

Ann. Naturhist. Mus. Wien	104 B	45 - 97	Wien, März 2003
---------------------------	-------	---------	-----------------

The Helotrephidae (Insecta: Heteroptera) of the Philippine Islands

H. Zettel*

Abstract

The Helotrephidae of the Philippine Islands are reviewed taxonomically. In the Philippines, the family is represented only by the genus *Hydrotrepes* CHINA, 1935. Three species have been previously described: *Hydrotrepes balnearius* (BERGROTH, 1918) from Luzon is redescribed and first recorded from Polillo Island; *H. pardalos* NIESER & CHEN, 1999 and *H. stereos* NIESER & CHEN, 1999, both from Mindanao, are discussed. Thirteen new species and three new subspecies are added: *Hydrotrepes bicolanus bicolanus* sp.n. (from South Luzon), *H. bicolanus seyferti* ssp.n. (from South Luzon and Catanduanes), *H. busuanganus* sp.n. (from Busuanga), *H. masbatensis* sp.n. (from Masbate), *H. milanae* sp.n. (from Leyte and Biliran), *H. minutus* sp.n. (from Busuanga), *H. ornatus* sp.n. (from North Luzon), *H. palawanensis* sp.n. (from Palawan), *H. philippinus* sp.n. (from North and Central Luzon), *H. sallyae* sp.n. (from Bayagnan), *H. samarensis* sp.n. (from Samar), *H. stereoides stereoides* sp.n. (from Central Luzon), *H. stereoides mindoroensis* ssp.n. (from Mindoro), *H. stereoides montanus* ssp.n. (from North Luzon), *H. visayasensis* sp.n. (from Masbate, Panay, Negros, Cebu, Leyte, and Samar), and *H. vulcanus* sp.n. (from South Luzon). Morphological details of all species and subspecies are illustrated. The three species from the Palawan Region belong to the *H. mirus* species group (sensu ZETTEL 1998), which is restricted to areas with Pleistocene land connections to the Southeast Asian mainland. Three endemic Philippine species groups (the *H. balnearius*, *H. philippinus*, and *H. stereos* species groups) are newly defined to include eleven of the other thirteen species from the Philippine Region (excluding Palawan). Their zoogeography is discussed. A key to the Philippine species and subspecies of *Hydrotrepes*, distribution maps, and notes on ecology and habitats are provided.

Key words: Heteroptera, Helotrephidae, *Hydrotrepes*, new species, new subspecies, new species group, taxonomy, description, zoogeography, distribution, new record, habitat, Philippines.

Zusammenfassung

Die Helotrephidae der Philippinen werden taxonomisch revidiert. Auf den Philippinen ist diese Familie nur durch die Gattung *Hydrotrepes* CHINA, 1935 vertreten. Drei Arten sind zuvor beschrieben worden: *Hydrotrepes balnearius* (BERGROTH, 1918) von Luzon wird redeskribiert und erstmals für Polillo nachgewiesen; *H. pardalos* NIESER & CHEN, 1999 und *H. stereos* NIESER & CHEN, 1999, beide von Mindanao, werden diskutiert. Dreizehn neue Arten und drei neue Unterarten werden beschrieben: *Hydrotrepes bicolanus bicolanus* sp.n. (von Süd-Luzon), *H. bicolanus seyferti* ssp.n. (von Süd-Luzon und Catanduanes), *H. busuanganus* sp.n. (von Busuanga), *H. masbatensis* sp.n. (von Masbate), *H. milanae* sp.n. (von Leyte und Biliran), *H. minutus* sp.n. (von Busuanga), *H. ornatus* sp.n. (von Nord-Luzon), *H. palawanensis* sp.n. (von Palawan), *H. philippinus* sp.n. (von Nord- und Mittel-Luzon), *H. sallyae* sp.n. (von Bayagnan), *H. samarensis* sp.n. (von Samar), *H. stereoides stereoides* sp.n. (von Mittel-Luzon), *H. stereoides mindoroensis* ssp.n. (von Mindoro), *H. stereoides montanus* ssp.n. (von Nord-Luzon), *H. visayasensis* sp.n. (von Masbate, Panay, Negros, Cebu, Leyte und Samar), und *H. vulcanus* sp.n. (von Süd-Luzon). Morphologische Details aller Species und Subspecies werden abgebildet. Die drei Arten aus der Palawan Region gehören in die *H. mirus*-Artengruppe (sensu ZETTEL 1998), die auf jene Gebiete beschränkt ist, welche pleistozäne Festlandverbindungen mit Südostasien gehabt haben. Drei Philippinen-endemische Artengruppen (die *H. balnearius*-, *H. philippinus*- und *H. stereos*-Gruppe) werden neu definiert, um elf der dreizehn weiteren Arten der Philippinischen Region (exklusive Palawan) zu umfassen. Ihre Zoogeographie wird diskutiert. Ein Bestimmungsschlüssel zu den philippinischen Arten und Unterarten von *Hydrotrepes*, Verbreitungskarten und Anmerkungen zur Ökologie und Habitatpräferenz werden ebenfalls geliefert.

* Dr. Herbert Zettel, Natural History Museum, International Research Institute of Entomology, Burggring 7, A-1014 Vienna, Austria

Introduction

Biologists have recognized the Philippine Islands as one of the ten greatest centres of endemism on earth. In insects, this enormous diversity is more the result of allopatric endemic species in many of the 7000 islands than of a high number of species per island. Due to the mainly oceanic origin and permanent isolation of the Philippines (except the Palawan Region), relatively few species of aquatic Heteroptera have reached the archipelago and survived there in the past, later splitting to yield the present high number of species. A good example are the Helotrephidae: Only one genus, *Hydrotrepes* CHINA, 1935, is so far known from the Philippines, but a few clades (here defined as species groups) have radiated to numerous regionally endemic species and subspecies. In Philippine Helotrephidae the species endemism is 100 %.

The first Philippine species of Helotrephidae was described early: *Hydrotrepes balnearius* (BERGROTH, 1918) from Luzon was the fifth discovered species of the family. It took more than eighty years for two more species, *H. pardalos* NIESER & CHEN, 1999 and *H. stereos* NIESER & CHEN, 1999, to be added, from Mindanao. Numerous samplings carried out during the last ten years, mostly by the author, yielded numerous specimens of *Hydrotrepes* from altogether fifteen islands, which are the base for the present study. *Hydrotrepes* shows a pattern of vicariancy like that in other aquatic and semiaquatic Heteroptera (see, e.g., ZETTEL & al. 1999 for Naucoridae, and ZETTEL 1994, 1996, 1997 for the Veliidae genus *Rhagovelia* MAYR, 1860). *Hydrotrepes* can be found in adequate habitats all over the Philippines. Until now, a maximum of three species per habitat has been collected in streams in North Luzon, Samar, and Leyte.

This paper raises the number of the Philippine species of *Hydrotrepes* to seventeen (sixteen described, one undescribed), which is even more than the species numbers in Borneo (11 species; see ZETTEL 2000, 2001) or Sulawesi and adjacent islands (11 species; see NIESER & CHEN 1999). NIESER & CHEN (1999) state for *Hydrotrepes* that "apparently Sulawesi is a special centre of differentiation". The same is true for the Philippine Islands. It seems evident, that the *Hydrotrepes* fauna is especially rich in those areas, which have not been reached by the genus *Helotrephes* STAL, 1860, which occupies similar ecological niches. The distribution of *Helotrephes* is limited to the east by Wallace's Line (modified sensu DICKERSON 1928) and is so far unknown from Palawan. Discovery of further species of *Hydrotrepes* from unexamined or poorly examined Philippine islands can be predicted for the future.

Material and methods

Material:

This taxonomic study is based on more than 1400 adult specimens of *Hydrotrepes* from fifteen of the Philippine Islands. Immatures, although often present in the samples, were not included in this study. Specimens collected by the author have been killed with ethyl-acetate and then dry mounted on paper cards. Some specimens of larger series have been preserved secondarily, after softening, in 70 % ethanol. The material is deposited in the following collections:



Fig. 1: *Hydrotrepes ornatus* sp.n., habitus, dorsal aspect (illustration: M. Buch).

Repositories:

- | | |
|-------|---|
| CNT | Coll. Nico Nieser, Tiel, The Netherlands |
| CSSAC | Camarines Sur State Agricultural College, Pili, Camarines Sur, Philippines |
| CSW | Coll. Franz Seyfert, Vienna, Austria |
| CVPG | Coll. V.P. Gapud, University of the Philippines, Los Baños, Laguna, Philippines |

CZW	Coll. Herbert & Sally Zettel, Vienna, Austria
IRRI	International Rice Research Institute, Entomological Collection, Los Baños, Laguna, Philippines
JTPC	Coll. John T. Polhemus, Englewood, Colorado, U.S.A.
MTMB	Hungarian Museum of Natural Sciences (Magyar Természettudományi Múzeum), Budapest, Hungary
NHMW	International Research Institute of Entomology, Natural History Museum, Vienna, Austria
SHUK	Entomological Collection, Snow Hall, University of Kansas, U.S.A.
UBCB	University of South Bohemia, Coll. Miroslav Papáček, České Budejovice, Czech Republic
UPLB	Museum of Natural History, University of the Philippines, Los Baños, Laguna, Philippines
ViSCA	Visayas State College of Agriculture, Baybay, Leyte, Philippines
ZMUH	Zoological Museum, University of Helsinki, Finland

Material is referred by citing the original labels of the dry mounted specimens. Each single label is marked with """; the backslash sign \ indicates the break of a line. Additions or corrections are made in []. Alcohol material is labelled in a short form including the unique collecting site number cited at the end of each label.

Terminology:

Terminology follows ZETTEL & POLHEMUS (1998) and ZETTEL (2000); the term "sternite" is used instead of (morphologically correct:) "abdominal sternum", and "subgenital plate" instead of "abdominal sternum 7" of the female. Specimens listed in the "Material" sections are "brachypterous" (= hind-wing-micropterous; forewing long, but without claval and embolar suture), if not otherwise stated (according to the development of hemelytra).

Methods:

A Leica WILD M10 binocular microscope with magnifications up to 128 x was used for examination of specimens; drawings were made by using a camera lucida.

Measurements (either in millimetres or as the ratio of two lengths) refer either to the holotype or to a randomly selected paratype of the other sex and the other morphs, respectively. If ranges of measurements are presented, they refer either to all specimens available or to a minimum of ten randomly selected specimens of each sex and morph. Body lengths and widths are presented in 0.05 mm steps, as higher accuracy is not useful because of the variation due to different preparations of the material.

Identification:

Species discrimination is mainly based on genitalia of male (aedeagus, parameres) and terminalia of female (subgenital plate, ventral laterotergites 7). To study these structures, dissection is necessarily required. For the identification of males, a dissection of the whole genital capsule and a careful lifting of the aedeagus (without removing it) readily enables the examination of all important parts. In dry mounted specimens, it is of advantage to glue the genital capsule upright on a small cardboard, so that aedeagus and parameres are visible from several aspects. For correct comparison, all figures in this paper show strictly the right aspect (in addition, apical view of apex of aedeagus and full face view of apex of both parameres).

For examination of females, first the whole terminal part of the abdomen should be removed (segment 7 and following). Then sternite 7 (subgenital plate) and laterotergites 7 should be removed from each other and from the remaining parts. Because of the strong pilosity, embedding these parts in a transparent, water-soluble medium (e.g., dimethyl hydantoin formaldehyde resin) facilitates better viewing of the diagnostically important ridges and furrows.

The taxonomic value of other characteristics has been discussed by POLHEMUS (1997). For Philippine species, colour allows only identification of some aberrant species, but most of the species groups; it is dimorphic in some species (depending on development of wings). The incision of the pronotal plate and the sternal carinae serve to distinguish few species or species groups, but – compared with species from other areas – both characteristics are surprisingly uniform in most Philippine species. Puncturation of the dorsum is an important character for distinguishing some species, but difficult to describe, and therefore only of value in direct comparison of specimens; it also varies between brachypterous and macropterous specimens. The density of puncturation is described by comparing the diameter of punctures with the smallest distance between the margins of two punctures.

Zoogeography

Zoogeographical studies on the Philippine islands yield similar or identical distribution patterns in most terrestrial and limnic organisms. The reason for this concurrence is the identical process of historical isolations. On the species level, the main factor for distribution patterns is the shape of islands during the Pleistocene cold periods, when many of the recent islands - now separated by shallow shelf seas - were connected to much larger islands by the lowered sea level (see, e.g., HEANEY 1986). For aquatic Heteroptera, this has been pointed out, e.g., by ZETTEL & al. (1999) for the Naucoridae. This paper follows the terminology commonly used in biogeographical studies on other animal groups, especially on mammals by HEANEY (1991).

The distribution of species and species groups of *Hydrotrepes* follow similar patterns. In the Philippines, the *H. mirus* group is restricted to Greater Palawan (Fig. 125), but it is also known from Japan, the southeast Asian mainland, and Borneo. The *H. balnearius* group is endemic in Greater Luzon (Fig. 125). The *H. philippinus* group is widely distributed in Greater Luzon, Greater Mindanao, and in Greater Negros-Panay (= West Visayas), one species (*H. visayasensis* sp.n.) surprisingly transgressing the border between the latter two regions (Fig. 126). The *H. stereos* group inhabits areas belonging to the Pleistocene islands Greater Luzon and Greater Mindanao, and has additionally, and probably relatively late, invaded Mindoro from Luzon (Fig. 127).

Biology, ecology, and habitat preferences

All Helotrephidae are subaquatic and are predacious fluid-feeders on small invertebrates. In *Hydrotrepes*, oxygen supply is from the air at the water surface and, additionally, from gas exchange between water and an air bubble on the abdominal venter. A few notes on the biology of "*H. balnearius*" have been published by USINGER (1937).

Most species of *Hydrotrepes*, including all from the Philippines, live in lentic parts of running waters, where they creep and swim at the water's edge or between roots or plant debris. No significant habitat differences have been observed between species so far. Most specimens have been collected in three types of microhabitats: (1) on steep rocky banks of streams, where water passes regularly and usually rather slowly; (2) on and between roots of trees hanging into the water body, preferably at places with undercut river banks; (3) in large aggregations of plant debris (twigs and leaves) in quiet bays of streams. Shaded habitats are generally preferred. USINGER (1937) reported: "... hundreds of nymphs and eight adults were collected about green or dead vegetation (grasses or weeds), either growing from the river-bottom or held in place at the surface by some obstructions." and "... in quiet pools beneath floating vegetation ..."; he identified his specimens as *H. balnearius*, because no other species has been known from the Philippines at that time, but the notes may refer to *H. stereoides* sp.n. or *H. philippinus* sp.n. as well.

Flight activities have not been observed so far, and there are no records of Helotrephidae from light traps. The low distribution abilities must be seen as the main reason for the restricted distribution areas of most species, which inhabit islands.

Presently, there is little knowledge about the sensitiveness of Helotrephidae to habitat changes by man. The most sensitive genera with benthic life habits, like *Fischerotrephes* ZETTEL, 1994, *Trephotomas* PAPÁČEK, ŠTYS & TONNER, 1988, or *Distotrephes* POLHEMUS, 1990, are so far not recorded from the Philippines. These three genera occur in Borneo and may be found in Palawan as well by more intensive investigations of intact habitats. Some Philippine species of *Hydrotrepes* can be found in huge numbers even in degraded areas, but others seem to be rare according to recent collecting activities.

Taxonomy

Hydrotrepes CHINA, 1935

Type species: *Helotrephes bouvieri* KIRKALDY, 1904 (from Sulawesi) by original designation.

Notes: *Hydrotrepes* is the most diverse genus of the Helotrephidae. It is distributed from Sri Lanka to the Philippines and Sulawesi, and is the only genus of the family which transgresses Wallace's Line eastwards. Very recent studies on its regional species diversity have been published: POLHEMUS (1997) on Sulawesi; NIESER & CHEN (1999) on Sulawesi and the Philippines; ZETTEL (1998), KOVAC & PAPÁČEK (2000), and PAPÁČEK & KOVAC (2001) on Thailand, Laos, and West Malaysia; and ZETTEL (2000, 2001) on Borneo. The monophyly of *Hydrotrepes* in the present sense is doubtful: see discussions in ZETTEL & POLHEMUS (1998), and ZETTEL (1998, 2000). ZETTEL (1998, 2000) has defined four species groups containing most species described from Indonesia and Southeast Asia.

The conception of species groups in this paper follows ZETTEL (2000). The *Hydrotrepes mirus* group is by definition (ZETTEL 1998, 2000) identical with the genus *Heterotrephes* ESAKI & MIYAMOTO, 1959. Because there are Bornean species with intermediate sets of characteristics, *Heterotrephes* is preliminarily included in *Hydrotrepes*.

Diagnosis: Body length 1.9 - 3.5 mm, body usually strongly convex; eye in macropterous form slightly larger than in brachypterous form, or subequal in size; w-shaped suture of cephalonotum present; posterolateral margin of cephalonotum continued ventrally of eye, in macropterous morph simple or with angulation close to posterior corner; antenna 2-segmented; rostral segment 4 about 1.8 - 2.9 times as long as segment 3; propleuron separated into "pronotal plate" and "pleural plate" which situated in different levels to each other; pronotal plate with (often shallow) incision at eye level (see, e.g., Figs. 11 - 13, 26, 47 - 51); mesoscutellum enlarged; mesosternal carina low ("*Heterotrephes*-type"; Figs. 17 - 19) or relatively high, obtuse and with ventral lamella ("*Hydrotrephe*s-type"; e.g., Figs. 89 - 95); metasternal carina with ventral margin straight, without lamella, posteriorly forming distinct corner ("*Heterotrephes*-type"; Figs. 17 - 19), or roundish and with thin distal lamella ("*Hydrotrephe*s-type"; e.g., Figs. 89 - 95); sternal carinae usually reaching onto abdominal sternite 3, or, rarely, sternite 4 with small median tooth; carina of sternite 3 either rhomboid and smooth (Figs. 17 - 19) or triangularly produced and with more or less distinct teeth or denticles (e.g., Figs. 28, 52, 89, 108); hemelytron without pseudendocorium, claval suture of macropterous morph pointing at posterior third of mesoscutellum; costal margin of hemelytron with row of numerous fine ridges; legs with pectinate bristles; tarsal formula 1-1-2; metafemur with distal ridge; male genitalia variously modified: aedeagus long, cylindrical, rarely unmodified, with relatively simple tip ("*Heterotrephes*-type"; Figs. 2, 5, 8), but usually with strongly modified apex (lamina or carina) and/or posterodistal surface (spur or denticle) ("*Hydrotrephe*s-type"; e.g., Figs. 20, 32, 38, 61, 111); right paramere usually distinctly shorter than left paramere (e.g., Figs. 21, 62, 106), rarely long, slender, and undulate (Figs. 3, 6, 9), with apex variously modified; left paramere rather uniform: long, more or less tapering toward apex, on basal half with small mediad directed lobe; female: abdominal segments symmetrical; sternites 5 and 6 more or less fused; subgenital plate strongly varying, with different modifications (e.g., with medial tumescence, tooth, distal laminae, ridge, distomedial triangular process, or hair tufts), sometimes distinctly shortened (e.g., Figs. 14 - 16, 30, 31, 57 - 60, 96 - 102, 110, 117).

