as long as wide (0.66/0.33); minimal width of interoculus slightly less than four times or more the width of an eye (♂ 1.22/0.33 ♀ 1.32/0.30). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.22 and 0.65, Scutellum at base broader than long (1.5/1.1). Ventral carina of pronotum and at base of abdomen well developed (fig. 71).

Male, parameres and aedeagus as in figs. 68-70. Female, subgenital plate (abdominal sternite 7) with a median process caudally (fig. 72).

Macropterous form essentially as apterous except for the development of hind wings and claval suture and clavalus on hemielytra.

Comparative notes

The left paramere is similar to that of H. celebensis and H. marana, supporting the supposition of J. Polhemus (1997) that H. celebensis seems to be the closest congener. However, H. celebensis is distinctly smaller, length 2.40-2.42, its female subgenital plate has an indication of medioceudal process (not reaching beyond the apices of the lateral angles) only, the dorsal paramere is more slender, the apical part of the ventral paramere somewhat stouter and the the heel of the apex of aedeagus more rounded; H. marana is also smaller, length up to 3.1 mm, width up to 2.16 mm and its aedeagus has a well developed spur. Although the
macropterous female holotype of *H. viriosus* is smaller (L 3.09) and broader (W cephalonotum 2.82) the head pattern, female subgenital plate, ventral abdominal carinae II, III and various ratios agree sufficiently to consider these as belonging to the same species.

**Hydrotrephes mexon** sp. n.
(figs. 74-79, 90, 126-2)

Type Material. – Holotype brachypterous male (NHMW, genital capsule detached, glued to the same card as the specimen): INDONESIA: Sulawesi Tengah, Salopo near Poso See, 29 Jan. 1995, leg. Seyfert & Greindl (45). – Paratypes (adults only) 2♂ 2♀ (including allotype) brach., 1♂ macr., 1 lvV (NHMW except 1♂ brach. NCTN).

**Description**

Brachypterous form. – Dimensions length ♂ 3.50-3.63-3.80, ♀ 3.70-3.80-3.89; width across eyes ♂
1.86-1.88-1.90, ♀ 1.98-1.99-2.00; posterior width of cephalonotum ♂ 2.59-2.60-2.60, ♀ 2.69-2.69-2.70; height at base of hemelytra ♂ 1.32-1.36-1.39, ♀ 1.40-1.51-1.63. Dimensions of single macropterous ♂ length 3.61, width across eyes 1.94, posterior width of cephalonotum 2.69, height 1.32.

Colour, generally yellowish with brown-grey to blackish markings, eyes blackish. Frons with blackish markings which become gradually narrower toward rostrum (fig. 79). Cephalonotum behind eyes blackish, posterior part yellowish with sparse dark mottling. Scutellum and hemelytra predominantly dark by dense confluent dark patches. Venter brown to dark grey, genal, pronotal pro- and meso- pleural plates and legs except at base, pale.

Cephalonotum, scutellum and hemelytra densely beset with impressed punctures, somewhat less deep and less dense between eyes, anteclypeus transversely ridged most distinctly in macropterous males. In dorsal view cephalonotum broader than long (2.6/2.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina bifid (fig. 90). Eye 2.5 times as long as wide (0.76/0.31); minimal width of interoculus four times more the width of an eye (♂ 1.22/0.31 ♀ 1.32/0.30). First two segments of rostrum very short, length of segments 3 and 4, 0.28 and 0.66 respectively. Scutellum at base broader than long (1.6/1.2). Ventral carina of pronotum and at base of abdomen well developed (fig. 78).

Male, parameres and aedeagus as in figs. 74-76. Female, subgenital plate (abdominal sternite 7), caudally truncate (fig. 77).

Macropterous form – Essentially as apterous except for being relatively broader and development of hind wings and claval suture and a small subtriangular area sutured off ventrabsally on hemelytra. Eye twice as long as wide (0.75/0.38).

Etymology
Mexon, comparative of Greek adjective meaning larger referring to the size of this species which is longer than its Sulawesi congeners.

Comparative notes
Apart from the distinctive male genitalia, this species is about 0.5 mm longer and has a more strongly developed prosternal carina than any known Sulawesi species.

_Hydrotrephes polhemii_ sp. n. (figs. 85, 88, 93-97, 126-2)


Type Material. – Holotype brachypterous male (MUDH) INDONESIA: Nusa Tenggara Timor prov., Flores, 9 Km S of Maumere, sea level, 18. April 1986, cultivated area, in slow flowing brook, leg. A. L. van Berge Henegouwen & S. Pariwono. – Paratypes: 7♂ 24♀, same data as holotype: 1♂ 4♀ (including allotype) brach., 2♂ 1♀ macr. (MUDH except for 1♂ 1♀ brach. NCTN); Flores, Wae Garit River, 6 km W of Ruteng, CL2179, 24.x.1985, 1100m, 5♂ 19♀ brach., 1♂ macr., 6lvV, J.T. & D.A. Polhemus (JTPC).

Description
Brachypterous form. – Dimensions length ♂ 2.82-2.87-3.00, ♀ 2.77-2.92-3.14; width across eyes ♂ 1.38-1.40-1.44, ♀ 1.39-1.44-1.50; posterior width of cephalonotum ♂ 1.89-1.93-2.00, ♀ 1.83-2.00-2.11; height at base of hemelytra ♂ 1.29-1.30-1.31, ♀ 1.30-1.33-1.41.

Colour, generally yellowish to light brown. Cephalonotum posteriorly yellow with light brown mottling, eyes grey-blackish. In frontal view a solid brown patch between eyes narrowing anteriorly and leaving a yellow band at inner margins of eyes (fig. 85). Scutellum and hemelytra light brown with variable, irregular and little contrasting medium brown mottling.

Cephalonotum, scutellum and hemelytra densely beset with impressed punctures, somewhat less deep between eyes and somewhat less dense on scutellum. Anteclypeus transversely ridged. In dorsal view cephalonotum broader than long (2.0/1.2); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched (fig. 88). Eye twice as long as wide (0.52/0.25); minimal width of interoculus about four times the width of an eye (♂ 0.93/0.24 ♀ 0.97/0.27). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.48. Scutellum at base as broad as or slightly broader than long (1.20/1.15). Prosternal carina with two tips (fig. 88), carina at base of abdomen well developed (fig. 97).

Male, parameres and apex of aedeagus as in figs. 93-95. Female, subgenital plate, caudally with a median tongue-like extension (fig. 96).

Macropterous form. – As brachypterous form except for development of hemelytra and hind wings and being somewhat broader relatively. In addition the carina over the lateral margin of cephalothorax does not quite reach its latero-caudal tip, forming a small angle. Dimensions of macropterous males and single female; length ♂ 2.72-2.75-2.78, ♀ 2.79; width across eyes ♂ 1.36-1.38-1.40, ♀ 1.40; posterior width of cephalonotum ♂ 1.89-1.95-2.02, ♀ 2.01; height ♂ 1.31-1.37-1.42, ♀ 1.30.
Etymology
Polhemi, genitive of Polhemus, named in honour of Dr. John T. Polhemus whose earlier survey of Sulawesi Hydrotrephes facilitated our work on this genus considerably.