Within the tribus Helotrephini, *Hydrotrephe*s differs from the Oriental genus *Helotrephes* in the lack of median carinae on sternites 5 and 6. Differences from taxa from Africa and Madagascar are not resolved.

Key to the Philippine species and subspecies of *Hydrotrephe*s

- | | | |
|---|--|---|
| 1 | Median carina of prosternum with hind margin straight or at most with very shallow concavity (Figs. 17 - 19, 53, 56). | 2 |
| - | Median carina of prosternum with hind margin deeply concave (Figs. 28, 29, 52, 54, 55, 89 - 95, 118). | 6 |
| 2 | Sternite 4 medially with small tooth-like carina; mesosternum low and metasternal carina long, without thin lamina (Figs. 17 - 19); distal part of pronotal plate slender (Figs. 11 - 13); male: aedeagus simple (Fig. 8) or with very small apical lamella (Figs. 2, 5); right paramere slender, nearly as long as left paramere (Figs. 3, 6, 9); female: subgenital plate with medioapical lobe of typical, approximately pentagonal shape (Figs. 14 - 16); Palawan Region. (<i>H. mirus</i> group) | 3 |

- Sternite 4 medially without tooth-like carina; mesosternum relatively high and metasternal carina short, with or without thin lamina (Figs. 53, 56); distal part of pronotal plate broad (Figs. 48, 51); male: aedeagus strongly modified, with elongate apical structure (Figs. 35, 44); right paramere shortened and distally widened (Figs. 36, 45); female: subgenital plate apically triangular (Fig. 57) or unknown; Samar, Mindanao. (*H. philippinus* group, partim). 5
 - 3 Incision of pronotal plate very shallow (Fig. 13); puncturation of dorsum very fine, in middle of head distances between punctures several times as long as diameters of punctures; carina of sternite 3 low (Fig. 19); aedeagus of male simple (Fig. 8); subgenital plate of female with wide apical lobe (Fig. 16); Busuanga. *H. minutus* sp.n.
 - Incision of pronotal plate very deep (Figs. 11, 12); puncturation of dorsum strong, in middle of head distances between punctures at most twice as long as diameters of punctures; carina of sternite 3 high (Figs. 17, 18); aedeagus of male with minute, transparent apical lamella (Figs. 2, 5); subgenital plate of female with narrow apical lobe (Figs. 14, 15). 4
 - 4 Body length of brachypterous morph 2.05 - 2.20 mm; apex of prosternal and metasternal carinae pronounced (Fig. 18); subgenital plate of female with narrow apical lobe (Fig. 14); Busuanga. *H. busuanganus* sp.n.
 - Body length of brachypterous morph 2.20 - 2.50 mm; apex of prosternal and metasternal carinae not pronounced (Fig. 17); subgenital plate of female with broad apical lobe (Fig. 15); Palawan. *H. palawanensis* sp.n.
 - 5 Mesosternal carina with roundish apex (Fig. 56); head between eyes yellow, postero-medially with black stripe and often with blackish spot in front of this stripe; eye index of brachypterous morph approximately 2.5; male: aedeagus subapically constricted, apically with curved lamina, posteriorly simple (Figs. 44); distal part of right paramere elongate (Fig. 45); Mindanao. *H. pardalos*
 - Mesosternal carina with acute apex (Fig. 53); head between eyes blackish brown with small yellow spot in centre (Fig. 122); eye index of brachypterous morph 3.8; male: aedeagus subapically not constricted, apically straight, posteriorly with short tooth (Figs. 35); distal part of right paramere stout (Fig. 36); Samar. ... *H. samarensis* sp.n.
 - 6 Cephalonotum with very densely set, fine punctures, completely matt; aedeagus without tooth at hind margin, with subapical constriction, apically truncate (Fig. 111); female unknown. Bayaganan. *H. sallyae* sp.n.
- Note: A similar dense puncturation is found in an undescribed *Hydrotrepes*, which is only known from two females from Samar and Leyte.
- Cephalonotum with relatively large punctures, at disk of pronotum distances of punctures in average at least as large as their diameters, in most species much larger posteriorly; aedeagus very different (e.g., Figs. 20, 32, 38, 61, 76, 105). 7
 - 7 Whole dorsum with vivid colour pattern of yellow and black, black marks large and confluent (Fig. 1); pronotum with large, densely set punctures, on disk distances between punctures in average about as large as diameters of punctures (in macropterous specimens somewhat larger than in brachypterous); carina of sternite 3 strongly denticulate (Fig. 108); aedeagus of male relatively simple, with elongate, finger-shaped apex (Fig. 105); female subgenital plate simple, of characteristic shape (Fig. 110); North Luzon. *H. ornatus* sp.n.

- At least mesoscutellum and hemelytron without similarly vivid colour pattern, in most species with small, dark brown, faded spots; pronotum with punctures smaller or less densely set, posteriorly on disk distances between punctures in average about twice as large as diameters of punctures or longer; carina of sternite 3 usually weakly or indistinctly dentate (Figs. 28, 29, 52, 54, 55, 89 - 95); aedeagus of male and subgenital plate of female different, variously modified. 8
- 8 Male. 9
- Female. 20
- 9 Aedeagus at distal hind margin with two tubercles, without sharp tooth, subapical tubercle rounded (Figs. 61, 64, 79, 82), angulate (Figs. 67, 70, 73), or indistinct (Fig. 76); left paramere relatively broad, with minute apical tooth (Figs. 63, 66, 69, 72, 75, 78, 81, 84); right paramere short, strongly curved, and apically truncate (Figs. 62, 65, 68, 71, 74, 77, 80, 83). Note that in following couplets characteristics of size und puncturation refer only to brachypterous specimens! Macropterous specimens are on average broader and have less dense puncturation. (*H. stereos* group) 14
- Aedeagus at hind margin with more or less distinct, sharp tooth, without two roundish tubercles (Figs. 20, 23, 32, 38, 41); left paramere usually more slender (Figs. 22, 25, 34, 40, 43); right paramere of various shape. 10
- 10 Aedeagus with apical "head" well separated by subapical constriction (Figs. 20, 23); incision of pronotal plate relatively deep (Figs. 26, 27). (*H. balnearius* group) 11
- Aedeagus without strong subapical constriction (Figs. 32, 38, 41); incision of pronotal plate relatively shallow (Figs. 47, 49, 50). (*H. philippinus* group, partim) ... 12
- 11 Right paramere distally very broad and apically sharply truncate (Fig. 21); North and Central Luzon, Pollilo. *H. balnearius*
- Right paramere distally relatively slender and apically rounded (Fig. 24); South Luzon. *H. vulcanus* sp.n.
- 12 Eye index of brachypterous male 3.1 - 3.2; distal part of right paramere relatively long and slender (Fig. 33); distal part of left paramere relatively broad (Fig. 34); aedeagus in apical view with distinct apical plate reaching posterior tooth (Figs. 32); North and Central Luzon. *H. philippinus* sp.n.
- Eye index of brachypterous morph 2.3 - 2.8; distal part of right paramere relatively short and broad (Figs. 39, 42); distal part of left paramere relatively slender (Figs. 40, 43); aedeagus in apical view without apical plate, or with very narrow plate only at extrem apex (Figs. 38, 41); Visayas. 13
- 13 Aedeagus with tooth at hind margin in middle of length, and with apex hardly narrowed (Fig. 41); Masbate. *H. masbatensis* sp.n.
- Aedeagus with tooth at hind margin clearly distal of middle of length, and with apex distinctly narrowed (Fig. 38); Masbate (!), Panay, Negros, Cebu, Leyte, Samar. *H. visayasensis* sp.n.
- 14 Subapical tubercle of aedeagus sharply angulate (Figs. 67, 70, 73); North and Central Luzon, Mindoro. 15
- Subapical tubercle of aedeagus rounded or reduced (Figs. 61, 64, 76, 79); from other areas. 17

- 15 Midline of head densely punctured, most distances of punctures shorter than their diameters; pronotum width 1.82 - 2.06 mm, typically below 1.92 mm; Central Luzon. *H. stereoides stereoides* ssp.n.
- Midline of head less densely punctured, most distances of punctures longer than their diameters; pronotum width 2.05 - 2.20 mm. 16
- 16 Pronotum width 2.11 - 2.20 mm; North Luzon. *H. stereoides montanus* ssp.n.
- Pronotum width ca. 2.05 mm; Mindoro. *H. stereoides mindoroensis* ssp.n.
- 17 Pronotum width more than 2.05 mm; carina of sternite 3 usually with sparse long pilosity (Fig. 89); apex of both parameres relatively broad (Figs. 62, 63); Mindanao. *H. stereos*
- Pronotum width 2.0 mm or less; carina of sternite 3 usually with dense long pilosity (Figs. 90, 94, 95); apex of both parameres relatively slender (Figs. 65, 66, 77, 78, 80, 81); from other islands. 18
- 18 Disk of pronotum with relatively small, very widely spaced punctures; Leyte, Biliran. *H. milanae* sp.n.
- Disk of pronotum with punctures of normal size and relatively densely set; South Luzon, Catanduanes. 19
- 19 Aedeagus with subapical tubercle reduced and with apex weakly, but distinctly concave (Fig. 76); South Luzon (Camarines Sur). *H. bicolanus bicolanus* ssp.n.
- Aedeagus with subapical tubercle not reduced and with apex rounded or straight (Figs. 79, 82); South Luzon (Albay, Sorsogon), Catanduanes. *H. bicolanus seyfertii* ssp.n.
- 20 Subgenital plate with broad, tongue-shaped medial lobe (Figs. 30, 31). (*H. balnearius* group) 21
- Subgenital plate different, medially with more or less developed tip, this often covered by dense pilosity (Figs. 58 - 60, 96 - 102). 22
- 21 Medial lobe of subgenital plate very broad (Fig. 30); North and Central Luzon, Polillo. *H. balnearius*
- Medial lobe of subgenital plate relatively slender (Fig. 31); South Luzon. *H. vulcanus* sp.n.
- 22 Subgenital plate with medioapical process weakly developed or well developed and apically rounded (Figs. 58 - 60); ventral laterotergite 7 relatively slender (Fig. 103); punctures on disk of pronotum distinctly finer than on sides. (*H. philippinus* group, partim) 23
- Subgenital plate with medioapical process long and acute (Figs. 96 - 102); ventral laterotergite 7 very broad (Fig. 104); punctures on disk of pronotum of similar size as on sides. Note that in following couplets characteristics of size und puncturation refer only to brachypterous specimens! Macropterous specimens are on average broader and have less dense puncturation. (*H. stereos* group) 25
- 23 Eye index of brachypterous female 3.0 - 3.2, of macropterous female 2.7 - 3.0; subgenital plate with short, indistinct apex (Fig. 58) (do not mistake apex with long matted hairs!); North and Central Luzon. *H. philippinus* sp.n.

- Eye index of brachypterous female 2.5 - 2.8, of macropterous female ca. 2.2 - 2.5; subgenital plate with long, well developed apex (Figs. 59, 60); Visayas. **24**
- 24 Punctures of pronotum relatively shallow, laterally most punctures strongly confluent; subgenital plate with apex moderately developed (Fig. 60); anterior half of head with more or less distinct brownish marks in centre and/or in front of eyes; Masbate. ***H. masbatensis* sp.n.**
- Punctures of pronotum deep, laterally only some punctures confluent; subgenital plate with apex strongly pronounced by sublateral concavities of distal lamella (Fig. 59); anterior half of head without brown mark; Masbate (!), Panay, Negros, Cebu, Leyte, Samar. ***H. visayasensis* sp.n.**
- 25 Subgenital plate with roundish inner medial tumescence wide (more than half of width of subgenital plate), with distal lamella not clearly separated from ventral surface by sharp ridge, but by blunt posterior end of ventral tumescence, and with medioapical process triangular (Figs. 96 - 98); North and Central Luzon, Mindoro. **26**
- Subgenital plate with inner medial tumescence narrow (approximately one fourth to one third of width of subgenital plate) and with distal lamella laterally separated from ventral surface by sharp transverse ridge (if shortly developed, then medioapical process spine-like) (Figs. 99 - 102); from other areas. **28**
- 26 Midline of head densely punctured, most distances of punctures shorter than their diameters; pronotum width 1.86 - 2.04 mm, typically below 1.98 mm; Central Luzon. ***H. stereoides stereoides* ssp.n.**
- Midline of head less densely punctured, most distances of punctures longer than their diameters; pronotum width 1.98 - 2.26 mm. **27**
- 27 Pronotum width 2.16 - 2.26 mm; North Luzon. ***H. stereoides montanus* ssp.n.**
- Pronotum width 1.98 - 2.13 mm; Mindoro. ***H. stereoides mindoroensis* ssp.n.**
- 28 Pronotum width 2.10 mm or more; subgenital plate very short, with large apical process, with hind margin of apical lamella laterally concave (Fig. 99); carina of sternite 3 usually with sparse long pilosity (Fig. 89); Mindanao. ***H. stereos***
- Pronotum width 2.05 mm or less; subgenital plate relatively long, with normal apical process, with hind margin of apical lamella laterally nearly straight (Figs. 100 - 102); carina of sternite 3 usually with dense long pilosity (Fig. 90, 94, 95); from other islands. **29**
- 29 Disk of pronotum with relatively small, widely spaced punctures; subgenital plate with transverse ridge on ventral surface relatively long and with apical process wide, triangular (Fig. 100); Leyte, Biliran. ***H. milanae* sp.n.**
- Disk of pronotum with punctures of normal size and relatively densely set; subgenital plate with transverse ridge on ventral surface variable and with apical process narrow, spine-like (Figs. 101, 102); South Luzon, Catanduanes. **30**
- 30 Subgenital plate with transverse ridge on ventral surface in average slightly longer developed (Fig. 101); South Luzon (Camarines Sur). ***H. bicolanus bicolanus* ssp.n.**
- Subgenital plate with transverse ridge on ventral surface in average slightly shorter developed (Fig. 102); South Luzon (Albay, Sorsogon), Catanduanes. ***H. bicolanus seyferti* ssp.n.**

The *Hydrotrepes mirus* species group

Diagnosis (after ZETTEL 1998 and 2000, modified): Aedeagus without posterior modification, with simple apex (Fig. 8) or with small apical lamella (Figs. 2, 5); right paramere long and more or less undulate (Figs. 3, 6, 9); subgenital plate of female with basal tumescence and with posteromedial lobelike lamina (female not known in all species) (Figs. 14 - 16); meso- and metasternal carinae distally stout, not laminate; carina of sternite 3 distally with rhomboidal lamina (Figs. 17 - 19); sternite 4 in some species with median tooth; lateral margin of hemelytron without row of short stout bristles; pronotum of macropterous specimens simple (not known in all species).

Distribution and discussion: So far, this group contains nine species from Japan, Southeast Asia (ZETTEL 1998, PAPÁČEK & KOVAC 2001), Borneo (ZETTEL 2000), and the Philippines. In the Philippines, the *H. mirus* group is restricted to those areas, which may have been connected with the Asian mainland by Pleistocene land bridges, i.e., to the Palawan Region (Fig. 125). The Philippine species differ from the Bornean species, e.g., in small body size, slender aedeagus, and slender left paramere of the male. In *H. palawanensis* sp.n. and *H. busuanganus* sp.n., the males bear a small apical lamella on the aedeagus as do the species of the *H. sarawakensis* group (see ZETTEL 2000); the different median carina of sternite 3 remains the most important characteristic for distinguishing these two groups.

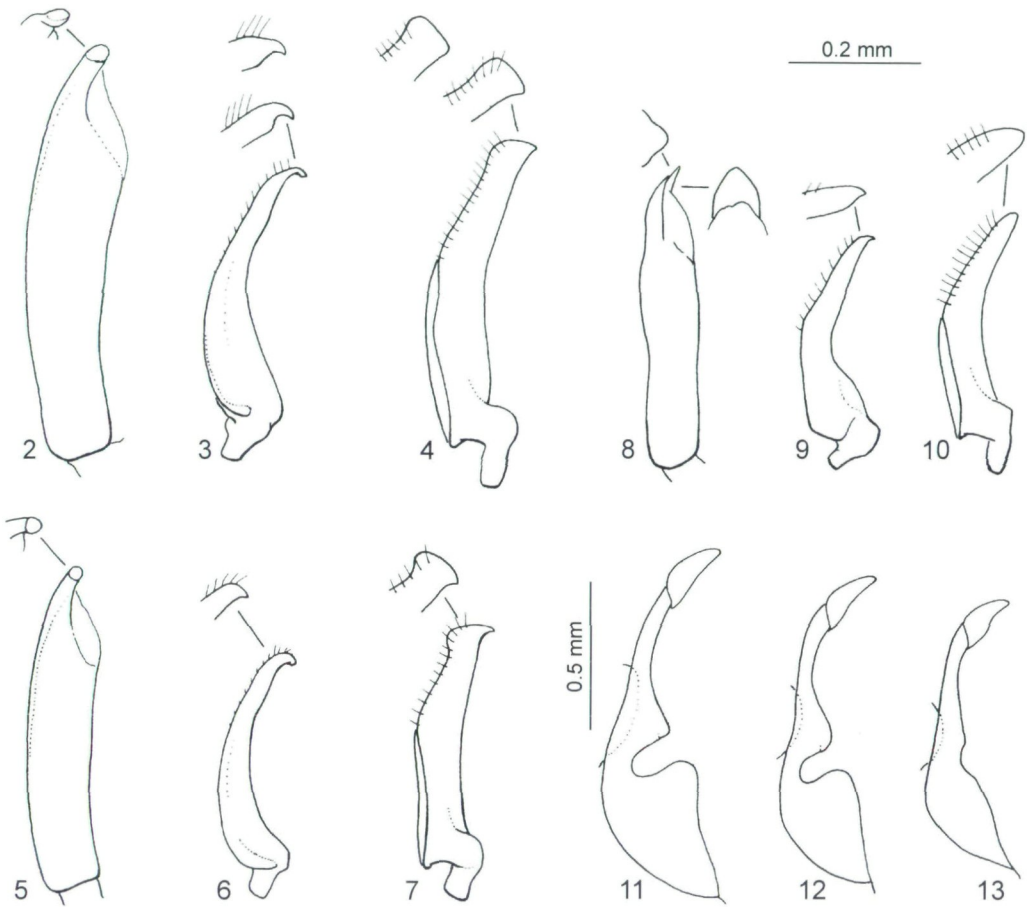
Hydrotrepes palawanensis sp.n. (Figs. 2 - 4, 11, 15, 17, 119, 125)

Holotype (brachypterous male): "PHILIPPINEN: Palawan\ 7 km N Narra, Estrella\ Falls, 2.4.1994\ leg. H. Zettel (57)" (NHMW); **paratypes**: 16 ♂♂, 13 ♀♀, same label data as holotype (NHMW, UPLB); 17 ♂♂, 15 ♀♀ "PHILIPPINEN: Palawan\ 7 km N Narra, Estrella\ Falls, 5.4.1994\ leg. H. Zettel (59)" (NHMW, UPLB, CNT, UBCB); 1 ♂ "PHILIPPINEN: Palawan\ 10 km W P. Princesa, Iwahig\ Penal Colony, 28.-29.11.\ 1994, leg. H. Zettel (71)" (CZW).

Description:

Brachypterous male: Body size: length 2.20 - 2.45 mm, width 1.65 - 1.80 mm; ground-colour yellowish, rarely light brownish; cephalonotum extensively and clearly marked with characteristical blackish brown pattern (Fig. 119), this varying slightly in extent; mesoscutellum at base with pair of large blackish, usually confluent dots; apical half of mesoscutellum and hemelytron either with distinct, small, irregular, frequently confluent, dark brown marks, or without distinct pattern and nearly uniformly brownish; venter yellowish brown; legs and antennae yellowish; rostrum brownish.

Cephalonotum with weakly rounded hind corners; head between large punctures with numerous minute punctures and matt, except along narrow midline between large punctures smooth and shining; pronotum without minute punctures, on disk with relatively sparsely set large punctures, at sides more densely punctured, along hind margin punctures finer than on disk; pronotal plate with very deep, elongate incision, anteriorly very slender (Fig. 11); inner corner of propleural plate truncate; eye index: 2.9; fourth rostral segment 2.3 times as long as segment 3; mesoscutellum 1.0 times as long as wide, shining, sparsely set with large punctures; hemelytron more densely set with large punctures, between punctures either nearly smooth or with indistinct microsculpture, and then more matt.



Figs. 2 - 13: *Hydrotrephes mirus* group: genitalia of males (right aspect): (2 - 4) *H. palawanensis* sp.n., (5 - 7) *H. busuanganus* sp.n., (8 - 10) *H. minutus* sp.n.; (2, 5, 8) aedeagus, (3, 6, 9) right paramere, (4, 7, 10) left paramere; (11 - 13) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen of (11) *H. palawanensis* sp.n., (12) *H. busuanganus* sp.n., (13) *H. minutus* sp.n.

Ventral carinae (Fig. 17): prosternal carina with slightly acute posterior corner, posterior edge very weakly concave; mesosternal carina low, distally without thin lamina; metasternal carina distally without thin lamina, with posterior apex weakly pronounced; carina of sternite 3 without denticles; sternite 4 with small median dimple.

Genitalia: aedeagus (Fig. 2) simple, without modification of hind margin, with narrowly rounded apex bearing small apical lamella; right paramere (Fig. 3) long, slightly shorter than left paramere, at distal hind margin with row of setae, in distal half undulate and evenly narrowed, but suddenly narrowed subapically, with curved acute apex; left paramere (Fig. 4) basally rather slender with small lobe, in middle of length weakly curved, in distal half subparallel, posteroapically rounded, anteroapically forming approximately right angle.

Brachypterous female: Body size: length 2.30 - 2.50 mm, width 1.70 - 1.85 mm; similar to male; eye index: 2.9; abdomen symmetrical; sternite 6 with slightly convex hind margin; subgenital plate (Fig. 14) basally convex, with long subparallel-sided, apically triangular distal lobe, with half-circular inner ridge.

Macropterous morphs: unknown.

Comparative notes: See Diagnosis of the species group, Key, and Comparative notes of *H. busuanganus* sp.n.

Distribution: Palawan Island (Fig. 125).

Etymology: The name of this species, "*palawanensis*" (Latinized adjective), refers to the island of its origin, Palawan.

***Hydrotrepes busuanganus* sp.n.** (Figs. 5 - 7, 12, 14, 18, 125)

Holotype (brachypterous female): "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 13 rd.km WNW\ Coron, Balulu Falls, 24.2.\ 1996, leg. H. Zettel (81)" (UPLB); **paratypes:** 1 ♀ (macropterous), same label data as holotype (CZW); 1 ♂ "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 5 km NW Coron\ Mabintangan Riv., 25.-29.2.\ 1996, leg. H. Zettel (82)" (CZW).

Description:

Brachypterous female: Body size: length 2.20 mm, width 1.55 mm; ground-colour yellowish; cephalonotum extensively and clearly marked with characteristical blackish brown pattern similar to that of *H. palawanensis* sp.n. (see Fig. 119); mesoscutellum yellowish, at base with pair of blackish dots; hemelytron with indistinct, partly confluent brownish marks; venter yellowish brown; legs and antennae yellowish; rostrum brownish.

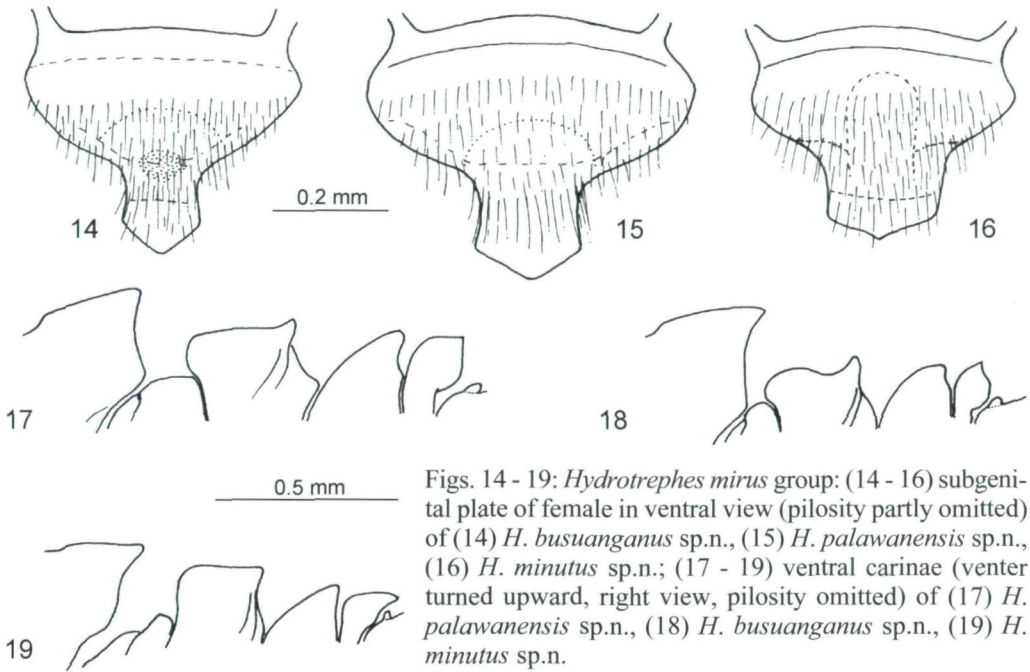
Cephalonotum with weakly rounded hind corners; head with large punctures, these close to inner eye margin very densely set (nearly reticulate), with minute punctures antero-laterally only; pronotum on disk with relatively sparsely set large punctures, at sides more densely punctured, along hind margin punctures finer than on disk; pronotal plate with very deep, elongate incision, anteriorly very slender (Fig. 12); inner corner of propleural plate truncate; eye index: 2.9; fourth rostral segment 2.3 times as long as segment 3; mesoscutellum 1.0 times as long as wide, relatively densely set with large punctures; hemelytron densely set with large punctures, between punctures without distinct microsculpture.

Ventral carinae (Fig. 18): prosternal carina with acute posterior corner, posterior edge weakly concave; mesosternal carina low, distally without thin lamina; metasternal carina distally without thin lamina, with ventral outline anteriorly convex, with pronounced, raised posterior tip; carina of sternite 3 without denticles; sternite 4 with small medial dimple.

Abdomen symmetrical; sternite 6 with slightly convex hind margin; subgenital plate (Fig. 14) basally convex, with long, slender, parallel-sided, apically triangular distal lobe, with short, curved inner ridge (dotted line in figure).

Brachypterous male: Body size: length 2.05 mm, width 1.45 mm; similar to female; eye index: 2.9.

Genitalia: aedeagus (Fig. 5) simple, without modification of hind margin, with narrowly rounded apex bearing minute apical lamella; right paramere (Fig. 6) long, slightly shorter



Figs. 14 - 19: *Hydrotrepes mirus* group: (14 - 16) subgenital plate of female in ventral view (pilosity partly omitted) of (14) *H. busuanganus* sp.n., (15) *H. palawanensis* sp.n., (16) *H. minutus* sp.n.; (17 - 19) ventral carinae (venter turned upward, right view, pilosity omitted) of (17) *H. palawanensis* sp.n., (18) *H. busuanganus* sp.n., (19) *H. minutus* sp.n.

than left paramere, at distal hind margin with row of setae, in distal half undulate and evenly narrowed to shortly curved, acute apex; left paramere (Fig. 7) basally rather slender with small lobe, in middle of length weakly curved, in distal half subparallel, posteroapically rounded and slightly extended, anteroapically forming very short tip.

Macropterous female: Body size: length 2.10 mm, width 1.55 mm; very similar to brachypterous female; mesoscutellum and hemelytron darker; eye index: 2.5; cephalonotum with indistinctly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous male: unknown.

Comparative notes: *Hydrotrepes busuanganus* sp.n. and the closely related *H. palawanensis* sp.n. are allopatric. As explained in the key, main differences are found in the body size, the puncturation of the head, the pro- and metasternal carinae (comp. Figs. 17 and 18), and especially in the female subgenital plate (comp. Figs. 14 and 15). Differences in male genitalia are minute: The aedeagus of *H. busuanganus* sp.n. has a smaller apical lamella (comp. Figs. 2 and 5) and the apex of the right paramere is less curved than in *H. palawanensis* sp.n. (comp. Figs. 3 and 6). Right and left parameres seem to differ in the shapes of their apices, but as these characteristics vary slightly in *H. palawanensis* sp.n. and as there is presently only one male of *H. busuanganus* sp.n. available, these differences should be confirmed by examination of more males.

Distribution: Busuanga Island (Calamianes group) (Fig. 125).

Etymology: The name "*busuanganus*" (Latinized adjective) is derived from the island Busuanga, from where this species is described.

***Hydrotrepes minutus* sp.n.** (Figs. 8 - 10, 13, 16, 19, 120, 125)

Holotype (brachypterous male): "Philippinen: Palawan Pr.\ Busuanga Isl., 13 rd.km\ WNW Coron, Balulu Falls\ 2.2.1999, leg. Zettel (171)" (UPLB); **paratypes**: 1 ♂, same label data as holotype (CZW); 2 ♂♂, 2 ♀♀, and 1 ♂, 1 ♀ (macropterous) "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 13 rd.km WNW\ Coron, Balulu Falls, 24.2.1996, leg. H. Zettel (81)" (CZW, UPLB); 10 ♂♂, 4 ♀♀ (macropterous) "PHILIPPINEN: Palawan Pr.\ Busuanga Is., 5 km NW Coron\ Mabintangen Riv., 25.-29.2.1996, leg. H. Zettel (82)" (CZW, UPLB, NHMW).

Description:

Brachypterous male: Body size: length 1.95 - 2.05 mm, width 1.45 - 1.55 mm; ground-colour yellowish; cephalonotum with extensive characteristic light brown marks (Fig. 120), these varying slightly in extent, anterior half of head completely yellow or with few very small brownish spots; mesoscutellum at base with pair of small brown dots, with more or less distinct brownish marks along sides, with disk either uniformly yellow or with small indistinct light brown marks; hemelytron with indistinct, small, irregular, frequently confluent, light brown marks, usually without distinct pattern; venter yellowish brown; legs and antennae yellow; rostrum yellowish brown.

Cephalonotum with weakly rounded hind corners; head between fine punctures smooth and shining, especially along narrow midline where distances between punctures larger than laterally; pronotum on disk and at hind margin smooth and shining, with minute punctures nearly obliterated, at sides with punctures similar as on head; pronotal plate with very shallow, wide incision, anteriorly slender (Fig. 13); inner corner of propleural plate truncate; eye index: 2.6; fourth rostral segment 1.8 times as long as segment 3; mesoscutellum 0.8 times as long as wide, shining, sparsely set with fine, but distinct punctures; hemelytron more densely set with fine punctures, between punctures smooth, punctures anteriorly larger than posteriorly.

Ventral carinae (Fig. 19): prosternal carina with acute posterior corner, posterior edge weakly concave; mesosternal carina low, distally without thin lamina; metasternal carina distally without thin lamina, with apex pointing caudad; carina of sternite 3 very low, without denticles; sternite 4 with small medial dimple.

Genitalia: aedeagus (Fig. 8) simple, without modifications, apically broad and bluntly angled, without apical lamella; right paramere (Fig. 9) long, slightly shorter than left paramere, at distal hind margin with row of setae, in distal half weakly undulate and hardly narrowed, with acute apex; left paramere (Fig. 10) basally rather slender with small lobe, in middle of length curved, in distal half evenly narrowed, apically narrowly rounded or weakly truncate.

Brachypterous female: Body size: length 2.15 - 2.20 mm, width 1.60 - 1.70 mm; similar to male; abdomen symmetrical; sternite 6 with slightly convex hind margin; subgenital plate (Fig. 16) basomedially strongly convex, with short subparallel-sided, medioapically weakly produced distal lobe.

Macropterous male: Body size: length 2.05 - 2.30 mm, width 1.50 - 1.65 mm; most characteristics as in brachypterous male; yellowish spots in some specimens more contrasting; eye index: 2.7; cephalonotum with very indistinctly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.20 - 2.30 mm, width 1.55 - 1.70 mm; characteristics as in brachypterous female, except characteristics mentioned for macropterous male.

Comparative notes: *Hydrotrepes minutus* sp.n. differs from the other two Philippine species of the *H. mirus* group by numerous characteristics, of which the shallow incision of the pronotal plate (Fig. 13), the fine puncturation of the dorsum, the short rostrum, the low carina of the sternite 3 (Fig. 19), the simple apex of the aedeagus of the male (Fig. 8), and the broad apical lobe of the subgenital plate of the female (Fig. 16) are most obvious. In contrast with the two previous species, *H. minutus* sp.n. has no distinct dimorphism in eye size between brachypterous and macropterous specimens.

Distribution: Busuanga Island (Calamianes group) (Fig. 125).

Etymology: The species name "*minutus*" (Latin adjective) means "small" and refers to the small size of the species, one of the smallest in the genus.

The *Hydrotrepes balnearius* species group

Diagnosis: Aedeagus with tooth at posterior surface, apically with widened "head", without apical plate (Figs. 20, 23); right paramere very short, apically truncate or rounded (Figs. 21, 24); subgenital plate of female posteromedially with tongue-shaped lobe (Figs. 30, 31); ventral laterotergite 7 of female relatively slender; pronotal plate with deep incision (Figs. 26, 27); meso- and metasternal carinae distally laminate (Figs. 28, 29); carina of sternite 3 directed posteriad, without long spine, with indistinct denticles; lateral margin of hemelytron without row of short, stout bristles; pronotum of macropterous specimens simple; body shape relatively slender.

Discussion: Species of this newly established group differ from all other congeners in the peculiar shape of the aedeagus (Figs. 20, 23); further, from the species of the *H. mirus* group and *H. sarawakensis* group in the structures of the sternal carinae; from the species of the *H. bouvieri* group and *H. martini* group in the absence of a row of stout setae on the lateral margin of the hemelytron; and from the following Philippine species groups in the broad medial lobe of the subgenital plate of the female.

Distribution: So far only two species from the Philippines, both from Greater Luzon, are placed within this group (Fig. 125).

Hydrotrepes balnearius (BERGROTH, 1918) (Figs. 20 - 22, 26, 28, 30, 125)

Helotrephes balnearius BERGROTH, 1918: 125; ESAKI & CHINA 1928: 137 (key; as questionable synonym of *H. martini* KIRKALDY), 172 (notes).

Hydrotrepes balnearius: CHINA 1935: 594, 613 (new combination, key); USINGER 1937: 179-180 (habitats, biology; of *H. balnearius*?); POLHEMUS & REISEN 1976: 288 (new records; of *H. balnearius*?); POLHEMUS 1990: 60 (listed).