Comparative notes
Similar to several Sulawesi species: H. kamarora, H. nieseri and H. taweli all described by J. Polhemus (1997) which are of about the same size, have a similar frontal pattern and have the subgenital plate of female with a more or less distinct caudal tongue. They all have a different paramere, the aedeagus of H. kamarora has a reduced apical spur, H. nieseri and H. taweli have the prosternal carina with one tip only. The latero-caudal angle of the cephalonotal carina is much smaller than the angulated tooth in H. angulatus China which has moreover a more irregular frontal pattern and a truncate subgenital plate in female.

Hydrotrephes zetteli sp. n.
(figs. 86, 92, 98-102, 126-2)

Type Material. – Holotype, brachypterous male (NCTN), INDONESIA, Sulawesi Utara, Sangir Island, Sungai Laine at ‘tourist spot’, Desa Laine (sometimes also spelt Leing). Small stream with waterfalls, inhabited area, Hydrotrephes from shaded part of large pothole at foot of waterfall, 12 Nov. 1994 leg. N. Nieser. – Paratypes same data as holotype 2 ♀ pr., 1 ♀ macr. (NCTN, 1 ♀ brach NHMW).

Description
Dimensions length ♂ 2.70, ♀ 2.53-2.66-2.80; width across eyes ♂ 1.37, ♀ 1.35-1.38-1.40; posterior width of cephalonotum ♂ 1.85, ♀ 1.83-1.86-1.90; height at base of hemielytra ♂ 1.50, ♀ 1.40-1.43-1.45.

Colour, generally dirty yellow with medium to dark brown markings. Cephalonotum with a transverse brown band behind eyes, with a medio-anterior projection slightly over half as wide as interoculus, medially cut by a yellowish line, anterior part of head width a narrower brown stripe (fig. 86). Posterior part of cephalonotum light with darker patches, notably a row along posterior margin. Hemielytra densely mottled with brown, scutellum lighter. Ventral part to dark grey, legs except at base, genal, pronotal and mesopleural plates pale, rostrum castaneous.

Cephalonotum, scutellum and hemielytra densely beset with impressed punctures, somewhat coarser on hemielytra and scutellum. Anteclypeus transversely ridged. In dorsal view cephalonotum broader than long (1.9/1.4); lateral margin carinate over its entire length. Genal and pronotal plates widely but relatively shallowly notched, prosternal carina bifid (fig. 92). Eye 1.7 times as long as wide (0.50/0.29); minimal width of interoculus about three times the width of an eye (0.90/0.29). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.50. Scutellum at base as broad as or broader than long (1.17/1.05). Prosternal carina with two tips (fig. 97), carina at base of abdomen well developed (fig. 102).

Male, parameres and apex of aedeagus as in figs. 98-100
Female, subgenital plate, caudally with a median tongue-like extension (fig. 101).

Macropterous form as brachypterous form except for development of hemielytra and hind wings and being relatively somewhat broader. Dimensions of single macropterous ♀: length 2.71, width across eyes 1.40, posterior width of cephalonotum 1.93, height 1.50.

Etymology
Zetteli, genitive of Zettel, named in honour of Dr. Herbert Zettel for his work on SE asian water bugs.

Comparative notes
At first sight very similar to H. pardalos sp. n. from Mindanao. Apart from differences in details of head pattern, the male genitalia (figs. 98-100, 107-109) and subgenital plates of females (figs. 101, 103) show distinct differences. For differences with similar Sulawesi species see key.

Hydrotrephes pardalos sp. n.
(figs. 83, 92, 105, 107-109)

Type Material. – Holotype brachypterous male (NCTN): PHILIPPINES: Mindanao, Lake Sebu area, Bakdolong, at base of hills, small mountain stream in cultivated area, banks mostly with trees shading most of the stream, strong current alternating with pools and quiet bays mainly under narrowly overhanging banks (Hydrotrephes), 10 Dec. 1993, N9379, leg. N. Nieser. – Paratypes (adults only): 80 ♀ 59 ♀: Mindanao: Same data as holotype 2♀ 14 ♀ brach., 2♀ 3♀ macr., 4 lvV. (NCTN except 3♀ 3♀ JTPC, 3♀ 3♀ NHMW, 1♂ 1♀ ZMAN, all brachypters). W. side of Sarangani Bay, Siguel River in deforested area, side pools of stream with low slightly overhanging grass banks, stagnant, water slightly turbid, area about 20 m², depth up to 0.2 m, 23. XI., N9351, 5♀ 3♀ brach., 1♀ macr., 3 lvV; Right side of Sarangani bay, Glan River, at edge. against tree trunk, no current, 26. XI., N9357, 1♀ macr., 1lv, 1lvIII. Lake Sebu area, Bakdolong,
Figs. 93-106. *Hydrotrephes* spp., details. – 93-97, *H. polhemi*, paratype male (93-95), paratype female (96; 97): 93, dorsal paramere; 94, apex of aedeagus; 95, ventral paramere; 96, subgenital plate; 97, carinae on abdominal sternites II; III; – 98-102, *H. zetteli*, holotype male (98-100), paratype female (101; 102); 98, dorsal paramere; 99, apex of aedeagus; 100, ventral paramere; 101, subgenital plate; 102, carinae on abdominal sternites II; III; 103, *H. pardalos*, paratype female, subgenital plate; 104 *H. stereos*, ditto; 105, *H. pardalos* paratype female, carinae of abdominal sternites II; III; 106 *H. stereos*, paratype female, ditto. – Scales 93-95, 98-100: 0.1 mm, 96, 97, 101-106: 0.5 mm.
stream through agricultural area adjacent to lake (same stream as N9379); mouth of stream, lowland stream aspect, low but steep banks, grassland and rice fields, at edge, 3. XIII., N9364, 2♀ brach.; canalized mountain stream, 3.xii., N9366 1♂ (RMNH); same, 4. XII., N9366a, 6♂ 1♀ brach. (1♂ 1♀ MUDH), 1♀ macr. (RMNH) Lake Sebu area: Just upstream of 3rd waterfall, edge upstream of boulder, between some floating plant debris, surroundings, one side with remnant of primary forest, C: 270µS, 7. XII., N9371, 7♂ brach.; Just downstream of dam at Lopo, edge of stream between grass from banks, 9. XII., N9377B, 2♂ brach.; Irrigation canal downstream of dam at Lopo, fast current, between plants at edge, 9. XII., N9378, 1♂ brach. All leg. N. Nieser 1993 and in NCTN unless otherwise indicated. Mindanao, Bukidnon prov., Malaybalay, Springsite, 650m, 7.xi.1966, 12♂ 17♀ 6lvV, (NHMW, UPLB); Malay Balay, Kaamulan site, 650m, 15-16.iii.1997, 6♂ 3♀ brach.; Misamis occ. prov., W. Ozamiz, Tanggub, Lumban, 6.iii.1997, 5♂ 1♀ brach. (UPLB, ZCWA); all leg. H. Zettel. Mindanao, Sarangani prov., Lumbab river, 13 km SW of Surallah, 600m, 19.vii.1985, 3♂ 2♀ brach., J.T. & D.A. Polhemus; Sarangani prov., Cacob River, SE of Koronalad, 550, 20.vii.1985, 10♂ 10♀; 8lvV, leg. J.T. & D.A. Polhemus (JTPC).