Material examined: holotype (?) (brachypterous male): "Los Banos\ P.I. Baker", "111", "Helotrephes\ balnearius\ Bergr." (ZMUH); **additional material:** 1 ♀ "Los Banos [Luzon, Laguna Prov.]\ P.I., Baker", "Helotrephes\ Martini Kirk." (in Horváth's handwriting), "Hydrotrepes\ balnearius (BERGR.)\ det. H. Zettel 1993" (MTMB); 1 ♀ "Philippinen: LZ, Laguna\ Los Banos, Mt. Makiling\ Flat Rocks, 14.2.1999\

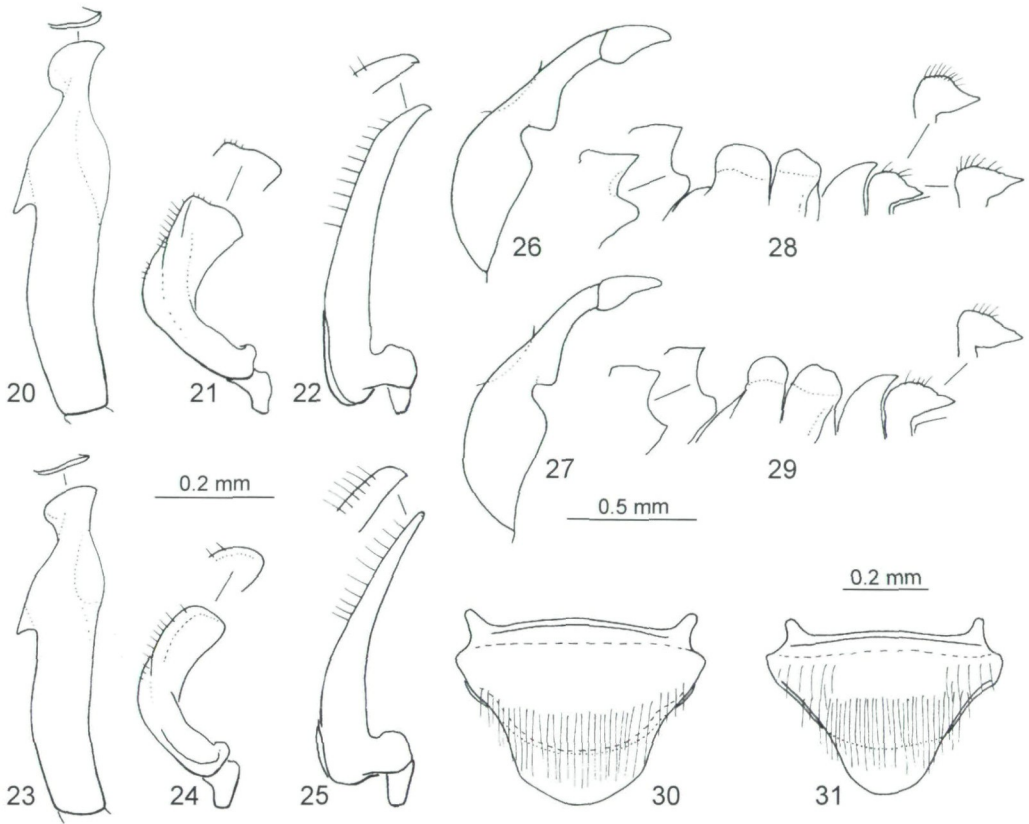
leg. H. Zettel (175)" (CZW); 7 ♂♂, 6 ♀♀ "ILOCOS SUR: BANTAY\ Caniaw BFD Sta. MT.\ STREAM: 21 OCT.1976\ H.O.SAN VALENTIN" (CVPG); 1 ♂, 3 ♀♀, and 1 ♀ (macropterous) "LA UNION: TUBAO\ Alipang River\ 13 OCTOBER 1976\ H.O. SAN VALENTIN" (CVPG); 1 ♂, 1 ♀, and 3 ♀♀ (macropterous) "LA UNION: TUBAO\ Alipang River\ 18 OCTOBER 1976\ A.A. BARROSO" (CVPG); 1 ♂, 1 ♀ "LA UNION:BACNOTAN\ DMMarcos Mem St\ Coll. 19 OCTOBER 1976\ ON CRK.: A.A. BARROSO" (CVPG); 9 ♂♂, 4 ♀♀ "PHILIPPINEN: Bataan [Zambales]/ Olongapo, Subic Base/ Riding Stable,2.12./ leg.H.Zettel 1993 (37d)" (NHMW, UPLB, CNT, JTPC); 3 ♀♀ "PHILIPPINEN: Bataan [Zambales]/ Olongapo, Subic Base/ Riding Stable,30.11.-5.12./ leg.H.Zettel 1993 (37e)" (NHMW); 5 ♂♂, and 7 ♂♂, 2 ♀♀ (macropterous) "Philippinen: Luzon,\ Zambales, Subic Bay\ Aeta village, 9.12.2000\ leg. H. Zettel (261)" (NHMW, UPLB); 5 ♂♂, 5 ♀♀ "BATAAN: BAGAC\ UMAGOL CRK.\ 24 APR. 1979\ F.A.MULIM-BAYAN\ EX. ON SUBMERGED\ ROOTS NR. BANKS" (CVPG); 2 ♀♀ "Montalban [Luzon: Rizal Prov.]\ Philippin.", "J.R. de la\ Torre Bueno\ Collection K.U." (SHUK); 1 ♀ "leg. Jäch (11)\ PHILIPPINEN - Luzon\ 30km E Lucena City\ Quezon NP 23.11.1992" (NHMW); 7 ♂♂, 5 ♀♀ (macropterous) "QUEZON: Polillo\ 3 APRIL 1977\ H SAN VALENTIN" (CVPG).

Type material: BERGROTH (1918) described "*Helotrephes balnearius*" from one "female" from Los Baños (in Laguna Province, Luzon) collected by Baker. One male specimen of *H. balnearius*, which is deposited in the Zoological Museum Helsinki, is probably the holotype, although it is not labeled as such. The type specimen could not be studied by CHINA (1935), but he had a specimen from the U.S. National Museum (Washington) for comparison, with the same data and probably from the same sampling. A third specimen, also a female, has been traced by the author in the museum in Budapest (MTMB). Baker's collections from the Philippines are widespread in numerous museums of the world. BERGROTH's (1918) description of *H. balnearius* is insufficient for an identification of the species, as it does not include characteristics of the terminalia of the abdomen, ventral carinae, pronotal plate, and puncturation, but mainly refers to colour and some other characteristics which are common to most species of *Hydrotrepes*. However, so far there are only two species of *Hydrotrepes* known from Los Baños, which is the entomologically best investigated locality in the Philippines: *H. balnearius* and *H. philippinus* sp.n. The latter species differs considerably from the original description in colouration and size. BERGROTH (1918) states a body length of 2.5 mm. In this study, measurements of lengths are: for *H. balnearius* 2.30 - 2.65 mm, for *H. philippinus* sp.n.: 2.65 - 3.00 mm. Therefore, the author has no doubt as to the correct interpretation of *H. balnearius*, even if the identity of the holotype is not guaranteed.

Description:

Brachypterous male: Body size: length 2.35 - 2.60 mm, width 1.60 - 1.75 mm; ground-colour yellowish; head posteriorly with usually solid, light or medium brown mark similar to that in *H. vulcanus* sp.n. (see Fig. 121); medial mark in anterior half of head absent in few specimens; posterior two thirds of pronotum, mesoscutellum, and hemelytra with small, irregular, partly confluent, brown marks; base of mesoscutellum with transverse, medially interrupted dark stripe; venter mainly medium to dark brown; legs and antennae yellowish; rostrum brown.

Cephalonotum with weakly rounded hind corners; head densely set with rather large punctures, distances between them much shorter than their diameter (except on narrow, weakly shining midline in some specimens), anterolaterally appearing nearly reticulate; pronotum with large punctures as on head, on disk anteriorly relatively densely set, with distances between punctures hardly more than one diameter, posteriorly sparsely set with distances up to four diameters of punctures in some specimens, at sides punctures densely set, partly confluent and surface appearing rugulose; pronotal plate with rela-



Figs. 20 - 31: *Hydrotrephes balnearius* group: (20 - 25) genitalia of males (right aspect): (20 - 22) *H. balnearius*, (23 - 25) *H. vulcanus* sp.n.; (20, 23) aedeagus, (21, 24) right paramere, (22, 25) left paramere; (26, 27) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen of (26) *H. balnearius* and (27) *H. vulcanus* sp.n.; (28, 29) ventral carinae (venter turned upward, right view; with variations of carinae of prosternum and sternite 3) of (28) *H. balnearius* and (29) *H. vulcanus* sp.n.; (30, 31) subgenital plate of female in ventral view (pilosity partly omitted) of (30) *H. balnearius* and (31) *H. vulcanus* sp.n.

tively deep and narrow incision, anteriorly broad (Fig. 26); inner corner of propleural plate truncate; eye index: 2.6; fourth rostral segment 2.1 times as long as segment 3; mesoscutellum 1.0 times as long as wide, between large punctures with very fine microreticulation; hemelytron similarly sculptured, but microreticulation much more developed and surface therefore matt.

Ventral carinae (Fig. 28): prosternal carina with more or less acute posterior corner, with posterior edge strongly concave; mesosternal and metasternal carinae high, distally with thin lamina; carina of sternite 3 birdhead-shaped, with indistinct denticles, more or less pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 20) strongly modified, with tooth at posterior margin and with posteriorly rounded and anteriorly pointed apical part, with apex narrowly lamellate,

without defined apical lamella; right paramere (Fig. 21) short, much shorter than left paramere, in middle of length strongly curved, distally widened, distoposteriorly with row of short setae, apically broadly truncate, in most specimens with weakly concave outline postero-apically; left paramere (Fig. 22) long and slender, with small basal lobe, distally evenly tapered, slightly twisted, with row of long setae, and with apex acute.

Brachypterous female: Body size: length 2.50 - 2.65 mm, width 1.70 - 1.80 mm; similar to male; eye index: 2.7; abdomen symmetrical; sternite 6 with slightly convex hind margin; subgenital plate (Fig. 30) with medial surface slightly convex and posteriorly with evenly distributed long pilosity, with very broad, tongue-shaped distal lobe, with convex inner ridge.

Macropterous male: Body size: length 2.40 - 2.60 mm, width 1.65 - 1.75 mm; most characteristics as in brachypterous male; brown marks on cephalonotum in average darker and more contrasting; eye index: 2.5; cephalonotum with indistinctly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.50 - 2.60 mm, width 1.70 - 1.80 mm; eye index: 2.4; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes balnearius* is the most widespread species in North and Central Luzon and the only species so far recorded from Polillo Island. In South Luzon it is replaced by an allopatric species, *H. vulcanus* sp.n. For identification see the Diagnosis of the species group and the Comparative notes of *H. vulcanus* sp.n.

Distribution: North and Central Luzon (Ilocos Sur, La Union, Zambales, Bataan, Rizal, Laguna, Quezon), Polillo.

Hydrotrepes vulcanus sp.n. (Figs. 23 - 25, 27, 29, 31, 121, 125)

Holotype (brachypterous male): "Philippinen: Luzon, Albay\ 40 km N Legaspi, 1 km W\ Malilipot, Busai Falls\ 23.2.1998, leg. Zettel(143)" (UPLB); **paratypes:** 1 ♂, 1 ♀, and 3 ♂♂, 2 ♀♀ (macropterous), same label data as holotype (NHMW, UPLB); 2 ♀♀ "BONGA, LEGASPI\ ON CREEK: 6 DEC. 1976: A.A.BARROSO" (CVPG).

Description:

Brachypterous male: Body size: length 2.35 - 2.40 mm, width 1.65 - 1.70 mm; ground-colour yellowish; head posteriorly with more or less solid, light or medium brown mark (Fig. 121); medial mark in anterior half of head varying in size, present in all specimens; posterior two thirds of pronotum, mesoscutellum and hemelytra with small, irregular, partly confluent, brown marks, or pattern faded and not clearly recognizable; base of mesoscutellum with more or less distinct transverse, medially interrupted dark stripe; venter mainly medium to dark brown; legs and antennae yellowish; rostrum brown.

Cephalonotum with weakly rounded hind corners; head densely set with rather large punctures, distances between them much shorter than their diameter, anterolaterally appearing nearly reticulate; pronotum with large punctures as on head, on disk anteriorly relatively densely set, with distances hardly more than one diameter, posteriorly sparsely set, with distances up to four diameters of punctures in some specimens, at sides punc-

tures densely set, partly confluent and surface appearing rugulose; pronotal plate with relatively deep and narrow incision, anteriorly broad (Fig. 27); inner corner of propleural plate truncate; eye index: 2.6; fourth rostral segment 2.1 times as long as segment 3; mesoscutellum 1.0 times as long as wide, between large punctures with hardly traceable microreticulation, weakly shining; hemelytron similarly sculptured, but microreticulation distinct and surface matt.

Ventral carinae (Fig. 29): prosternal carina with more or less acute posterior corner, with posterior edge strongly concave; mesosternal and metasternal carinae high, distally with thin lamina; carina of sternite 3 birdhead-shaped, with indistinct denticles, more or less pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 23) strongly modified, with tooth at posterior margin and with posteriorly narrowly rounded and anteriorly weakly pointed apical part, with apex in dorsal view narrowly lamellate, without defined apical lamella; right paramere (Fig. 24) short, much shorter than left paramere, in middle of length strongly curved, distally widened, distoposteriorly with row of short setae, apically broadly and gently rounded, without concave outline postero-apically; left paramere (Fig. 25) long and slender, with small basal lobe, distally evenly tapered, strongly twisted, with row of long setae, and with apex acuminate.

Brachypterous female: Body size: length 2.35 - 2.50 mm, width 1.70 - 1.75 mm; similar to male; eye index: 2.5; abdomen symmetrical; sternite 6 with slightly convex hind margin; subgenital plate (Fig. 31) with medial surface hardly convex and posteriorly with evenly distributed long pilosity, with tongue-shaped distal lobe, with convex inner ridge.

Macropterous male: Body size: length 2.35 - 2.50 mm, width 1.65 - 1.70 mm; most characteristics as in brachypterous male; marks on dorsum dark or light brown; eye index: 2.5; cephalonotum with indistinctly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.40 - 2.50 mm, width 1.75 - 1.80 mm; eye index: 2.3; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes vulcanus* sp.n. is closely related with *H. balnearius*, but can be easily distinguished by the relatively narrow and more rounded apex of the right paramere of the male (comp. Figs. 21 and 24) and by the more narrow medial lobe of the subgenital plate of the female (comp. Figs. 30 and 31). Further, the left paramere of *H. vulcanus* sp.n. is distally more twisted than in *H. balnearius* (comp. Figs. 22 and 25). The aedeagus of *H. vulcanus* sp.n. is stouter and with the posterior tooth and the apex less acute than in *H. balnearius*, but the shape of the aedeagus is slightly varying in *H. balnearius*.

Distribution: South Luzon (Albay) (Fig. 125).

Etymology: The species is named after *Vulcanus*, the Roman deity of fire (used as a noun in apposition). The epithet refers to the type locality at the slopes of Mount Mayon, one of the most active volcanoes in the Philippines.

The *Hydrotrepes philippinus* species group

Diagnosis: aedeagus (Figs. 32, 35, 38, 41, 44) apically without headlike structure, with tooth at posterior surface (except in *H. pardalos*), with or without completely defined apical plate; right paramere short, apically truncate (Figs. 33, 36, 39, 42, 45); left paramere distally slender (Figs. 37, 40, 43, 46), less distinct in *H. philippinus* sp.n. (Fig. 34); subgenital plate of female short, posteromedially with more or less developed process (Figs. 57 - 60) (female of *H. samarensis* sp.n. unknown); ventral laterotergite 7 of female relatively slender (Fig. 103); pronotal plate with shallow incision (Figs. 47 - 51); meso- and metasternal carinae distally laminate (except reduced in *H. samarensis* sp.n.) (Figs. 52 - 56); carina of sternite 3 directed posteriad, without long spine, with denticles distinct or indistinct; lateral margin of hemelytron without row of short, stout bristles; pronotum of macropterous specimens simple (not known in all species).

Discussion and distribution: Species of this newly established species group are – with some modifications – similar to each other in characteristics of the pronotal plate, ventral carinae, genitalia of males, and subgenital plate of females. They differ from the species of the *H. mirus* group, *H. sarawakensis* group, and *H. martini* group, e.g., in the structures of the sternal carinae, and from the species of the *H. bouvieri* group, *H. balnearius* group, and *H. stereos* group, e.g., in the structures of the aedeagus.

So far only five species from the Philippines are in this group. It contains two pairs of closely related species: *H. philippinus* sp.n. + *H. samarensis* sp.n. and *H. visayasensis* sp.n. + *H. masbatensis* sp.n. The first species pair is distributed in Luzon and Samar, respectively, the second species pair is widely distributed in the Visayas (Fig. 126). *Hydrotrepes pardalos* from Mindanao is the most aberrant species; its position within this group is preliminary.

Hydrotrepes philippinus sp.n. (Figs. 32 - 34, 47, 52, 58, 126)

Holotype (brachypterous male): "Philippinen: LZ, Mount.Pr.\ Sagada, Echo Valley, Under-\ ground River, 23.-24.2.1999\ 1500 m, leg. H. Zettel (186)" (UPLB); **paratypes:** 4 ♂♂, 5 ♀♀, and 4 ♂♂, 3 ♀♀ (macropterous), same label data as holotype (NHMW, UPLB); 11 ♂♂, 15 ♀♀, and 1 ♂ macropterous "Philippinen: LZ, Mount.Pr.\ S Sagada, Bagnen, slopes of \ Mt.Polis, 1600 m, 26.2.\ 1999, leg. H. Zettel (189)" (NHMW, UPLB, CNT); 1 ♂, 2 ♀♀, same label data except "... leg. F. Seyfert (15)" (CSW, UPLB); 1 ♀, and 1 ♂ (macropterous) "Philippinen: LZ, Mount.Pr.\ 5km S Bontoc, Balitian Riv.\ 900 m, 27.2.1999\ leg. H. Zettel (190)" (NHMW); 2 ♂♂, 3 ♀♀ "Philippinen: LZ, Mount.Pr.\ NE Sagada, Banga'an\ Bomod-ok Wf., 22.2.1999\ 1500 m, leg.H.Zettel (185)" (CZW, UPLB); 9 ♂♂, 8 ♀♀, and 11 ♂♂, 14 ♀♀ (macropterous) "Philippinen: LZ, Mount.Pr.\ Chico River, Gonogon\ 1100 m, 21.2.1999\ leg. H. Zettel (184)" (CZW, UPLB); 3 ♂♂, 3 ♀♀, and 11 ♂♂, 8 ♀♀ (macropterous), same label data except "... leg. F. Seyfert (8b)" (CSW, UPLB, NHMW); 2 ♀♀, and 2 ♂♂ (macropterous) "PHILIPPINEN: Laguna Pr.\ Los Banos, Mt.Makiling\ Molawin Creek,Flat Stones\ 9.2.1996, leg.Zettel (75)" (CZW); 3 ♂♂ "Philippinen: Luzon, Laguna\ Los Banos, Mt. Makiling\ Flat Stones, 10.2.1998\ leg. H. Zettel (132)" (NHMW, UPLB).

Description:

Brachypterous male: Body size: length 2.65 - 2.80 mm, width 1.90 - 2.00 mm; body slightly depressed; dorsal ground-colour yellow to brownish yellow; dorsal dark colour pattern consisting of comparatively large, light to dark brown, never clearly delimited marks; posterior half of head usually completely dark except along eye margins and

light midline anteriorly; anterior half of head with or without large central mark; pronotum usually with nearly completely dark transverse stripe along hind margin and with second stripe in front of it medially, in many specimens with various additional small marks antero-submedially, laterally, or posteriorly; mesoscutellum and hemelytra with irregular, mostly confluent, brown marks; base of mesoscutellum with transverse dark stripe; venter light to medium or dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; head set with rather large punctures, on wide, shining midline distances between punctures approximately as long as their diameter, laterally much shorter than their diameter, anterolaterally nearly confluent, matt; pronotum on disk shining, with sparsely set fine punctures more distinct anteriorly, nearly obsolete posteriorly, laterally with punctures of same size as on head, with distances approximately as long as their diameter, along lateral margins punctures confluent and surface appearing rugulose; pronotal plate with shallow incision, anteriorly broad (Fig. 47); inner corner of propleural plate truncate; eye index: 3.1 - 3.2; fourth rostral segment 1.9 times as long as segment 3; mesoscutellum approximately 1.0 times as long as wide, between large, sparsely set punctures on disk with very fine microreticulation, this more distinct on sides; hemelytron similarly sculptured, but microreticulation much more developed and surface therefore matt.

Ventral carinae (Fig. 52): prosternal carina with very acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with small thin lamina; carina of sternite 3 triangularly produced, usually long, with more or less distinct denticles, relatively pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 32) apically strongly modified, with short tooth at posterior margin, with rounded apex in lateral view, and with well defined, apically curved apical plate; right paramere (Fig. 33) much shorter than left paramere, but relatively longer than in other species of the group, in basal half curved, distally subparallel, relatively slender, distoposteriorly with row of short setae, apically obliquely truncate; left paramere (Fig. 34) long and slender, with basal lobe, distally relatively wide, weakly tapered, with row of long setae, and with apex acute.

Brachypterous female: Body size: length 2.70 - 3.00 mm, width 1.95 - 2.10 mm; similar to male; eye index: 3.0 - 3.2; abdomen symmetrical; sternite 6 with straight hind margin; subgenital plate (Fig. 58) with medial surface convex and posteriorly bluntly angled, with evenly distributed long pilosity, with distal lamella medially forming blunt or indistinct tooth, with convex inner ridge.

Macropterous male: Body size: length 2.65 - 2.95 mm, width 1.95 - 2.10 mm; most characteristics as in brachypterous male; colour considerably darker; dorsum predominantly blackish brown with reduced yellowish marks: usually one large yellow mark on disk of pronotum anteriorly and one pair of dots on mesoscutellum; anterior half of head, pronotum, mesoscutellum, and hemelytra with small, partly confluent marks of varying extent; eye index: 2.7 - 3.0; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.65 - 2.90 mm, width 1.95 - 2.10 mm; eye index: 2.7 - 3.0; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes philippinus* sp.n. has relatively small eyes. This characteristic and the structures of the aedeagus set *H. philippinus* sp.n. close to *H. samarensis* sp.n. For distinction see the Comparative notes of that species. The aedeagus (Fig. 32) and the subgenital plate of the female (Fig. 58) are unique within the Philippine fauna.

Distribution: Luzon: (Mountain Province, Laguna) (Fig. 126).

Etymology: The specific epithet "*philippinus*" (Latinized adjective) refers to the country of origin of this species. The more general name has been chosen, because this species is regarded as "typical" for the *H. philippinus* species group, a very characteristic, endemic element of the Philippine fauna.

***Hydrotrepes samarensis* sp.n.** (Figs. 35 - 37, 48, 53, 122, 126)

Holotype (brachypterous male): "Philippinen: N. Samar\ Veriato, El Amigo\ Veriato Falls, 25.1.2000\ leg. H. Zettel (217)" (UPLB).

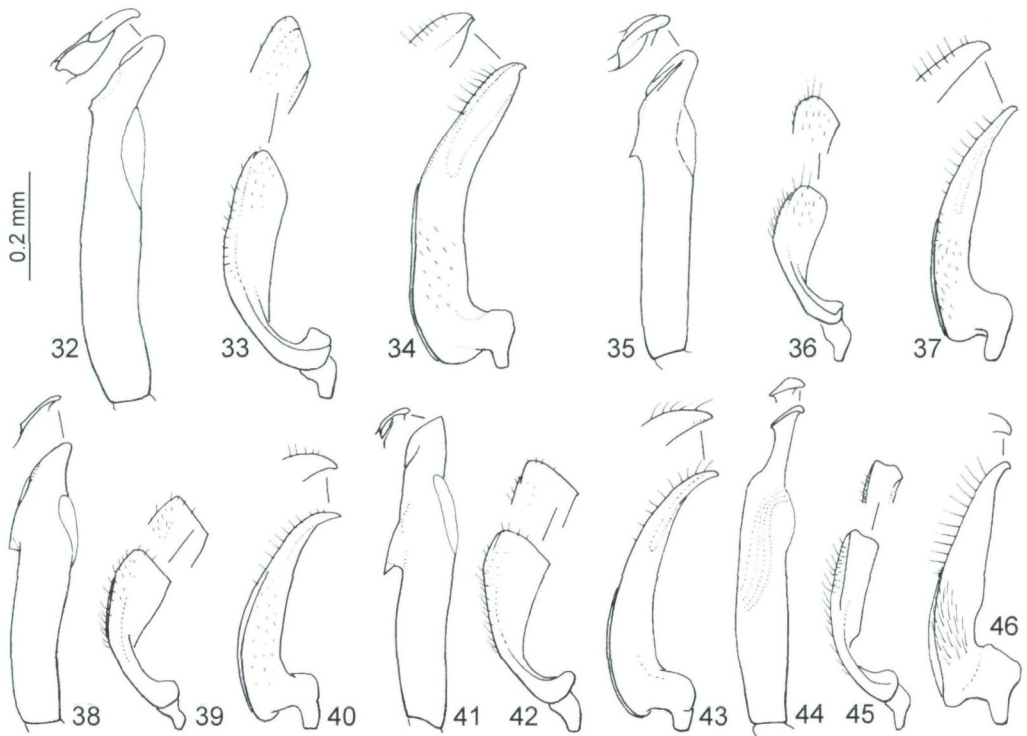
Description:

Brachypterous male: Body size: length 2.40 mm, width 1.65 mm; body distinctly depressed; dorsal ground-colour yellow; dorsal colour pattern consisting of large dark brown marks; head mostly brown, with large central spot, areas around eyes and apex yellowish (Fig. 122); pronotum anteriorly yellow, in posterior third to half with irregular transverse blackish brown stripe; mesoscutellum and hemelytra with large, irregular, mostly confluent, not well delimited brown marks; base of mesoscutellum with two large, medially confluent blackish brown marks; venter light to medium brown; legs and antennae yellow; rostrum light brown.

Cephalonotum with weakly rounded hind corners; whole cephalonotum with rather fine punctures; head with punctures densely set, distances between them shorter than their diameter (except on narrow, shining midline), anterolaterally confluent, surface there rugulose and matt; punctures on disk of pronotum sparsely set, with distances longer than their diameter, punctures more distinct anteriorly, nearly obsolete posteriorly, between punctures with fine, intermixed, minute punctures; lateral areas of pronotum very densely punctured, punctures frequently confluent and surface appearing rugulose; pronotal plate with shallow incision, anteriorly broad (Fig. 48); inner corner of propleural plate truncate; eye index: 3.8; fourth rostral segment 2.2 times as long as segment 3; mesoscutellum approximately 1.0 times as long as wide, between large, sparsely set punctures on disk with very few fine minute punctures anteriorly, with fine microreticulation posteriorly and, more distinct, laterally; hemelytron with large, densely set punctures and with microreticulation distinctly developed, matt.

Ventral carinae (Fig. 53): prosternal carina with weakly acute posterior corner, with posterior edge hardly concave; mesosternal carina with acute apex, without thin lamina; metasternal carina reduced, without distinct thin lamina; carina of sternite 3 triangularly produced, with distinct denticles, moderately pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 35) apically strongly modified, with short tooth at posterior margin, with rounded apex in lateral view, and with incompletely defined, apically straight apical "plate"; right paramere (Fig. 36) short, much shorter than left paramere, in basal half curved, distally subparallel, distoposteriorly with row of short setae, apically



Figs. 32 - 46: *Hydrotrepes philippinus* group: genitalia of males (right aspect): (32 - 34) *H. philippinus* sp.n., (35 - 37) *H. samarensis* sp.n., (38 - 40) *H. visayasensis* sp.n., (41 - 43) *H. masbatensis* sp.n., (44 - 46) *H. pardalos*; (32, 35, 38, 41, 44) aedeagus, (33, 36, 39, 42, 45) right paramere, (34, 37, 40, 43, 46) left paramere.

truncate, with strongly rounded posterior corner; left paramere (Fig. 34) long and slender, with basal lobe, distally curved, slender, with row of long setae, strongly tapering towards acuminate apex.

Brachypterous female and macropterous morphs: unknown.

Comparative notes: The single holotype specimen has a very typical set of characteristics making it easily distinguishable from all other Philippine species. The small eyes (of the brachypterous morph) and the weakly produced head (Fig. 122) are unique in *Hydrotrepes* and resemble - convergently developed - the species of the undescribed genus "*Ascetotrepes*" (Polhemus, in prep.). The eye index of *H. samarensis* sp.n. is 3.8, which is considerably larger than in other species, where it reaches a maximum of 3.2 in *H. philippinus* sp.n., probably its closest relative. *Hydrotrepes samarensis* sp.n. has a more depressed body than any other species of *Hydrotrepes*. This results also in a modification of the sternal carinae, including a reduction of the laminate areas of the meso- and metasternum (Fig. 53). Characteristics of male genitalia (Figs. 35 - 37) set *H. samarensis* sp.n. clearly into the *H. philippinus* group and close with *H. philippinus* sp.n. However, *H. samarensis* sp.n. differs from all other species of this group in the colouration of the head and in details of the aedeagus. It shares the posteriorly not incised prosternal

carina with *H. pardalos*. It is noteworthy that the type of *H. samarensis* sp.n. has been collected together with *H. visayasensis* sp.n., because this is so far one of the two known sympatric occurrences of group-relatives in the Philippines. See also Notes of the sympatric *Hydrotrepes* sp. at the end of this paper.

Distribution: Northern Samar (Fig. 126).

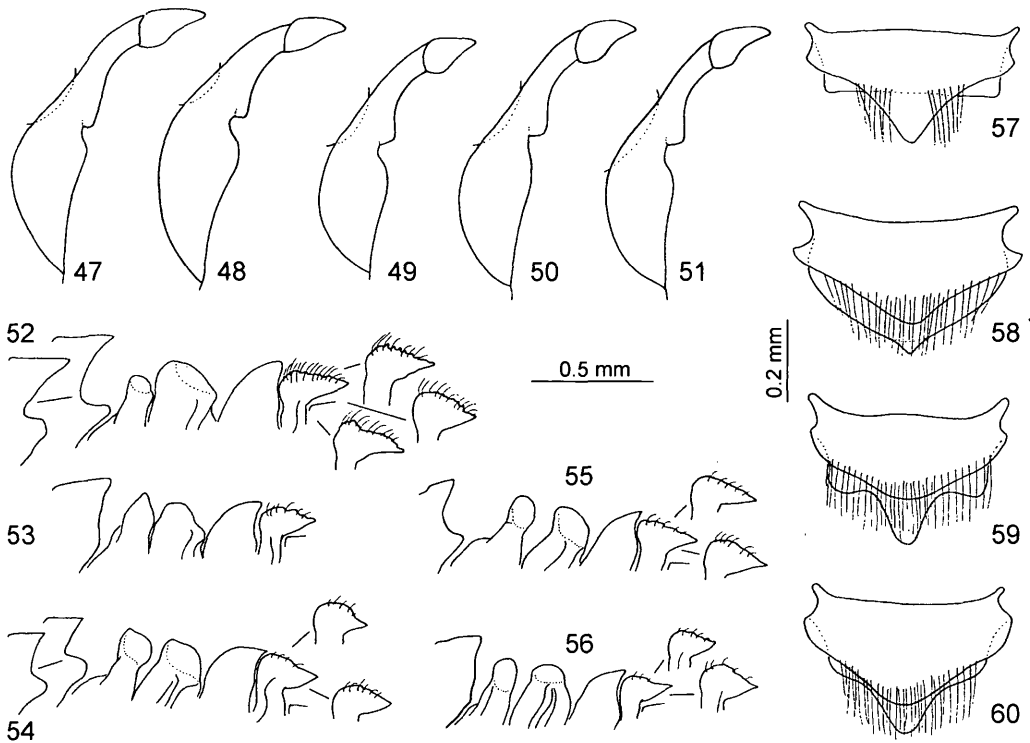
Etymology: The name "*samarensis*" (Latinized adjective) refers to the island of origin, Samar.

Hydrotrepes visayasensis sp.n. (Figs. 38 - 40, 49, 54, 59, 126)

Holotype (brachypterous male): " "PHILIPP. 16.III.1994\ Negros occ., Mambucal\ Seven Falls, ca. 900m\ leg. Schödl (2)" (NHMW); **paratypes:** 6 ♂♂, 1 ♀, and 1 ♀ (macropterous), same label data as holotype (NHMW); 4 ♀♀ "PHILIPP. 17.III.1994\ Negros occ., Lizaes\ W[E] Bacolod, Bago river\ ca. 500m; leg. Schödl (4)" (NHMW); 10 ♂♂, 2 ♀♀, and 3 ♂♂, 1 ♀ (macropterous) "PHILIPPINEN: Negros\ Mambucal\ 13.2.1994\ leg. Seyfert & Graindl" (NHMW); 4 ♂♂, 4 ♀♀, and 1 ♂ (macropterous) "PHILIPPINEN: Negros\ Mambucal, Mt. Canlaon\ Seven Falls, 13.2.1994\ leg. Seyfert & Graindl" (NHMW); 4 ♂♂, 3 ♀♀, and 1 ♂ (macropterous) "PHILIPPINEN: Negros\ Mambucal, Mt. Canlaon\ 13.2.1994\ leg. Seyfert & Graindl" (NHMW); 2 ♀♀ "PHILIPPINEN: Negros\ Mambucal, Mt. Canlaon\ 11.2.1994\ leg. Seyfert & Graindl" (NHMW); 1 ♂, and 1 ♀ (macropterous) "PHILIPPINEN: Negros\ Mambucal\ Pula riv., 11.2.1994\ leg. Seyfert & Graindl" (NHMW); 4 ♂♂, 2 ♀♀ "PHILIPPINEN: Negros\ SE Bacolod, Mambucal\ Seven Falls, 15.-16.3.\ 900m, lg. Zettel 1994 (39a)" (NHMW, UPLB); 1 ♀ "PHILIPPINEN: Negros\ SE Bacolod, Mambucal\ Health Resort, 15.3.\ 900m, lg. Zettel 1994 (39b)" (NHMW); 2 ♂♂, 2 ♀♀ "PHILIPPINEN: Negros\ SE Bacolod, Mambucal\ 1000 m, 16.3.1994\ leg. H. Zettel (39d)" (NHMW); 2 ♂♂, 6 ♀♀ "PHILIPPINEN: Negros\ W [E] Bacolod, Lizaes\ Bago riv., 550 m, 17.3.\ leg. Zettel 1994 (40)" (NHMW, UPLB); 1 ♂, 2 ♀♀, and 1 ♂ (macropterous) "PHILIPPINEN: Negros\ SE Murcia, Barangay\ Caliban riv., 250m, 18.3.\ leg. H. Zettel 1994 (41)" (NHMW); 12 ♂♂, 6 ♀♀, and 2 ♂♂ (Macropterous) "Philippinen: Negros or.\ W Dumaguete, Valencia\ Banica Valley Resort\ 25.2.1997, lg. Zettel (117)" 8CZW, UPLB); 4 ♂♂, 11 ♀♀ "PHILIPPINEN: Panay, Antique\ 50km NE San Jose d.B. [de Buenavista]\ San Remigio, Napula Falls\ lg. Zettel, 20.3.1994 (43)" (NHMW, UPLB); 4 ♂♂, 6 ♀♀, and 1 ♂ (macropterous) "PHILIPPINEN: Panay, Ilo-Ilo\ 10km NE Igaras, Nadsadan\ Falls, 500m, 22.3.1994\ leg. H. Zettel (47)" (NHMW, UPLB); 1 ♀ "PHILIPP. 20.III.1994\ Panay, Prov. Antique\ 50 km NE San Jose. Schödl (6)" (NHMW); 7 ♂♂, 5 ♀♀ "Philippinen: Cebu, S Badian\ Matutinao, Kawasan Falls\ 2-50 m, 23.-24.2.1997\ leg. H. Zettel (116)" (CZW, UPLB); 48 ♂♂, 33 ♀♀, and 2 ♂♂, 3 ♀♀ (macropterous) "Philippinen: Leyte\ Hilusig, rivers\ 14.2.2000\ leg. H. Zettel (238)" (NHMW, UPLB, ViSCA, CNT, IRR, UBCB); 5 ♂♂, 1 ♀, and 2 ♂♂, 1 ♀ (macropterous) "Philippinen: Leyte, rivers at Hilusig, 6.3.2001\ leg. H. Zettel (295)" (NHMW); 1 ♂, 2 ♀♀, and 1 ♂, 2 ♀♀ (macropterous) "Philippinen: Leyte, Makinhas, 11.3.2001\ Pacdanganan River, leg. H. Zettel (299)" (NHMW, UPLB); 7 ♂♂, 5 ♀♀ "Philippinen: N. Samar\ Veriato, El Amigo\ Veriato Falls, 16.3.\ 1998, leg. Zettel (162)" (CZW, UPLB); 1 ♀ "Philippinen: N. Samar\ Veriato, El Amigo\ Veriato Falls, 25.1.2000\ leg. H. Zettel (217)" (NHMW); 2 ♀♀ "Philippinen: Masbate Isl.\ 8 km SE Masbate, S Mobo\ Ubo Falls, 3.3.1998\ leg. H. Zettel (153)" (NHMW).

Description:

Brachypterous male: Body size: length 2.30 - 2.55 mm, width 1.60 - 1.80 mm; dorsal ground-colour yellow to pale; dorsal dark colour pattern mainly consisting of small, light to dark brown, mostly well delimited marks; posterior half of head with two clearly separated, longitudinal stripes close to midline and with more or less confluent large spots along posterior margin; anterior half of head without dark marks; disk of pronotum with numerous small brown dots, in some specimens incompletely confluent with two transverse lines close to anterior and posterior margins, lateral and posterior margins without dots; base of mesoscutellum with pair of transverse dark marks; mesoscutellum and hemelytron with numerous small, mostly not confluent brown spots; venter dark brown; legs and antennae yellow; rostrum brown.