Description

Brachypterous form. – Dimensions length ♂ 2.23-2.32-2.43, ♀ 2.40-2.47-2.51; width across eyes ♂ 1.20-1.22-1.26, ♀ 1.23-1.29-1.30; posterior width of cephalonotum ♂ 1.62-1.67-1.70, ♀ 1.72-1.76-1.80; height at base of hemielytra ♂ 1.00-1.07-1.15, ♀ 1.05-1.24-1.50.

Colour, dorsally pale yellow with variable dark brown-grey markings. Eyes dark castaneous to blackish. Head region (fig. 83), typically with a broad median band between upper half of eyes, anteriorly a pair of small dots and a larger median dot, the pattern of these patches is, however, quite variable. Pronotal area anteriorly with a solid transverse dark area posteriorly with variable mottling which tends to be confluent in dark specimens. Scutellum and hemielytra variably mottled with dark, scutellum usually lighter than hemielytra.

Cephalonotum densely punctate to finely alveolate, postclypeus transversely ridged. In dorsal view cephalonotum broader than long (1.75/1.30); lateral margin carinate over its entire length. Pro- and mesopleural plates widely but relatively shallowly notched (fig. 92). Eye longer than wide (0.47/0.28), minimal width of interoculus over 21/2 times the width of an eye (0.80/0.28). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.20 and 0.35. Scutellum only slightly longer than its basal width (0.95/0.93). Ventral carina at base of abdomen well developed (fig. 92).

Male, parameres and aedeagus as in figs. 107-109. Female, subgenital plate, triangular (fig. 103).

Macropterous form. – Essentially as apterous except for being relatively broader and development of hind wings and claval suture on hemielytra. Dimensions: length ♂ 2.30-2.35-2.40, ♀ 2.40-2.42-2.45; humeral width of cephalonotum ♂ 1.65-1.72-1.78, ♀ 1.72-1.77-1.80.

Etymology

Pardalos, Greek adjective meaning variegated or spotted, referring to the variable but nearly always strong motting on dorsal and lateral surfaces of this species.

Comparative notes

About the same size as the other known species from the Philippines (Luzon), H. balnearius (Bergroth) which has, however, a rather uniformly dark coloured head. Species from N. Sulawesi have different male genitalia, specifically the apex of aedeagus usually has a strongly developed spur pointing backward (J. Polhemus 1997). For H. stereos see below.

Hydrotrepheus stereos sp. n.

(figs. 84, 94, 104, 106, 110-112)

Type Material. – Holotype macropterous male (NCTN): PHILIPPINES, Mindanao, Lake Sebu area, ‘Cold River’ one of the streams feeding Sebu lake, mountain stream, clear hyaline water, many cascades alternated with short ± level stretches with pebbly bottom, C:210µS, surroundings valley and flat parts cleared, slopes mostly with secondary forest, but also with a few pockets of primary forest, 8 Dec. 1993, N9375. 76♂ 10♀ paratypes (adults only): Mindanao, Lake Sebu area: Same data as holotype, allotype brach. ♀ and 1♂ macr., 1lvIV 1lvV; second (largest) waterfall in stream out of lake, at foot of ± 30m high waterfall, large pothole, a lot of fine spray, sample at quiet edge, 6. XII., N9368 1♀ brach. (ZMAN); Just upstream of 3rd waterfall, edge upstream of boulder, between some floating plant debris, surroundings, one side with remnant of primary forest, C: 270µS, 7. XII., N9371, 7♀ brach. (1♀ NHMW); Just downstream of dam at Lopo, edge of stream between grass from banks, 9. XII., N9377B, 1♂ 2♀ brach. (1♂ 1♀ JTPC, 1♀ RMNH); Further downstream of dam at Lopo, agricultural fields, open but shaded by stand of bamboo at the upstream point of small island, 9. XII., N9377C, 1♀ brach. all leg. N. Nieser 1993 and in NCTN unless otherwise specified), Mindanao Bukidnon prov., 8 km NW Lanta-

Description

Dimensions, males macropterous form, females brachypterous form. Length ♂ 2.80-2.86-2.94, ♀ 2.90-3.02-3.12; posterior width of cephalonotum ♂ 1.95-1.99-2.07, ♀ 2.08-2.15-2.23; width across eyes ♂ 1.40-1.44-1.46, ♀ 1.54-1.59-1.62; height at base of hemielytra ♂ 1.2-1.3, ♀ 1.1-1.2. Dimensions of single brachypterous male: length 2.99, posterior width of cephalonotum 2.02, width across eyes 1.50.

Colour. Dorsally generally brownish yellow with dark brown-grey markings, eyes blackish. Dark stripe dorsally between eyes, reaching slightly more than halfway, usually divided by a narrow light band medially (fig. 84). Postclypeus rarely with a faint dark mark. Cephalonotum posteriorly of eyes usually with confluent dark spots except for a light patch medioanteriorly on pronotal area. Hemielytra and scutellum with fine dense dark grey points which may become confluent to form larger patches especially at base of hemielytra. Venter light brown with ill-defined infuscations. Legs yellowish with some small dark stripes and spots.

Cephalonotum, scutellum and hemielytra densely punctate, postclypeus transversely ridged most distinctly in macropterous males. In dorsal view cephalonotum broader than long (2.0/1.4); lateral margin carinate over its entire length. Pro- and mesopleural plates widely but relatively shallowly notched (fig. 94). Eye twice as long as wide (0.58/0.30); minimal width of interoculus slightly over three times the minimal width of interoculus. First two segments of rostrum very short, length of segments 3 and 4 respectively 0.22 and 0.44. Scutellum at base broader than long (1.17/1.00). Ventral carina at base of abdomen well developed (fig. 106).

Male, parameres and aedeagus as in figs. 110-112. Female, subgenital plate, strongly incised (fig. 104).

Macropterous form. – Essentially as apterous except for being relatively broader and development of hind wings and claval suture and a small subtriangular area sutured off ventrobasally on hemielytra.

Etymology

Stereos, Greek adjective meaning robust, referring to the solid build of this species.


Comparative notes

Similar to H. pardalos except for larger size. Typically marked specimens have a narrow median light stripe in the dark band between eyes which does not occur in H. pardalos, compare figs. 83, 84. The aedeagus and subgenital plate of female are different (figs. 103, 104, 107-112).

Helotrephes otoeis sp. n.

(figs. 118-124)

Description

Dimensions, length ♂ 2.32-2.34-2.38, ♀ 2.32-2.40-2.47, posterior width of cephalonotum ♂ 1.80-1.84-1.90, ♀ 1.82-1.90-1.96, width across eyes ♂ 1.28-1.33-1.39, ♀ 1.30-1.35-1.39, height at base of hemielytra ♂ 1.2-1.3-1.4, ♀ 1.30-1.5-1.6.

Colour, yellowish mottled with medium brown, eyes castaneous, venter dark. Mottling on cephalonotum irregular but leaving a more or less well-defined median longitudinal pale stripe free. Central part of prothoracic part of cephalonotum with four distinct larger brown spots arranged in a trapezium, narrower posteriorly (fig. 120). Posterior border of cephalonotum with a row of distinct larger brown spots. Scutellum with four larger spots along its margin, one pair about halfway, one pair near apex. Hemielytra more densely mottled and appearing darker, with an irregular row of large spots along costal margin (fig. 118).

Cephalonotum, scutellum and hemielytra rugulose due to a dense pattern of alveoli, postclypeus transversely ridged. Humeral angle of cephalothorax with a dense pattern of alveoli, postclypeus transversely ridged. Humeral angle of cephalothorax with four distinct larger brown spots arranged in a trapezium, narrower posteriorly (fig. 120). In dorsal view cephalonotum broader than long (1.85/1.37); lateral margin carinate over its entire length. Pro- and meso-pleural plates widely but relatively shallowly notched (fig. 125). Eye twice as long as wide (0.53/0.27); minimal
width of interoculus three times the width of an eye or less (♂ 0.75/0.25 ♀ 0.80/0.30). First two segments of rostrum very short, length of segments 3 and 4 respectively 0.18 and 0.35. Scutellum at base broader than long (♂ 0.90/0.80 ♀ 0.93/0.90). Ventral carina as in fig. 123.

Male, parameres as in figs. 121, 122.
Female, subgenital plate, laterally indented (fig. 124).

Etymology
Otoeis, greek adjective meaning ‘with an ear or handle’, referring to the (in frontal view) earlike extensions at humeral angles of pronotum.

Comparative notes
This species is immediately recognized by the process at the humeral angles of pronotum (figs. 118-120). Within described species it is in view of the structure of the male genitalia, closest to H. semiglubosus Stål.

Remarks
There were four described species of Helotrephes known (J. Polhemus 1990, Zettel 1995a) but there are some seven or eight new species from Thailand awaiting description (Zettel 1996). H. otoeis is the first representative of the genus found in the Malesian Archipelago at some distance from the continent. The only other island species, H. formosanus is known from Taiwan.

Family Notonectidae Latreille, 1802
This family has been treated in our first paper on Sulawesi water bugs (Nieser & Chen 1991) and the Sulawesi fauna of the genus Enithares Spinola has been revised by Nieser & Chen (1996). That leaves to report on some additional material and presenting a key to the genus Anisops Spinola.

The tylus is the area between anterior angles of eyes and base of labrum; the term was introduced by Truxal (1953) in his revision of the sister group, Buenoa Kirkaldy. Brooks (1951) uses the term facial tubercle for the tylus. In Anisops instead of ocular index based on synthlipsis, the ocular index based on vertex (ocular index (V) Nieser 1975) is used.

The species of Anisops recorded so far from Sulawesi are, with the possible exception of A. salihabu sp. n., more or less widespread species many of which have adapted to environments in agricultural areas. There are still several species with disjunct distribu-

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Figs. 118-125. Helotrephes otoeis, holotype male (118-123; 125), allotype female (124). – 118, habitus lateral view; 119, cephalothorax frontal view; 120, habitus dorsal view; 121, dorsal paramere; 122, ventral paramere; 123, ventral median carina; 124, subgenital plate; 125, cephalothorax in lateral view. – Scales 118-120, 125: 1mm, 121, 122: 0.25 mm, 123, 124: 0.5 mm.
Fig. 126. Localities of *Hydrotrephes* species in Sulawesi.
Key to males of *Anisops* from Sulawesi

1. Small species, length 5.5 mm or less .............. 2
   - Larger species, length over 5.5 mm .............. 7
2. Tylus densely hairy, with longer hairs at the outside, length 4.7-5.0 mm, synthlipsis one third the anterior width of vertex .. *A. paracrinatus* Brooks, 1951
   - Tylus at most with a few hairs .................. 3
3. Small species, length 4.2-4.5 mm, with very narrow synthlipsis about one fifth the anterior width of vertex .................. *A. biroi* Brooks, 1951
   - Larger species, length 5 mm or more .......... 4
4. Tylus laterally compressed with a small lozenge-shaped fossa on top; synthlipsis slightly more than one third the anterior width of vertex ...... 5
   - Tylus neither compressed nor with a small lozenge-shaped fossa on top; length 5.2-5.4 mm, synthlipsis narrow 0.057-0.064 mm but as the vertex is also narrow the relative width of synthlipsis is about half anterior width of vertex ...... 6
5. Tylus dorsally produced into a distinct carina which continues on the anterior two thirds of frons between eyes, base of rostral prong not projecting anteriorly of fourth rostral segment (fig. 131), length 5.1-5.5 mm, ........................................ *A. tabitiensis* Lundblad, 1934
   - Tylus dorsally at most with an indication of a carina which does not extend between eyes, base of rostral prong distinctly projecting in front of fourth rostral segment (fig. 129), length 5.2-5.9 mm ................................. *A. rhombooides* sp. n.
6. Fore tarsus without a row of small teeth ........
   - Fore tarsus with a short row of three small teeth in basal half .......... *A. philippinensis* Brooks, 1951
7. Eyes touching each other (holoptic) posteriorly for over one fourth the length of head, fore femur very thick, length 5.7-.6.6 mm .............................. *A. breddini* Kirkaldy, 1901a
   - Synthlipsis sometimes very narrow but eyes not holoptic ........................................ 8
8. Large species, length over 6.5 mm ............... 9
   - Medium sized species, length 5.5-6.5 mm .... 10
9. Length 9 mm or more, in dorsal view frons extending anteriorly of eyes forming a short cephalic horn, base of middle tibia with a short inward projection bearing apically a circular group of stout thickly set setae ...... *A. stali* Kirkaldy, 1904
   - Length 6.5-7.2 mm, in dorsal view head anteriorly rounded .............. *A. occipitalis* Breddin, 1905
10. In dorsal view vertex projecting in front of the eyes forming a cephalic projection ............... 11
   - In dorsal view anterior margin of head almost straight ............................................... 11
11. Tylus laterally compressed with a small lozenge-shaped fossa on top (see also couplet 5) ........ ................................................ *A. rhombooides* sp. n.
   - Tylus slightly swollen, not laterally compressed; length 5.4-5.8 mm (see also couplet 6) ...........
     - *A. philippinensis* Brooks, 1951
12. In frontal view frons with an oval excavation dorsally of eyes, claws of middle leg of the same shape, length 6.0-7.8 mm ...........................................
     - *A. nasutus* Fieber, 1851
   - In frontal view frons excavated between and above eyes, claws of middle leg of different shape, one long narrow and smoothly curved the other shorter thicker and sinuate .............................. *A. kuroiwae* Matsumura, 1915

[Remark: this species is widely known under its junior synonym *A. batillifrons* Lundblad, 1933]

**Anisops nasutus** Fieber

*Anisops nasuta* Fieber, 1851b: 60-61.