Figs. 47 - 60: *Hydrotrepheis philippinus* group: (47 - 51) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen of (47) *H. philippinus* sp.n., (48) *H. samarensis* sp.n., (49) *H. visayasensis* sp.n., (50) *H. masbatensis* sp.n., (51) *H. pardalos*; (52 - 56) ventral carinae (venter turned upward, right view; with variations of carinae of prosternum and sternite 3) of (52) *H. philippinus* sp.n., (53) *H. samarensis* sp.n., (54) *H. visayasensis* sp.n., (55) *H. masbatensis* sp.n., (56) *H. pardalos*; (57 - 60) subgenital plate of female in ventral view (pilosity partly omitted) of (57) *H. pardalos*, (58) *H. philippinus* sp.n., (59) *H. visayasensis* sp.n., (60) *H. masbatensis* sp.n.

Cephalonotum with weakly rounded hind corners; head set with medium-sized to large punctures, on wide, shining midline distances between them longer than their diameter, laterally shorter than their diameter, anteriorly between punctures with minute micropunctures; pronotum on disk shining, with sparsely set large punctures (posteriorly slightly smaller), their distances ca. 1.5 - 4 times their diameter, laterally with distances between punctures partly shorter than their diameters, few punctures confluent; pronotal plate with shallow incision, anteriorly broad (Fig. 49); inner corner of propleural plate truncate; eye index: 2.3 - 2.5; fourth rostral segment 1.9 times as long as segment 3; mesoscutellum approximately 1.0 times as long as wide, between large, sparsely set punctures with very fine micropunctuation (except in middle), which more distinct on sides; hemelytron similarly sculptured, but micropunctuation more developed and surface therefore matt; in some specimens micropunctuation of lateral areas of mesoscutellum and hemelytron replaced by fine microreticulation.

Ventral carinae (Fig. 54): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with thin

lamina; carina of sternite 3 relatively shortly, triangularly produced, at most with indistinct denticles, weakly pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 38) with sharp tooth at distal two fifths of posterior margin, with angled or slightly rounded apex in lateral view, very narrow in apical view, without apical plate; right paramere (Fig. 39) very short, in basal half curved, distally widened, broad, distoposteriorly with row of short setae, apically straightly truncate; left paramere (Fig. 40) long and slender, with basal lobe, distally slender, strongly tapered, with row of long setae, and with acute apex.

Brachypterous female: Body size: length 2.20 - 2.50 mm, width 1.60 - 1.80 mm; similar to male; eye index: 2.5 - 2.6; abdomen symmetrical; sternite 6 with straight hind margin; subgenital plate (Fig. 59) with medial surface convex and posteriorly evenly rounded, with evenly distributed long pilosity, with distal lamella medially forming triangular, apically rounded lobe, sublaterally distinctly convex, laterally with pair of roundish lobes, without inner ridge.

Macropterous male: Body size: length 2.15 - 2.50 mm, width 1.60 - 1.75 mm; most characteristics, including colour, as in brachypterous male; eye index: 2.2 - 2.4; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.15 - 2.55 mm, width 1.65 - 1.85 mm; eye index: 2.2 - 2.4; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes visayasensis* sp.n. differs from *H. philippinus* sp.n. and *H. samarensis* sp.n. by normal-sized eyes. For distinction from *H. masbatensis* sp.n. see Comparative notes of this species, and the key. The genitalia of the male are diagnostic. Although *H. visayasensis* sp.n. is now recorded from six islands, it is very uniform all over its distribution area. The only exception is that specimens from Cebu are lighter in colour and usually only with a faded dark colour pattern; similarly light colour has already been recognized in other water bugs from Cebu (ZETTEL & CHEN 2000). The syntopic occurrence of *H. visayasensis* sp.n. with its closest relative, *H. masbatensis* sp.n., on Masbate Island is surprising.

Distribution: Panay (Antique, Ilo-Ilo), Negros (Negros Occidental, Negros Oriental), Cebu, Leyte (Leyte), Samar (Northern Samar), Masbate (Fig. 126). This species has a somewhat curious distribution, because many bug species living in the East Visayas (Samar, Leyte) occur also in Mindanao, but rarely in the West Visayas (Panay, Negros, Cebu, etc.). Therefore, it seems that *H. visayasensis* sp.n. has originated in the West Visayas and has reached the East Visayas quite recently.

Etymology: The name "*visayasensis*" (Latinized adjective) refers to the Visayas, the central islands of the Philippines, where this species is widely distributed.

Hydrotrepes masbatensis sp.n. (Figs. 41 - 43, 50, 55, 60, 126)

Holotype (brachypterous male): "Philippinen: Masbate Isl.\ 3.5 km SE Masbate, Tugbo\ Tugbo River, 2.3.1998\ leg. H. Zettel (152)" (UPLB); **paratypes:** 36 ♂♂, 31 ♀♀, same label data (NHMW, UPLB, CNT, IRR1); 1 ♂ "Philippinen: Masbate Isl.\ 8 km SE Masbate, S Mobo\ Ubo Falls, 3.3.1998\ leg. H. Zettel (153)" (NHMW).

Description:

Brachypterous male: Body size: length 2.35 - 2.55 mm, width 1.65 - 1.80 mm; dorsal ground-colour yellow; dorsal dark colour pattern mainly consisting of small, light to dark brown, well delimited marks; posterior half of head with two more or less separated, longitudinal stripes close to midline and with mostly confluent large spots along posterior margin, in most specimens forming transverse dark brown band following cephalonotal suture; anterior half of head with usually indistinct, small brownish marks in centre and two pairs in front of eyes; disk of pronotum with numerous small brown dots, variably confluent, but mostly isolated; base of mesoscutellum with pair of transverse dark marks, medially confluent in some specimens; mesoscutellum and hemelytron with numerous small, mostly not confluent brown spots; venter dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; head densely set with medium-sized punctures, distances between them everywhere shorter than than their diameter, laterally and anteriorly much shorter, punctures confluent; minute micropunctures present on interspaces anteriorly and laterally, but indistinct; pronotum on disk shining, with sparsely set, rather large and shallow punctures (posteriorly slightly smaller and more shallow than anteriorly), distances between them ca. 1.5 - 4 times their diameters, punctures towards sides strongly condensed, in wide area distances shorter than their diameters, in broad stripe along lateral margins most punctures confluent; pronotal plate with shallow incision, anteriorly broad (Fig. 50); inner corner of propleural plate truncate; eye index: 2.7 - 2.8; fourth rostral segment 2.1 times as long as segment 3; mesoscutellum approximately 1.0 times as long as wide; mesoscutellum and hemelytron between large, shallow, sparsely set punctures with fine, dense micropunctuation or microreticulation, matt.

Ventral carinae (Fig. 55): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with thin lamina; carina of sternite 3 triangularly produced, at most with indistinct denticles, with weak pilosity; sternite 4 without carina.

Genitalia: aedeagus (Fig. 41) with sharp tooth in middle of posterior margin, in lateral view with subapical part wide, with nearly parallel sides, with apex angled, in apical view very narrow, without apical plate; right paramere (Fig. 42) very short, in basal half curved, distally strongly widened, broad, distoposteriorly with row of short setae, apically straightly truncate; left paramere (Fig. 43) long and slender, with basal lobe, distally slender, strongly tapered, with row of long setae, and with acute apex.

Brachypterous female: Body size: length 2.40 - 2.60 mm, width 1.75 - 1.85 mm; similar to male; eye index: 2.7 - 2.8; abdomen symmetrical; sternite 6 with straight hind margin; subgenital plate (Fig. 60) with medial surface convex and posteriorly evenly rounded, with evenly distributed long pilosity, with distal lamella medially forming short, triangular, apically rounded lobe, sublaterally hardly convex, laterally without additional lobes, without inner ridge.

Macropterous morphs: unknown.

Comparative notes: *Hydrotrepes masbatensis* sp.n. is closely related to *H. visayasensis* sp.n., but males can be distinguished easily by the different shape of the aedeagus (comp. Figs. 38 and 41), females by the shape of the distal lamella of the subgenital plate (comp.

Figs. 59 and 60). In direct comparison, *H. masbatensis* sp.n. and *H. visayasensis* sp.n. obviously differ in both sexes by the punctures of the pronotum, which are less deep, and laterally denser and more confluent in *H. masbatensis* sp.n.

Distribution: Masbate Island (Fig. 126).

Etymology: The name "*masbatensis*" (Latinized adjective) refers to the island of origin, Masbate.

Hydrotrepes pardalos NIESER & CHEN, 1999 (Figs. 44 - 46, 51, 56, 57, 126)

Hydrotrepes pardalos NIESER & CHEN, 1999: 103 ff.

Material examined: paratypes: 4 ♂♂, 2 ♀♀ "♂" (or "♀", respectively), "PILIPINAS\ Mindanao\ [South Cotabato] L[ake]. Sebu area\ leg: Nieser", "N9373 stream\ Bakdolong\ 10.XII.[19]93\ in hills", "Hydrotrepes\ pardalos\ Nieser & Chen\ paratype ♂ [or "♀"]" (NHMW); 6 ♂♂, 6 ♀♀ "PHILIPPINEN: Mindanao\ Bukidnon Pr., Malaybalay\ Spring Site, 650m,\ 7.11.1996 \leg. H. Zettel (91)" (NHMW); 4 ♂♂, 2 ♀♀ "Philippinen: Mindanao\ Bukidnon Prov., Malaybalay\ Kaamulan Site, 650 m\ 15-16.1997,lg.Zettel (130)" (CZW); 3 ♂♂, 1 ♀ "Philippinen: Mindanao\ Misamis occ., W Ozamiz\ Tangub, Lumban, 6.3.\ 1997, leg. H.Zettel (124)" (CZW); holotype in CNT, additional paratypes in CNT, JTPC, UPLB, National Natural History Museum Leiden, and Zoological Museum Amsterdam (NIESER & CHEN 1999); **additional material:** 2 ♂♂, 2 ♀♀ "Philippinen: Mindanao\ Bukidnon, Malaybalay\ Kaamulan, 650 m, 15.-20.\ 3.2000, leg. Zettel (247)" (CZW, UPLB); 1 ♂, 2 ♀♀ (macropterous) "DAVAO: MT. APO\ CATIGAN RIVER\ 3000 FT: 5-18-79\ V.P.GAPUD" (CVPG).

Notes: A detailed description has been presented by NIESER & CHEN (2000) and is not repeated. However, figures and a short description of the diagnostic characteristics are provided to make them comparable with those of other Philippine species. *Hydrotrepes pardalos* is very uniform all over its wide distribution area in Mindanao.

Diagnosis: Body length of brachypterous male 2.30 - 2.55 mm, of brachypterous female 2.35 - 2.65 mm, of macropterous male 2.50 mm, and of macropterous female 2.50 - 2.55 mm; body width of brachypterous male 1.65 - 1.80 mm, of brachypterous female 1.70 - 1.85 mm, of macropterous male 1.80 mm, and of macropterous female 1.80 - 1.85 mm; colour pattern of head as illustrated by NIESER & CHEN (1999), or with medial stripes of head confluent; small brown dots on dorsum usually weakly confluent; head finely and densely punctured; disk of pronotum finely, very sparsely punctured, very densely punctured towards sides; mesocutellum with fine and scattered punctures and distinct microreticulation; hemelytron with larger and denser punctures, with distinct microreticulation; pronotal plate with small, roundish emargination (Fig. 51); ventral carinae (Fig. 56): prosternal carina with weakly acute posterior corner, posterior edge nearly straight; mesosternal carina and metasternal carina distally with thin lamina, both distally rounded; carina of sternite 3 birdhead-shaped, relatively short, with indistinct denticles, moderately pilose; genitalia of male: aedeagus (Fig. 44) elongate, subapically constricted, with elongate apex terminating in strongly curved lamella, without apical plate; right paramere (Fig. 45) relatively short, strongly curved, distally moderately widened, apically sharply truncate; left paramere (Fig. 46) distally evenly tapered and with obvious row of long bristles, with acute apex; subgenital plate of female (Fig. 57) very short, ventral surface produced into triangular apex, inner lamella straightly truncate.

Comparative notes: *Hydrotrepes pardalos* differs from most Philippine species in the not or hardly incised prosternal carina. This characteristic is otherwise found only in the

H. mirus species group, which is restricted to the Palawan Province and which can be distinguished by several characteristics listed in the key, couplet 2; and in *H. samarensis* sp.n. from which it can be easily distinguished by characteristics mentioned in the key, couplet 4. Within the *H. philippinus* species group, *H. pardalos* can be recognized by the very aberrant apex of the aedeagus (Fig. 44) and the triangular apex of the subgenital plate of the female arising from the ventral surface (Fig. 57), but not from the dorsal (inner) lamina as in the other species (Figs. 58 - 60; female of *H. samarensis* sp.n. unknown). Both, aedeagus and subgenital plate, are unique within described *Hydrotrepes* species (but see also *Hydrotrepes* sp. at the end of this paper). Therefore *H. pardalos* is placed in the *H. philippinus* group with minor reservations.

Distribution: Mindanao (South Cotabato, Sarangani, Davao, Bukidnon, Misamis Occidental) (NIESER & CHEN 1999, and this study: Fig. 126).

The *Hydrotrepes stereos* species group

Diagnosis: Aedeagus with knob-like tumescence on posterior surface (weakly developed in *H. bicolanus bicolanus* sp.n.), with head-shaped structure apically, without apical plate (Figs. 61, 64, 67, 70, 73, 76, 79, 82); right paramere short, apically truncate (Figs. 62, 65, 68, 71, 74, 77, 80, 83); left paramere wide, apically with minute hook (Figs. 63, 66, 69, 72, 75, 78, 81, 84); subgenital plate of female short, posteromedially with narrowly triangular to spine-like process (Figs. 96 - 102); ventral laterotergite 7 of female relatively wide (Fig. 104); pronotal plate with shallow incision (Figs. 85 - 88); meso- and metasternal carinae distally laminate (Figs. 89 - 95); carina of sternite 3 directed posteriad, without long spine, with indistinct denticles; lateral margin of hemelytron without row of short stout bristles; pronotum of macropterous specimens simple.

Discussion: Species of the *H. stereos* group are uniform in the pronotal plate, ventral carinae, genitalia of males, and subgenital plate of females. They differ from the species of the *H. mirus* group, *H. sarawakensis* group, and *H. martini* group, in the structures of the sternal carinae, inter al.; and from the species of the *H. bouvieri* group, *H. balnearius* group, and *H. philippinus* group, in the structures of the aedeagus, inter al. There are numerous similarities with the species of the *H. philippinus* group, but strong differences in the apical structures of the aedeagus, in the wide left paramere, in the broad ventral laterotergites 7 of the female, and in the larger puncturation of the pronotal disk. Species of the *H. stereos* group differ from other Philippine species in having a slightly elongate mesoscutellum (ca. 1.05 - 1.10 times as long as wide).

The *Hydrotrepes stereos* complex consists of several closely related allopatric "forms" which are widely distributed in the Philippines. The characteristics they have in common are more by far than distinguishing characteristics. Even differences in genitalia of males and subgenital plates of females are small, although stable. Without knowledge of their genetic distance, it is merely a matter of taste, whether to rank these populations as different species or to regard them as subspecies of one widely distributed species. In this paper, some of the populations are described as morphospecies, but three "forms" from North and Central Luzon and Mindoro and two "forms" from South Luzon and Catanduanes, respectively, are more closely related and described as subspecies.

Distribution: So far four Philippine species are set into this group, which is widely distributed on the islands belonging to the Pleistocene islands Greater Luzon, Greater Mindoro, and Greater Mindanao (Fig. 127).

***Hydrotrepes stereos* NIESER & CHEN, 1999** (Figs. 61 - 63, 85, 89, 99, 104, 127)

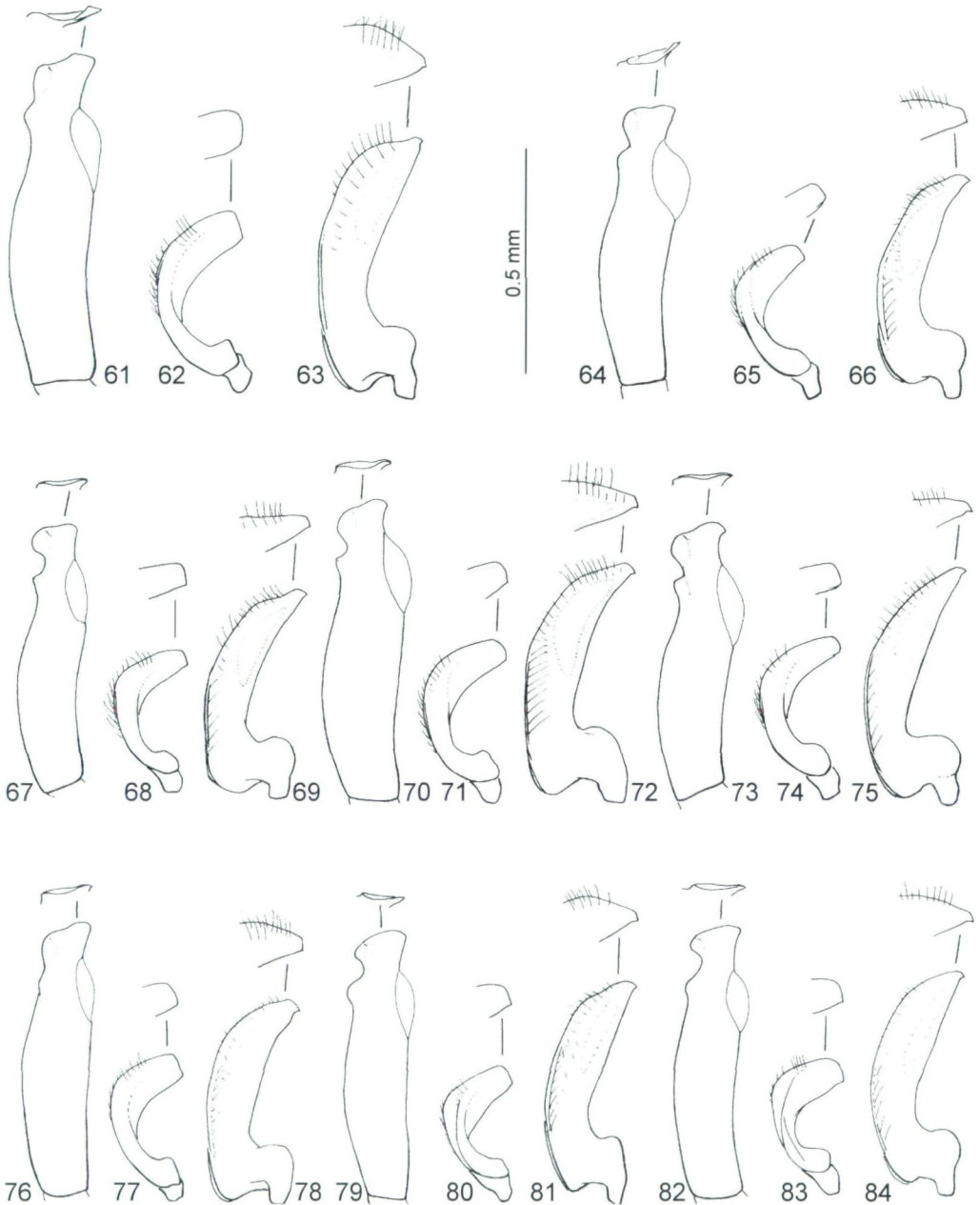
Hydrotrepes stereos NIESER & CHEN, 1999: 105 ff.