Distribution. – E. India through SE Asia, China, Philippines and Indonesia to New Guinea and Australia also widespread in Pacific Isles.

**Anisops occipitalis** Breddin

*Anisops occipitalis* Breddin, 1905b: 152.


Distribution. – From SE China including Taiwan through Indonesia to New Guinea, Australia and
New Caledonia, if Lansbury (1965) is correct in supposing that *A. leucothea* Esaki is a synonym then it is also widespread in Pacific Islands.

**Anisops paracrinitus** Brooks


Distribution. – Described from E. Australia, widespread in Indonesia.

**Anisops tabitiensis** Lundblad

(fig. 131)

*Anisops tabitiensis* Lundblad 1934b: 121-123.


Remarks. – Length ♂ 5.22 (Solomon): 5.60 (PNG), 5.90 (Nw Hebr.), 5.88 (PNG). Brooks (1951) states that the tibial comb in males has ‘approximately twenty-one teeth’, however, specimens checked have about 30, in accordance with Lundblad (1934b). Lansbury (1964) gives 23-34 and suggests that *A. tabitiensis* as presently conceived may contain more than one species which ‘cannot at present be satisfactorily separated’. See below under *A. rhombooides* sp. n. also for distribution.

**Anisops stali** Kirkaldy

*Anisops stali* Kirkaldy, 1904: 113, 132.


Distribution. – From Australia through Indonesia and Mindanao to SE China (including Taiwan) and Okinawa.

**Anisops rhombooides** sp. n.

(figs. 127-130)


Type Material. – Holotype male (NCTN), dark form: BRUNEI DARUSSALAM, Labi Road 29.5 km, wet bracken/sedge field, small shallow pond overgrown with *Eleocharis*, up to 0.3 m deep, water clear light brown, 15 April 1993, N9342B, leg. N. Niesen. – Paratypes: 14♂ 8♀; same data as holotype 3♂ 3♀ (including allotype, 1♂ 1♀ BMKB). – INDONESIA, Sulawesi Tenggara, P. Buton, Desa Gareng-Gareng, dirty pond in village, some small shrubs and grasses, 8. III. 1989, N8938, leg. N. Niesen. – Paratypes: 14♂ 8♀; same data as holotype 3♂ 3♀. Sulawesi Utara, Danau Linow, sulphur lake at Lahendong, sampled around some tufts of *Eleocharis*, depth 0.2m, no other vegetation, 10. XII. 1994, 2♂, leg. N. Niesen. Sulawesi [Tengah], river S. Palu, 27.i.1995, 1♂ leg. Seyfert & Greindl (NHMW). – PHILIPPINES, Mindanao, Lake Sebu, village pond next to market, circular pond, diameter about 100m, the actual moat 5-10 m wide, mostly shallow but a few water buffalo washing holes, central isle half dry half marsh, moat with varied vegetation, *Potamogeton gramineus-group*, *Callitriche* like plant and various Cyperaceae, also vegetation overhanging from banks, 7.xii.1993, N9374, leg. N. Niesen, 5♂ 5♀ (2♂ 2♀ NCTN, 1♂ 1♀ OXUM, 1♂ 1♀ RMNH, 1♂ 1♀ ZMAN).

Description

Dimensions, length ♂ 5.20-5.56-5.90 ♀ 5.50-5.67-6.25; width of head ♂ 1.25-1.29-1.32 ♀ 1.28-1.31-1.40; width of pronotum ♂ 1.32-1.38-1.50 ♀ 1.32-1.44-1.60; anterior width of vertex ♂ 0.18-0.20-0.21 ♀ 0.19-0.23-0.26; synthlipsis ♂ 0.056-0.065-0.075 ♀ 0.081-0.091-0.113.

Colour (based on alcohol-preserved specimens), dark form, generally dark, head pale with blackish eyes (in dry specimens the eyes become pale grey), tyulus and rostrum variable pale to dark, fourth rostral segment always blackish, pronotum pale but transparent showing underlying dark mesonotum, scutellum pale, hemelytra and hind wings entirely hyaline, hind wings usually iridescent, the dorsum of abdomen shining through wings, dorsum of abdomen dark, in most specimens a pale area in the middle; thoracic venter pale, abdominal venter blackish with inner margin of connexiva and rim of median abdominal keel yellow, legs variable from light brown to black with outer borders pale.

Labrum three quarters as long as its basal width (0.15/0.20) bare, apex rounded; eyes longer than median length pronotum (0.92/0.75). Pronotum,
humeral width twice its median length (1.4/0.7) with lateral margins diverging posteriorly, half as long as its median length (0.35/0.72); posterior margin convex, medianly shallowly emarginate. Scutellum large, four fifth as long as its basal width (1.00/1.25). Posterior femur with 19-25 spine-like setae in dorso-posterior and 35-40 in ventro-posterior row. Length of leg segments as in table ♀♀.

Figs. 127-135. Anisops spp., details. – 127-130, *A. rhomboides* male paratype (127-129), female paratype (130): 127, fore leg; 128, proximal part of fore tibia with tibial comb; 129, head in lateral view; 130, ovipositor; 131 *A. tahitiensis*, male, head in lateral view; 132-135, *A. salibabu*, male paratype (132-134), female paratype (135): 132, fore leg; 133, proximal part of fore tibia with tibial comb; 134, head in lateral view; 135, ovipositor. – Scales: 128, 133: 0.1mm, 127, 129, 131, 132, 134: 0.5 mm, 130, 135: 0.25 mm.
Male structural characteristics, in dorsal view the lateral margins of head parallel with anterior margin nearly straight and vertex level with eyes, width of head 0.9 times the humeral width of pronotum (1.3/1.4), just under seven times the anterior width of vertex (6.0-6.9, ocular index (V) = 0.37); synthlipsis on average just over one third the anterior width of vertex (0.28-0.36). Along median axis, median length of head equal to slightly shorter than median length of pronotum (0.89-1.04). Tylus laterally compressed resulting in a somewhat conical elevation, apically with a shallow lozenge-shaped fossa, dorsally with an indication of a carina which does not continue between eyes. Rostral prong (fig. 129) with base originating near distal end and distinctly projecting in front of fourth rostral segment; twice the length of third rostral segment (0.55/0.28), including the part laterally on third rostral segment apex acuminate and in most specimens somewhat sinuate. Stridulatory comb on fore tibia (figs. 127, 128) consisting of 28-32 teeth gradually increasing in size towards anterior margin of tibia. Fore tarsus without row of small pegs.