Material examined: paratypes: 1 ♀ "PILIPINAS: Min-\danao Lake Se-\ bu area leg:\ N. Nieser 1993", "N9371 just\ upstream\ 3rd fall\ plantdebris" (NHMW); 1 ♂, 1 ♀ "PILIPINAS\ Mindanao\ L. Sebu area\ leg: Nieser", "quiet edge,\ boulders w.\ algae & mud", "N9375 cold\ River, 8.XII.\ 1993, feeding\ Lake Sebu" (NHMW); 25 ♂♂, 25 ♀♀, and 6 ♂♂, 6 ♀♀ (macropterous) "PHILIPPINEN: Mindanao\ Bukidnon, 4km NE Lantapan\ Kaatuan, Kulasihan Riv., 850m \9.11.1996, leg. H. Zettel (93)" (NHMW), more paratypes from the same locality in UPLB; **additional material:** 1 ♂, 2 ♀♀ (macropterous) "DAVAO: MT. APO\ CATIGAN RIVER\ 3000 FT: 5-18-79\ V.P.GAPUD" (CVPG).

Diagnosis: Body large; body length of brachypterous male 2.95 - 3.30 mm, of brachypterous female 3.00 - 3.30 mm, of macropterous male 3.00 - 3.20 mm, and of macropterous female 3.00 - 3.25 mm; body width of brachypterous male 2.05 - 2.15 mm, of brachypterous female 2.10 - 2.25 mm, of macropterous male 2.10 - 2.20 mm, and of macropterous female 2.15 - 2.30 mm; colour varying, dark brown dots usually small and not much confluent; colour pattern of head as illustrated by NIESER & CHEN (1999); puncturation large and dense; micropuncturation of head nearly reaching posterior margin; microsculpture of mesoscutellum and hemelytron usually strongly developed as reticulation, rarely puncturation, lacking only in centre of mesoscutellum; pronotal plate with shallow incision (Fig. 85); ventral carinae (Fig. 89): prosternal carina with more or less acute posterior corner, posterior edge moderately concave; carina of sternite 3 bird-head-shaped, relatively long, with indistinct denticles, moderately pilose; genitalia of male: aedeagus (Fig. 61) distoposteriorly with two tubercles, subapical tubercle roundish and well developed, apical margin slightly concave, in apical view very narrow, without apical plate; right paramere (Fig. 62) very short, in basal half curved, distally relatively narrow, apicad weakly tapered, distoposteriorly with row of short setae, apically truncate; left paramere (Fig. 63) long and very stout, with basal lobe, distally wide, subapically with numerous long setae, suddenly tapered close to apex, and with apex hardly truncate, angular; subgenital plate of female (Fig. 99) very short, with medial ventral surface convex, medioposteriorly rounded, lateroposteriorly delimited by long sharp ridge, with long pilosity, with distal lamella medially forming triangular, apically acute process, sublaterally very strongly convex, laterally angled and slightly truncate, with inner roundish swelling narrow, width less than one third of width of subgenital plate.

Comparative notes: *Hydrotrepes stereos* is a large species. It can be easily distinguished from similarly large subspecies of *H. stereoides* sp.n. by the roundish subapical tubercle of the aedeagus (Fig. 61), the relatively broad left paramere (Fig. 63), and most of all by the differently structured subgenital plate of the female (comp. Fig. 99 with Figs. 96 - 98). For distinction from the most closely related, but much smaller *H. milanae* sp.n. see the Comparative notes of that species.

Distribution: Mindanao (South Cotabato, Sarangani, Davao, Bukidnon) (NIESER & CHEN 1999, and this study: Fig. 127).



Figs. 61 - 84: *Hydrotrepes stereos* group: genitalia of males (right aspect): (61 - 63) *H. stereos*, (64 - 66) *H. milanae* sp.n., (67 - 69) *H. stereoides stereoides* sp.n., (70 - 72) *H. stereoides montanus* ssp.n., (73 - 75) *H. stereoides mindoroensis* ssp.n., (76 - 78) *H. bicolanus bicolanus* sp.n., (79 - 81) *H. bicolanus seyferti* ssp.n. (from Catanduanes), (82 - 84) *bicolanus seyferti* ssp.n. (from Albay); (61, 64, 67, 70, 73, 76, 79, 82) aedeagus, (62, 65, 68, 71, 74, 77, 80, 83) right paramere, (63, 66, 69, 72, 75, 78, 81, 84) left paramere.

***Hydrotrepes milanae* sp.n.** (Figs. 64 - 66, 86, 90, 100, 127)

Holotype (brachypterous male): "Philippinen: Leyte\ Hilusig, rivers\ 14.2.2000\ leg. H. Zettel (238)" (UPLB); **paratypes**: 17 ♂♂, 23 ♀♀, and 1 ♂, 6 ♀♀ (macropterous), same label data as holotype (NHMW, UPLB, ViSCA); 18 ♂♂, 10 ♀♀, and 3 ♂♂, 2 ♀♀ (macropterous) "Philippinen: Leyte,\ rivers at Hilusig,\ 6.3.2001\ leg. H. Zettel (295)" (NHMW, UPLB, ViSCA); 2 ♂♂ "Philippinen: Leyte,\ Makinhas, 11.3.2001\ Pacdanganan River,\ leg. H. Zettel (299)" (NHMW); 1 ♀ "Philippinen: Biliran\ SE Almeria, Balagombong\ Falls, 14.3.1998\ leg. H. Zettel (161)" (CZW).

Description:

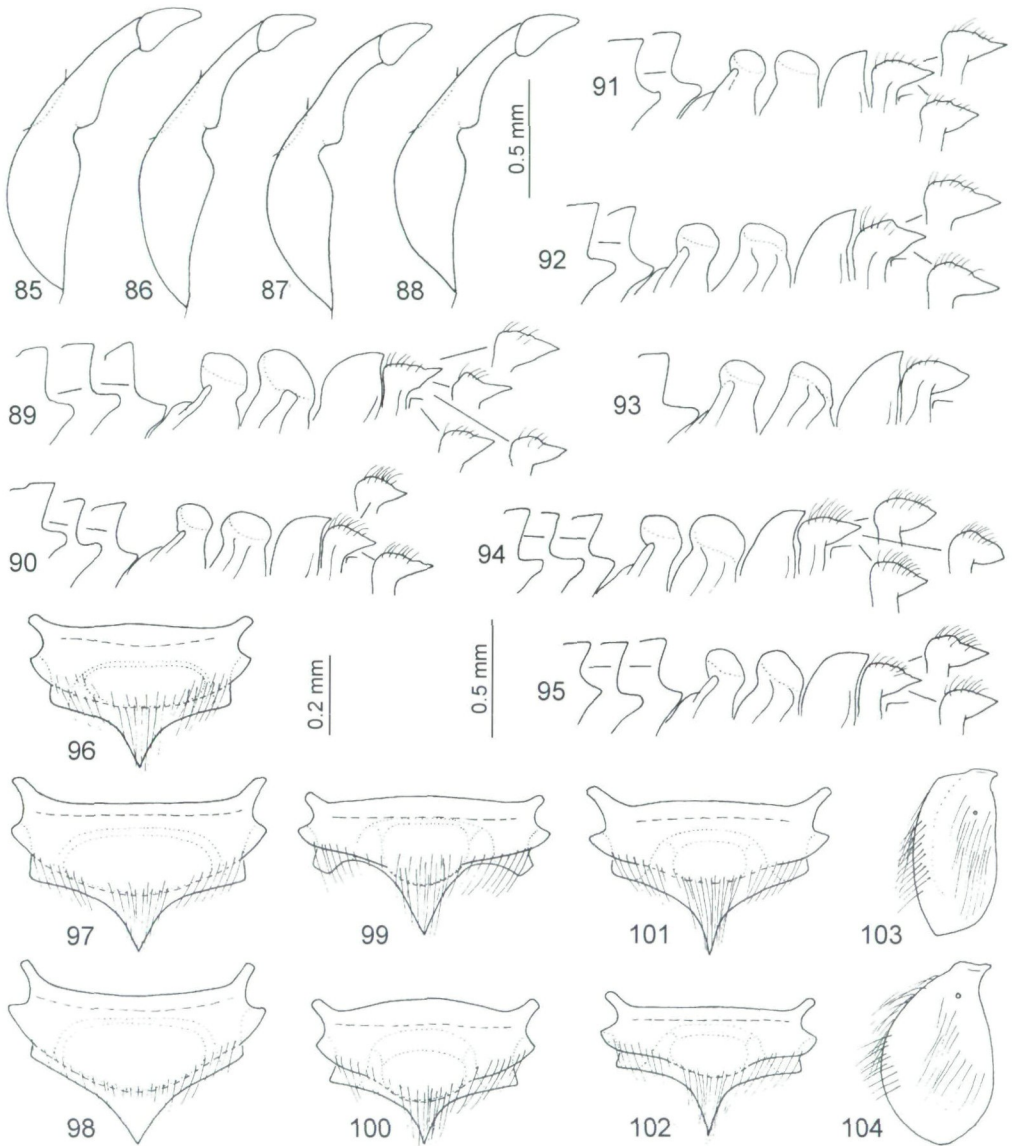
Brachypterous male: Body size: length 2.60 - 2.75 mm, width 1.80 - 1.95 mm; dorsal ground-colour yellow; dorsal dark colour pattern blackish brown, mainly consisting of small, well-delimited marks; posterior half of head with two broad, but meadially narrowly separated longitudinal stripes and with more or less confluent large marks along posterior margin; anterior half of head with roundish or elongate central mark of varying size; pronotum (except narrow margins) with numerous, more or less confluent, small brown dots; base of mesoscutellum with transverse dark stripe (rarely medially interrupted); mesoscutellum and hemelytron with numerous small, more or less confluent brown spots; venter dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; head set with rather large punctures, on shining midline distances between them as long or longer than their diameters, laterally much shorter than their diameters, along inner eye margins more or less confluent, anteriorly between punctures with minute micropunctures; pronotum with very large, deep punctures, on disk shining and with distances between punctures in average distinctly longer than their diameters, laterally denser, with distances between punctures mostly shorter than their diameter, along lateral margins few punctures confluent; pronotal plate with shallow incision, anteriorly broad (Fig. 86); inner corner of propleural plate truncate; eye index: 2.4 - 2.5; fourth rostral segment 2.2 times as long as segment 3; mesoscutellum approximately 1.1 times as long as wide, with large, deep punctures, distances between them mostly longer than their diameter, between punctures on disk shining, along lateral margins with very fine micropunctuation; hemelytron similarly sculptured, but large punctures less deep, micropunctuation much more developed, and surface nearly matt.

Ventral carinae (Fig. 90): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with thin lamina; carina of sternite 3 triangularly produced, at most with indistinct denticles, rather densely pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 64) distoposteriorly with two tubercles, subapical tubercle roundish and distinct, apical margin hardly concave, in apical view very narrow, without apical plate; right paramere (Fig. 65) very short, in basal half curved, distally relatively narrow, apicad weakly tapered, distoposteriorly with row of short setae, apically slightly truncate; left paramere (Fig. 66) long and stout, with basal lobe, distally wide, subapically strongly tapered and with numerous long setae, and with apex narrowly truncate, angular.

Brachypterous female: Body size: length 2.55 - 2.80 mm, width 1.85 - 2.00 mm; similar to male; eye index: 2.7 - 2.8; abdomen symmetrical; sternite 6 with slightly concave hind margin; subgenital plate (Fig. 100) relatively short, with medial surface convex,



Figs. 85 - 104: *Hydrotrepes stereos* group (except Fig. 103): (85 - 88) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen of (85) *H. stereos*, (86) *H. milanae* sp.n., (87) *H. stereoides stereoides* sp.n., (88) *H. bicolanus bicolanus* sp.n.; (89 - 95) ventral carinae (venter turned upward, right view, with variations of carinae of prosternum and sternite 3) of (89) *H. stereos*, (90) *H. milanae* sp.n., (91) *H. stereoides stereoides* sp.n., (92) *H. stereoides montanus* ssp.n., (93) *H. stereoides mindoroensis* ssp.n., (94) *H. bicolanus bicolanus* sp.n., (95) *H. bicolanus seyfertii* ssp.n.; (96 - 102) subgenital plate of female in ventral view (pilosity partly omitted) of (96) *H. stereoides stereoides* sp.n., (97) *H. stereoides montanus* ssp.n., (98) *H. stereoides mindoroensis* ssp.n., (99) *H. stereos*, (100) *H. milanae* sp.n., (101) *H. bicolanus bicolanus* sp.n., (102) *H. bicolanus seyfertii* ssp.n.; (103, 104) ventral laterotergite 7 (ventral view pilosity partly omitted) of (103) *H. philippinus* sp.n. and (104) *H. stereos*.

medioposteriorly rounded, lateroposteriorly delimited by sharp ridge, with long pilosity, with distal lamella medially forming triangular, apically acute process, sublaterally distinctly convex, laterally angled, with inner roundish swelling narrow, approximately one third of width of subgenital plate.

Macropterous male: Body size: length 2.60 - 2.75 mm, width 1.90 - 2.00 mm; most characteristics as in brachypterous male; colour of dorsum slightly darker by larger and in average more confluent dots; eye index: 2.5 - 2.6; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.70 - 2.80 mm, width 1.95 - 2.05 mm; eye index: 2.2 - 2.4; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes milanae* sp.n. is closely related to *H. stereos*. Modifications of the apex of the aedeagus and of the subgenital plate are similar in both species and indicate that they are adelphotaxa, which is also supported by zoogeographical relationships (species from Greater Mindanao). The two species can be distinguished by the body size, the apices of both parameres (comp. Figs. 62 and 65, 63 and 66), and the subgenital plate of the females (comp. Figs. 99 and 100). In *H. milanae* sp.n. the long pilosity on the carina of sternite 3 is similarly densely developed as in *H. bicolanus* sp.n.

Distribution: Leyte (Leyte); Biliran (the occurrence in Biliran should be confirmed by males) (Fig. 127).

Etymology: This species is named in honour of Dr. Paciencia Milan, President of the Visayas State College of Agriculture, who friendly facilitated the author's visits to Leyte.

Hydrotrepes stereoides sp.n.

Notes: This species is distributed in North and Central Luzon, and in Mindoro. *Hydrotrepes stereoides* sp.n. is similar to the most southern species of the group, *H. stereos*, from which it is geographically separated by more differentiated species in Bicol and in the East Visayas. Three subspecies of *H. stereoides* sp.n. are recognized, which differ in size and punctuation of the cephalonotum; genitalia of males and subgenital plates of females are very uniform.

Etymology: This species is named for its similarity with *H. stereos*. Two of the three subspecies have a similar "robust built" like *H. stereos*.

Hydrotrepes stereoides stereoides sp.n. (Figs. 67 - 69, 87, 91, 96, 127)

Holotype (brachypterous male): "Philippinen: Luzon, \ Zambales, Subic Bay \ Aeta village, 9.12.2000 \ leg. H. Zettel (261)" (UPLB); **paratypes:** 22 ♂♂, 29 ♀♀, and 6 ♂♂, 3 ♀♀ (macropterous) same label data as holotype (NHMW, UPLB, CNT); 3 ♂♂, 3 ♀♀, and 1 ♀ (macropterous) "CAVITE: Alfonso \ Pajo: Humayao Cr \ 17 MAY 1977: H.SAN \ VALENTIN" (CVPG).

Description:

Brachypterous male: Body size: length 2.55 - 3.00 mm, width 1.80 - 2.05 mm; dorsal ground-colour yellow; dorsal dark colour pattern blackish brown, mainly consisting of

small, well delimited marks; posterior half of head with two medially narrowly separated longitudinal stripes and with more or less confluent large marks along posterior margin; anterior half of head with small roundish central mark, rarely lacking; pronotum (except narrow posterior and lateral margins) with numerous, more or less confluent, small, brown dots; base of mesoscutellum with transverse dark stripe (very rarely medially interrupted); mesoscutellum and hemelytron with numerous small, more or less confluent brown dots; venter dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; head set with rather large punctures, on shining midline distances between them shorter to slightly longer than their diameters, laterally much shorter and punctures confluent over wide area, anteriorly minute micropunctures between punctures; pronotum on disk shining, with very large, deep punctures, anteromedially with distances between punctures partly shorter than their diameters, posteromedially distinctly longer, laterally very dense, with distances between punctures much shorter than their diameter, along lateral margins few punctures confluent; pronotal plate with shallow incision, anteriorly broad (Fig. 87); inner corner of propleural plate truncate; eye index: 2.5 - 2.7; fourth rostral segment 2.3 times as long as segment 3; mesoscutellum approximately 1.1 times as long as wide, with large, deep punctures, distances between punctures, slightly longer than their diameters, with very fine micropunctuation, this lacking in some specimens on disk; hemelytron similarly sculptured, but large punctures less deep, micropunctuation much more developed, and surface nearly matt, in some specimens micropunctuation replaced by microreticulation.