Female structural characteristics. Head parallel-sided to very slightly diverging posteriorly, nearly six times as wide as anterior width of vertex (1.32/0.23, ocular index (V) = 0.43), its median length equal to shorter than median length of pronotum (0.83-1.0), synthlipsis two fifth the anterior width of vertex (0.09/0.23). Ovipositor fig. 130.

Etymology
Rhomboides refers to the lozenge shaped fossa on tylus.

Comparative notes
Similar to A. tahitiensis Lundblad which, however, in males has a distinct keel running from tylus upward between eyes and rostral prong not projecting in front of fourth rostral segment (fig. 131). Females of A. tahitiensis have a relatively slightly wider synthlipsis (half anterior width of vertex) and head three fifth the length of pronotum. If our concept is correct A. tahitiensis is distributed from New Guinea through Melanesia to Tahiti and A. rhomboides around the Sulawesi Sea.

Anisops salibabu sp. n. (figs. 132-135)
Type Material. – Holotype male (NCTN), dark form, INDONESIA, Sulawesi Utara: Pulau Salibabu, Lirung, nearly dry stream on hill shaded by remnants of forest, small shallow pools of water with much plant debris connected by a trickle of water, 24.xi.1994, N9483. – Paratypes (adults only): 18♀; Same data as holotype 4♂ 6♀ dark form, 2♂ 1♀ light form, 2 lvV. (NCTN); P. Sangir, Salurang, roadside pond with Nymphaea, 20.xi.1994, N9482, leg. N. Nieser, 5♂ 5♀ (2♂ 2♀ NCTN, 1♂ 1♀ NHMW, 1♂ 1♀ OXUM, 1♂ 1♀ SEMC). P. Karakelang, Ambela, first part of irrigation trench, shaded, no aquatic vegetation, 28.xi.1994, N9494, 3♂ 1♀ 2lvV (1♂ 1♀ MBBJ, 2♂ NCTN), Dumoga Bone N.P. area, lakes, kleiner See, Fischteich (small lake, fish pond) 1985, 4♂ 4♀ leg. G. Zimmermann (1♂ 1♀ NCTN, 1♂ 1♀ RMNH, 1♂ 1♀ ZC, 1♂ 1♀ ZMAN).

Remark: The localities in the Sangir/Talaulud isles are all rather small stagnant shaded waters in or at the edge of woodland.

Description
General shape, a small broad-headed species, body fusiform with greatest width at the level of apex of scutellum. Dimensions (measurements taken from alcohol-preserved specimens), length ♂ 5.2-5.28-5.4 ♀ 5.2-5.59-5.8; width of head ♂ 1.30-1.27-1.28 ♀ 1.23-1.35-1.40; humeral width of pronotum ♂ 1.30-1.31-1.35 ♀ 1.38-1.48-1.55; anterior width of vertex ♂ 0.12-0.14-0.15 ♀ 0.19-0.21-0.24; synthlipsis ♂ 0.056-0.058-0.064 ♀ 0.081-0.092-0.100.

Colour (based on alcohol specimens), pale form, hemielytra hyaline except for a slight infuscation at base, body pale yellowish except for eyes, rostrum, posterior part of abdominal dorsum, most of abdominal sternites (except median carina) and bands along the sutures of connexiva, which are brown-grey to blackish. Dark form as light with additional dark areas: meso- and metanotum including scutellum and base of abdomen brown to dark brown, connexiva predominantly brown. Although all specimens are morphologically macropterous, only the dark form has developed indirect flight muscles. The thoracic pigmentation of the dark form develops during general development, judging from our material, in about the same pattern as in Corixidae (Young 1965) and Gerris (Andersen 1973). One of the male light form specimens from N9483 had just moulted and had developing indirect flight muscles, the others apparently had the spongy tissue indicating permanently reduced flight muscles. No systematic differences in ratios between measurements have been found between the dark and light form.

Structural characteristics, labrum over half as long as wide (0.14/0.23), with a few small semierect bristles (usually 3-5, but they easily rub off), apex obtuse. Eyes a quarter of their length longer than median length pronotum (0.95/0.75). Pronotum twice as wide as its median length (1.40/0.66), lateral margins diverging posteriorly, half as long as median length (0.33/0.66).
Male structural characteristics, in dorsal view the outline of the head is rounded with anterior margin nearly straight and vertex only slightly indented, width of head 0.95–1.0 times the humeral width of pronotum, 8–10 times the anterior width of vertex (8.2–10.1, ocular index (V) = 0.25); synthlipsis over one third the anterior width of vertex (0.37–0.45). Along median axis, head longer than pronotum (0.76/0.65). Humeral width of pronotum twice its median length (1.31/0.65); lateral margins diverging somewhat about half its median length (0.35/0.65); posterior margin convex, medianly emarginate. Tylus moderately swollen, labrum two thirds as long as its basal width (0.13/0.19) with a few bristles, apex rounded. Rostral prong (fig. 134) with base originating near proximal end and three quarters the length of third rostral segment, apex acuminate. Stridulatory comb on fore tibia (figs. 132, 133) consisting of 19–23 teeth gradually increasing in size towards anterior margin of tibia. At the base of the comb (towards posterior margin of tibia) there are 0–4 isolated much smaller teeth. Tarsus without small pegs on its inner surface. Length of leg segments as in table 1.

Female structural characteristics. Head parallelsided, anteriorly truncate with vertex slightly indented, width of head six and a half times as wide as anterior width of vertex (5.8–6.9, ocular index (V) = 0.36), its median length shorter than median length of pronotum (0.71–0.99), synthlipsis slightly less than half the anterior width of vertex (0.09/0.21).

Etymology
Salibabu, a noun in apposition refers to the island where the holotype was collected.

Comparative notes
*A. salibabu* belongs to the *A. philippinensis*-group, small species with no distinct characteristics. Dr. Lansbury wrote us that he formerly included some populations from the Australian region in *A. philippinensis* Brooks (Lansbury 1964, 1978) but that he is now inclined to consider these different species. The main difference between *A. salibabu* and *A. philippinensis* is the lack of small pegs on male fore tarsus in *A. salibabu*. Moreover, the median length of head in *A. philippinensis* is shorter to equal median length of pronotum and the number of teeth in the male tibial comb seems to be less (17).

*Enithares bakeri* Brooks

*Enithares bakeri* Brooks, 1948: 40.


*Enithares ektakta* Nieser & Chen


Material. – INDONESIA, Sulawesi Utara, Pulau Sangihe, Lelepu, Sungai Lelepu, lowland stream, *Enithares* from small rather deep (0.3 m) pools at edge of stream, hidden under overhanging vegetation, 13. XI. 1994, N9464, 2♂ 2♀, leg. N. Nieser

*Enithares producta* Lansbury


*Nychia sappho* Kirkaldy


Material. – INDONESIA, Sulawesi Utara, Domoga Bone N.P., lakes, kleiner See, Fischteich {small lake, fish pond}, 1985, 1♀ macr. leg. G. Zimmermann

**DISCUSSION OF THE SULAWESI FAUNA OF NEPOMORPHA**

(see table 2)

The most obvious characteristic of the Sulawesi fauna of Nepomorpha is the paucity of Naucoridae s.str. This is especially interesting as New Guinea has a very rich fauna with seven endemic genera and numerous species (La Rivers 1971a), the Philippines have five genera of which three are endemic (D. & J. Polhemus 1987) with some ten species of which several are still undescribed (J.T. Polhemus in litt.) and to the west the Laccocorinae are well represented (La Rivers 1971b). As collecting in recent years has been quite intensive it is quite probable that the Naucoridae s.str. in Sulawesi are effectively restricted to *Naucoriscutellaris*. For this reason the species of Naucoridae occurring in the Sunda islands have been lumped to genera in table 2. The Aphelocheiridae are with...
four species reasonably well represented compared to one each in Irian, Mindanao and Jawa, two in Borneo and so far one in Sumatra although one or two of the W. Malaysian species which have ample distribution into Thailand (see table 2) may be found to extend their range into Sumatera. The relative abundance of Aphelocheiridae may partly be due to quite intensive collecting, in which especially the stream fauna has not been neglected, in Sulawesi compared to some of the other islands. Both Bornean species, e.g., have been found in the same area and most of Kalimantan has hardly been sampled with respect to water bugs. In New Guinea, with its rich fauna of Naucoridae, possibly most niches were occupied before Aphelocheirus reached the island. This implies that Naucoridae would be a much older group than Aphelocheiridae, which in view of the world distribution (Naucoridae world-wide, Aphelocheiridae Old World but poorly represented in the Australian and European subregions) and the large number of autapomorphic characteristics found in this family (Mahner 1993) could be the case. The fossil record does not help much as no fossils have been attributed to Aphelocheiridae so far. To apply the inverse argument for Sulawesi, Aphelocheirus reached this island before stream inhabiting Naucoridae did, which leaves the question why, as the island is surrounded by a rich and diverse Naucorid fauna.

A second more general feature are the distinct differences in distribution area of species of various genera. Species of Aphelocheirus, Enithares and Hydrostrophes tend to have restricted distributions which results in most of them being endemic in the quite large areas used in table 2. Of these Enithares and Hydrostrophes are very richly represented in Sulawesi and most of the endemic species seem to be restricted to a small part of the island, although as in many cases these species are only known by their type series, this pattern may change somewhat in the future. The peculiar shape of Sulawesi may be the main cause. The complicated geological history of Sulawesi seems to have had less influence on this aspect as the number of species per area appears to be the same in parts of different geological origin. This would mean that these species have evolved after the island got its present composition and that the speciation is more closely related to the more recent bottle necks to gene flow than to more ancient geological isolation (J. & D. Polhemus 1990). The origin of the fauna is apparently from the SE Asian mainland through the Sunda isles. Characteristic and richly represented taxa in the Australian-New Guinea fauna (Gelastocoridae, Naucoridae, Ochteridae) do not seem to have spread westward.

As far as known at present a number of genera has reached Borneo or Jawa & Nusa Tenggara, or both, but not Sulawesi: Distotrephes, Helotrephes, Idiotrephes, Helocoris, Laccocoris and Aphelonecta. The same pattern is true for genera of Gerromorpha (J. & D. Polhemus 1990). Initially it could be supposed that this may also have contributed to the relative abundance of species of Enithares and Hydrostrophes in Sulawesi. When their first representatives reached Sulawesi they may have found good niche opportunities due to the absence of related forms. But if the pattern of a large number of species each with their own small distribution area is confirmed, as is seen especially in Enithares (Nieser & Chen 1996) then local geographical isolation would be the main candidate for the driving force behind the species richness of these genera in Sulawesi (J. & D. Polhemus 1990).

REFERENCES
Incorporated are also papers which have not been specifically referred to in the text but which have contributed data to table 2, these have been marked by an *.


Truxal, F. S., 1953. A revision of the genus Buenoa

Received: 7 October 1997
Revised version accepted: 10 April 1999.
Table 2. Distribution catalogue of Nepomorpha found in Indonesia and adjacent areas.

As the study centers on Sulawesi, New Guinean species have only been incorporated when they have also been found west of New Guinea. Likewise for the Naucoridae, which probably will not have representatives in Sulawesi, the distribution is only presented per genus.

Abbreviations: Ba = Bali, Bo = the Island of Borneo, I = New Guinea, J = Jawa, Ma = Maluku, Mi = Mindanao, N = Nusa Tenggara, R = note, see under the number below the table, Sl = Sulawesi, Sm = Sumatera, W = West Malaysia (+Singapore); abbreviations + = endemic, ● recorded, ? questionable record, number under R = see Remarks

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|                                   | philippinensis Brooks             | 34
|                                   | rhomboides sp.n.                  |
|                                   | salbabu sp. n.                    |
|                                   | stali Kirkaldy                    |
|                                   | sutleri Brooks                    |
|                                   | thienemanni Lundblad              |
|                                   | Apheloeotus lansbury              |
|                                   | alexis Lansbury                   | 35
|                                   | gavini Lansbury                   |
|                                   | gigan Zettel                      |
|                                   | jaechi Zettel                     |
|                                   | nakatae Lansbury                  |
|                                   | Enithares Spinola                 |
|                                   | bakeri Brooks                     |
|                                   | bulberi Brooks                    |
|                                   | caesaries Nieser & Chen           |
|                                   | charakia Nieser & Chen            |
|                                   | ektakta Nieser & Chen             |
|                                   | genitalis Lundblad                |
|                                   | hippokleides Kirkaldy             |
|                                   | harvathi Kirkaldy                 |
|                                   | intricata Breddin                 |
|                                   | lansburyi Nieser & Chen           |
|                                   | lombokensis Lansbury              |
|                                   | maai Lansbury                     |
|                                   | malayensis Brooks                 |
|                                   | mandalayensis Distant             |
|                                   | margarethae Nieser & Chen         |
|                                   | martini Kirkaldy                  |
|                                   | megalops Lansbury                 |
|                                   | paramegaloops Lansbury            |
|                                   | phenakismos Nieser & Chen         |
|                                   | producta Lansbury                 |
|                                   | ripleyana Lansbury                |
|                                   | skutalis Nieser & Chen            |
|                                   | stanata Nieser & Chen             |
|                                   | subparalela Lansbury              |
|                                   | thienemanni Lundblad              |
|                                   | timorensis Brooks                 |
|                                   | uncata Lundblad                   |
|                                   | vicintricata Lansbury             |
|                                   | Nychia Stål                       |
|                                   | sappho Kirkaldy                   | 41

**Ochteridae**

| Ochterus Latreille                |
| grandiusculus Nieser & Chen       |
| homorfor sp. n.                   |
| marginatus (Latreille)            |
| noualhieri Bahr                   |
| pardalo sp. n.                    |
| surigoensis Gapud                 |
| thienemanni Jaczewski             |
| trichotos sp. n.                  |
| xustori Nieser & Chen             |

**Pleidae**

| Paraplea Esaki & China            |
| frontalis (Fieber)                |
| liturata (Fieber)                 |

W Sm J Ba N Bo Sl Ma I Mi R
Remarks
1. Aphioloeirus femoratus and A. grik reach into NW Thailand.
2. Aphioloeirus hyalinipennis is a very widespread species, from Pakistan through India and Myanmar to Taiwan, Okinawa and New Guinea (Jaczewski 1962). The New Guinea record should be verified, however.
3. Sigara connexa has also been recorded from Myanmar and Vietnam.
4. Hydrotrephy polhemusi known from Flores only.
5. Hydrotrephy setelli known from Sangir island only.
6. Idiotrephy chinei also known from several localities in Thailand (Zettel 1995b).
7. Tiphotrephy indicus has been recorded from India, Myanmar, Thailand and W. Malaysia.
8. Micronecta fugitans has also been recorded from Thailand.
9. Micronecta grisea has been recorded from India and Sri Lanka through Vietnam to Taiwan.
10. Micronecta haliploides has been recorded from NE India and Sri Lanka through Thailand to Vietnam.
11. Micronecta quadririgrata one of the most widespread species, from Iran through India to Taiwan, the Philippines and N. Australia.
12. Micronecta siva has been recorded from India and Sri Lanka, Myanmar and Vietnam.
13. Micronecta tarsalis has been recorded from S. India, Sri Lanka and Vietnam.
14. Micronecta virgata has been recorded from Australia and Pacific islands.
15. Centipocoris has also some S. American representatives (D. Polhemus 1987).
18. Laccocoris 5 species of which four are restricted to N. Borneo in the area under consideration.
19. Cercometes asiaticus reaches NW Thailand, we have seen 21ª from the Philippines, Palawan, Busuanga, 24-29.II.1996 leg. H. Zettel (ZPC), first record for the Philippines. The var. longicollis Mont. has, except for 1 specimen from W. Malaysia, so far only been recorded from Borneo.
22. J. Polhemus & Keffer (1999) point out that Laccotrophes robustus is restricted to the Philippines, the widespread large species should be called L. pfeiferiae.
23. Ranatra diminuta has also been recorded from Luzon (J. Polhemus & Reisen 1978).
24. Ranatra longipes has two subspecies in Sulawesi, R. l. celebensis Lansbury (1972) which has only been collected in Sulawesi Selatan; specimens from Sulawesi Tenggara belong to the nominal subspecies (Nieser & Chen 1991). We have seen 4♀ 4♂ of the nominal subspecies from the Philippines, Palawan, Busuanga, 23-24.II.1996 leg. H. Zettel (ZPC), first record for the Philippines.
25. Ranatra natunensis Natuna Besar island only.
26. Ranatra parmae occurs also in Thailand and Laos.
27. Ranatra stali is endemic to the Philippines, mainly Mindanao with 1 record for Leyte and 2 for Luzon (Lansbury 1972, J. Polhemus & Reisen 1976).
28. Ranatra sulawesi has 2 subspecies, R. s. sebui Nieser & Chen (1996) restricted to Mindanao. The nominate subspecies has also been found in Thailand (new record for Thailand, locality in Thai script, KKUC).
29. Ranatra variipes is distributed through the countries bordering the Bay of Bengal extending S to Jawa.
30. Anisops breddini is distributed from India and Sri Lanka through SE Asia to Indonesia.
31. Anisops cleopatra was described from New Caledonia (Distant 1914) and later recorded from Jawa and Sumatera (Lundblad 1933), it has, however, never been found in between these areas so we doubt these populations belong to a single species.
32. Anisops kuroiwae is distributed from India through SE Asia to Hainan, Taiwan, Iriomote and the Philippines.
33. Anisops nigrolineata, although described from Jawa, is mainly known from India but distributed over Myanmar, Thailand and Sibuyan Island in the Philippines.
34. Anisops niveus mainly known from India and Sri Lanka, also occurring in Vietnam.
35. Anisops philippinensis has also been recorded from Luzon, records from the Australian Region probably refer to a different species, see comparative notes under A. salibabu.
36. Anisops thienemanni was described from Jawa and seems to be common in Australia. As it has not been found in the area in between we doubt if these populations belong to a single species.
37. Aphioloeirus gavini is distributed from Malaysia through Thailand to Vietnam.
38. Aphioloeirus jacchi is known by the unique holotype from Sibiter Island (Zettel 1995c).
39. Enithares ektakta has been recorded from Sangir Island only.
40. Enithares genitalis has also been recorded from Luzon (J. Polhemus & Reisen 1978).
41. Enithares malayensis has been recorded from the Riau islands which belong politically to Indonesia, but for our purpose have been added zoogeographically to W. Malaysia.
42. Enithares martini is widespread in Mindanao including the Sulu islands and has also been recorded from Luzon.
43. Enithares uncata and E. mandalayensis are very similar and their distributional areas seem to be exclusive. E. uncata restricted to Jawa and Sumatera, E. mandalayensis in continental SE Asia. Lansbury (1968) suggests that they may be different on subspecific level only.
44. Nychia sappho extends into Australia & Continental SE Asia.
Table 1. Leg measurements of Nepomorpha in mm.

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<tr>
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<td>0.27</td>
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</tr>
<tr>
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<tr>
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<tr>
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<td>0.80</td>
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<tr>
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<tr>
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<td>0.80</td>
<td>0.24</td>
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<td><em>Hydrotrephes makros</em> (1 ♂ 1 ♀ only)</td>
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<tr>
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<td>1.39</td>
<td>0.42</td>
<td>0.40</td>
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<tr>
<td><em>Hydrotrephes mexon</em> (based on 4 ♂ 2 ♀)</td>
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<tr>
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<td>0.90</td>
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</table>

1 in *Micronecta* females tibia+tarsus
2 in *Ochterus* tarsal segment 1 is measured with 2 together, the hind leg has 3 tarsal segments. As there seems to be no systematic difference between the leg measurements in males and females, they have been lumped in *O. pardalos*.