Ventral carinae (Fig. 91): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with thin lamina; carina of sternite 3 triangularly produced, at most with indistinct denticles, rather weakly pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 67) distoposteriorly with two tubercles, subapical tubercle angulate, distinct, apical margin hardly concave, in apical view very narrow, without apical plate; right paramere (Fig. 68) very short, in basal half curved, distally relatively narrow, apicad weakly tapered, distoposteriorly with row of short setae, apically narrowly truncate; left paramere (Fig. 69) long and stout, with basal lobe, distally wide, subapically strongly tapered and with numerous long setae, and with apex narrowly truncate, angular.

Brachypterous female: Body size: length 2.65 - 3.00 mm, width 1.85 - 2.05 mm; similar to male; eye index: 2.4 - 2.8; abdomen symmetrical; sternite 6 with straight hind margin; subgenital plate (Fig. 96) relatively short, with medial surface convex, medioposteriorly rounded, lateroposteriorly without sharp ridge, with long pilosity, with distal lamella medially forming triangular, apically acute process, sublaterally distinctly convex, laterally angled, with inner roundish swelling wide, more than half of width of subgenital plate.

Macropterous male: Body size: length 2.50 - 2.75 mm, width 1.80 - 1.90 mm; most characteristics as in brachypterous male; colour of dorsum slightly darker by larger and in average more confluent dots; eye index: 2.2 - 2.6; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: Body size: length 2.45 - 2.95 mm, width 1.80 - 2.10 mm; eye index: 2.3 - 2.5; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes stereoides* sp.n. is defined by three main characteristics: (1) The subapical tubercle of the aedeagus of the male is angulate (Figs. 67, 70, 73). (2) The subgenital plate of the female has the inner roundish swelling wide, and (3) is lacking a sharp ridge delimiting the ventral swelling from the apical lamella (Figs. 96 - 98). The nominotypical subspecies is defined by dense puncturation of the cephalonotum and relatively small size. Brachypterous specimens from the type locality have a cephalonotal width of 1.82 - 1.97 mm. Specimens from Cavite are distinctly larger than those from Zambales and preliminarily included in this subspecies.

Distribution: Central Luzon (Zambales, Cavite) (Fig. 127).

***Hydrotrepes stereoides montanus* ssp.n.** (Figs. 70 - 72, 92, 97, 123, 127)

Holotype (brachypterous male): "Philippinen: LZ, Mount.Pr.\ Sagada, Echo Valley, Under-\ ground River, 23.-24.2.1999\ 1500 m, leg. H. Zettel (186)" (UPLB); **paratypes:** 4 ♂♂, 1 ♀, and 1 ♂ (macropterous), same label data as holotype (NHMW, UPLB); 4 ♀♀ "Philippinen: LZ, Mount.Pr.\ Chico River, Gonogon\ 1100 m, 21.2.1999\ leg. H. Zettel (184)" (CZW, UPLB); 1 ♀, same label data except "... leg. F. Seyfert (8b)" (CSW); 1 ♂, 4 ♀♀, and 3 ♀♀ (macropterous) "Philippinen: LZ, Mount.Pr.\ NE Sagada, Banga'an\ Bomod-ok Wf., 22.2.1999\ 1500 m, leg.H.Zettel (185)" (CZW, UPLB); 1 ♀, and 1 ♂ (macropterous), same label data except "... leg.F.Seyfert (9)" (CSW, UPLB); 2 ♂♂ "Philippinen: LZ, Mount.Pr.\ 5km S Bontoc, Balitian Riv.\ 900 m, 27.2.1999\ leg. F. Seyfert (16)" (CSW, UPLB); 2 ♂♂, 1 ♀, and 1 ♂, 3 ♀♀ (macropterous) "Philippinen: LZ, Benguet\ Asin Hot Springs\ W Baguio, 17.2.1999\ leg. H. Zettel (180)" (CZW, UPLB).

Description: Largest subspecies; body length of brachypterous male 3.05 - 3.35 mm, of brachypterous female 3.05 - 3.25 mm, of macropterous male 3.10 - 3.15 mm, and of macropterous female 3.15 - 3.20 mm; body width of brachypterous male 2.10 - 2.20 mm, of brachypterous female 2.15 - 2.25 mm, of macropterous male 2.20 mm, and of macropterous female 2.15 - 2.20 mm; colour in average lighter than in nominotypical subspecies, with small dots less confluent, with paired stripes on head anteriad diverging in some specimens (Fig. 123), with central mark on anterior half of head elongate in some specimens; midline of head with distances between punctures larger than their diameter (up to three times their diameter), with micropuncturation posteriad surpassing middle of length, in most specimens nearly reaching posterior margin; mesoscutellum with micropuncturation on sides, but not on disk; pronotal plate, ventral carinae (Fig. 92), genitalia of male (Figs. 70 - 72), and subgenital plate of female (Fig. 97) not significantly differing from nominotypical subspecies.

Comparative notes: This subspecies, which is presently known from five localities in the mountains of North Luzon, differs consistantly from the other two subspecies in the large body size.

Distribution: Luzon (Mountain Province, Benguet).

Etymology: The name of the subspecies "*montanus*" (Latin for mountainous) refers to the type locality in the Mountain Province.

***Hydrotrepes stereoides mindoroensis* ssp.n.** (Figs. 73 - 75, 93, 98, 127)

Holotype (macropterous male): "PHILIPPINEN - Mindoro\ 28km S Calapan 1993\ Balete 100-700m (19)\ leg. Jäch 27.-29.11." (NHMW); **paratypes:** 1 ♂ (slightly shriveled), 1 ♀, same label data as holotype

(NHMW); 1 ♂, and 1 ♀ (macropterous) "leg. Jäch 1.12.\ PHILIPPINEN - Mindoro\ 20km W Calapan 1992\ Hidden Paradise (21)" (NHMW); 2 ♀♀ "leg. Jäch 20.-21.11.\ PHILIPPINEN - Mindoro\ 20km W Calapan 1992\ Hidden Paradise (10)" (NHMW, UPLB).

Description: Large subspecies; body length of brachypterous male ca. 2.90 mm, of brachypterous female 2.85 - 3.05 mm, of macropterous male 2.90 mm, and of macropterous female 2.90 mm; body width of brachypterous male ca. 2.05 mm, of brachypterous female 2.00 - 2.15 mm, of macropterous male 2.05 mm, and of macropterous female 2.05 mm; colour as in the darkest specimens of the nominotypical subspecies, with most dark dots confluent; central mark in anterior half of head distinct, roundish, and relatively large; additional paired small brownish spots in front of eye present in some specimens; midline of head with distances between punctures longer than their diameters (up to three times their diameters), with micropunctuation reaching close to posterior margin of head; punctuation of disk of pronotum compared with other two subspecies relatively small and sparse, but strongly varying in density; mesoscutellum with micropunctuation on sides, but not on disk; pronotal plate, ventral carinae (Fig. 93), genitalia of male (Figs. 73 - 75), and subgenital plate of female (Fig. 98) not significantly differing from nominotypical subspecies.

Comparative notes: *Hydrotrepes stereoides mindoroensis* ssp.n. is larger than typical specimens of the nominotypical subspecies, but constantly smaller than *H. stereoides montanus* ssp.n., with which it shares a similar punctuation of the head.

Distribution: Mindoro (Mindoro Oriental) (Fig. 127).

Etymology: The subspecific epithet "*mindoroensis*" (Latinized adjective) refers to the island of origin, Mindoro.

Hydrotrepes bicolanus sp.n.

Notes: *Hydrotrepes bicolanus* sp.n. occurs in the Bicol Region. Strong similarities in the genitalia of the male and the subgenital plate of the female indicate that the examined material belongs to one geographically varying species. The two subspecies can be well separated by the aedeagus of the males (comp. Fig. 76 with Figs. 79 and 82), but are otherwise extremely similar. The nominotypical subspecies is very common at the slopes of the Mount Isarog and has been found in the Buhi district and in the Bicol National Park, too. *Hydrotrepes bicolanus seyferti* ssp.n. is more widely distributed, and populations vary slightly in some characteristics.

Etymology: The name *bicolanus* (Latinized adjective) refers to the distribution of this species in Bicol, the name of the region consisting of the provinces Camarines Norte, Camarines Sur, Albay, Sorsogon, and Catanduanes.

Hydrotrepes bicolanus bicolanus sp.n. (Figs. 76 - 78, 88, 94, 101, 127)

Holotype (brachypterous male): "Philippinen: Camarines Sur\ 20km E Naga, 5km E Carolina\ Mt. Isarog, Malabsay Falls\ 19.2.1998, leg. Zettel (141)" (UPLB); **paratypes:** 55 ♂♂, 37 ♀♀, and 13 ♂♂, 11 ♀♀ (macropterous), same label data as holotype (NHMW, UPLB, IRRI, CNT, UBCB); 1 ♂, 7 ♀♀, and 8 ♂♂, 24 ♀♀ (macropterous) "Philippinen: LZ, Camarines\ Sur, 20 km E Naga, 5 km E\ Carolina, Malabsay Falls\

20.11.1999, leg. Zettel (208)" (CZW, UPLB); 19 ♂♂, 16 ♀♀ "Philippinen: Camarines Sur\ 20km E Naga, 3km E Carolina\ Mainit Spring ("Hydro")\ 20.2.1998, leg. Zettel (142)" (NHMW, UPLB); 12 ♂♂, 9 ♀♀, same label data except "... 4.3.1999, leg. Zettel (193)" (NHMW, UPLB); 3 ♂♂, 1 ♀ "Philippinen: Camarines Sur\ 20km E Naga, E Carolina\ slopes of Mt. Isarog\ 4.3.1999, leg. Seyfert (19)" (CSW, CZW); 14 ♂♂, 12 ♀♀ "Philippinen: Camarines Sur\ Lake Buhi area, Twin Falls\ nr. Itbog, 22.3.1998\ leg. H. Zettel (164)" (CZW, UPLB); 2 ♂♂, 3 ♀♀, and 2 ♂♂, 2 ♀♀ (macropterous) "Camarines Sur, Pili\ Boncao, Caririga Creek\ 11-30-2001, leg. \ Almazar, Fabricante & Ibo" (CSSAC); 19 ♂♂, 16 ♀♀, and 1 ♂ (macropterous) "Philippinen: Luzon, Cama-/ rines Sur, Pili, Buncao, / Caririga Creek, 1.2.2002/ leg. H. Zettel (301)" (CZW, UPLB); 7 ♂♂, 7 ♀♀, and 2 ♂♂, 3 ♀♀ (macropterous) "Camarines Sur, Pili\ Boncao, Himaon Creek\ 11-30-2001, leg. \ Almazar, Fabricante & Ibo" (CSSAC); 6 ♂♂, 13 ♀♀ "Philippinen: Luzon, Cama-/ rines Sur, Pili, Buncao, / Himaon Creek, 1.2.2002/ leg. H. Zettel (302)" (CZW, UPLB); 1 ♂, 1 ♀ (brachypterous) "Philippinen: LZ, Cama-/ rines Sur, Lupi, Alanao/ Bahi River [border with Camarines Norte], 10.2.2002/ leg. H. Zettel (307)" (CZW).

Brachypterous male: Body size: length 2.60 - 2.90 mm, width 1.85 - 2.00 mm; dorsal ground-colour yellow; dorsal dark colour pattern blackish brown, mainly consisting of small, well delimited marks; posterior half of head with two meadially narrowly separated longitudinal stripes and with more or less confluent large marks along posterior margin; anterior half of head with small roundish central mark, this rarely indistinct; pronotum (except anteromedial area and narrow posterior and lateral margins) with numerous, more or less confluent, small brown dots; base of mesoscutellum with transverse dark stripe (rarely narrowly interrupted medially); mesoscutellum and hemelytron with numerous small, more or less confluent brown spots; venter dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; head set with rather large punctures, on shining midline distances between punctures longer than their diameters, laterally much shorter and punctures confluent in wide area, anteriorly between punctures with minute micropunctures; pronotum with very large, deep punctures, on disk shining, anteromedially with distances between punctures partly shorter than their diameters, posteromedially distinctly larger (and puncture smaller), laterally very dense, with distances between punctures much shorter than their diameter, along lateral margins punctures confluent; pronotal plate with shallow incision, anteriorly broad (Fig. 88); inner corner of propleural plate truncate; eye index: 2.4 - 2.6; fourth rostral segment 2.1 times as long as segment 3; mesoscutellum approximately 1.05 times as long as wide, with large, deep punctures, distances between punctures in middle larger, laterally shorter than their diameter, laterally between punctures with very fine micropunctuation; hemelytron densely set with punctures, micropunctuation much more developed than on mesoscutellum, and surface at most weakly shining.

Ventral carinae (Fig. 94): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae rather high, distally with thin lamina; carina of sternite 3 triangularly produced, relatively short, apex frequently blunt, at most with very indistinct denticles, rather densely pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 76) distoposteriorly with two tubercles, but subapical tubercle strongly reduced, apical margin weakly concave, in apical view very narrow, without apical plate; right paramere (Fig. 77) very short, in basal half curved, distally relatively slender, apicad hardly tapered, distoposteriorly with row of short setae, apically narrowly truncate; left paramere (Fig. 78) long and very stout, with basal lobe, distally wide, subapically strongly tapered and with numerous long setae, and with apex narrowly truncate, angular.

Brachypterous female: Body size: length 2.60 - 2.85 mm, width 1.90 - 2.05 mm; similar to male; eye index: 2.4 - 2.7; abdomen symmetrical; sternite 6 with nearly straight hind margin; subgenital plate (Fig. 101) relatively short, with medial surface convex, medio-posteriorly rounded, lateroposteriorly with sharp ridge, with long pilosity, with distal lamella medially forming narrowly triangular, spine-like apical process, sublaterally convex, laterally angled, with inner roundish swelling narrow, less than one third of width of subgenital plate.

Macropterous male: body size: length 2.60 - 2.70 mm, width 1.85 - 2.00 mm; most characteristics as in brachypterous male; colour of dorsum in average not darker than brachypterous specimens; eye index: 2.4 - 2.5; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Macropterous female: body size: length 2.60 - 2.70 mm, width 1.85 - 2.00 mm; eye index: 2.4 - 2.6; characteristics as in brachypterous female, except those mentioned for macropterous male.

Comparative notes: *Hydrotrepes bicolanus* sp.n. is a relatively dark, small species with dense puncturation of the cephalonotum, with relatively dense pilosity on the carina of sternite 3 (Fig. 94, 95), and with a characteristic subgenital plate of the female (Figs. 101, 102), which has a spine-like mediodistal process and a narrow inner round swelling. The nominotypical subspecies is well-characterized by the weakly developed subapical tubercle of the aedeagus (Fig. 76) and differs from *H. b. seyferti* ssp.n. also in the slightly concave apical margin of the aedeagus.

Distribution: Luzon (Camarines Sur, Camarines Norte) (Fig. 127).

Hydrotrepes bicolanus seyferti ssp.n. (Figs. 79 - 84, 95, 102, 127)

Holotype (brachypterous male): "Philippinen: Catanduanes\ N Bato, S San Miguel\ Balongbong Falls, 7.3.\ 1999, leg. F. Seyfert (21)" (UPLB); **paratypes:** 11 ♂♂, 4 ♀♀, and 2 ♂♂, 2 ♀♀, same label data as holotype (CSW, UPLB, NHMW); 17 ♂♂, 18 ♀♀, and 3 ♂♂, 2 ♀♀ (macropterous), same label data except "... leg. H. Zettel (195)" (NHMW, UPLB); 9 ♂♂, 5 ♀♀ "Philippinen: Catanduanes\ W Bato, Maribini Falls\ 6.3.1999\ leg. H. Zettel (194)" (NHMW, UPLB); 1 ♀ (macropterous) "Philippinen: Catanduanes\ W Virac, Sto. Domingo\ Pajo River area, 10.3.\ 1999, leg. Zettel (199)" (NHMW); 3 ♂♂, 1 ♀, and 2 ♂♂, 1 ♀ (macropterous) "Philippinen: Catanduanes\ E San Andres, below Lu Yong\ Cave, 12.4.2000\ leg. H. Zettel (254)" (CZW, UPLB); 61 ♂♂, 69 ♀♀ "Philippinen: LZ, Albay\ Malinao, Palali Falls\ 200 m, 14.3.1999\ leg. H. Zettel (201)" (NHMW, UPLB, IRRI, CNT, UBCB); **additional material:** 2 ♀♀ "Philippinen: Sorsogon\ San Roque, Palok Tok\ Falls, 26.2.1998\ leg. H. Zettel (147)" (NHMW).

Description: Body small; body length of brachypterous male 2.50 - 2.80 mm, of brachypterous female 2.50 - 2.80 mm, of macropterous male 2.55 - 2.75 mm, and of macropterous female 2.55 - 2.80 mm; body width of brachypterous male 1.75 - 1.90 mm, of brachypterous female 1.80 - 1.95 mm, of macropterous male 1.85 - 1.95 mm, and of macropterous female 1.85 - 2.00 mm; colour more variable than in nominotypical subspecies, especially specimens from Catanduanes tending to light dorsal colour pattern with weakly confluent dots; puncturation on midline of head and disk of mesoscutellum on average denser than in the nominotypical subspecies, posteriorly on disk of pronotum denser in numerous, but not in all specimens; micropuncturation of mesoscutellum and hemelytron more obvious in some specimens; ventral carinae (Fig. 92) as in the the nominate subspecies, except carina of sternite 3 usually longer, with acute apex; aedeagus (Figs. 79, 82) vary-

ing slightly between populations, with distinct, roundish subapical tubercle and with apical margin convex or straight, not concave; subgenital plate of female (Fig. 97) with slightly more extended ridge than in ssp. *bicolanus*; pronotal plate, right and left paramere of male (Figs. 80, 81, 83, 84) not significantly differing from ssp. *bicolanus*.

Comparative notes: In *H. b. seyfertii* ssp.n. the apical margin of the aedeagus is rounded or straight, not concave as in the other species and subspecies of the *H. stereos* group. This characteristic is more distinctly expressed in the population from Catanduanes than in that from Albay (comp. Figs. 79 and 82). From the nominotypical subspecies, *seyfertii* ssp.n. differs strongly in the well-developed subapical tubercle of the aedeagus. The intra-specific diversity of *H. bicolanus* in the most southern provinces of Luzon must be studied in a more comprehensive survey. The record from Sorsogon needs confirmation by examining males.

Distribution: Catanduanes, Luzon (Albay, Sorsogon) (Fig. 127).

Etymology: This species is named after Mag. Franz Seyfert. This Viennese admirer of nature and amateur entomologist is a friend of the author and has supported the scientific activities of the Natural History Museum Vienna for many years. He has travelled to the Philippines twice, to the Visayas and to Camiguin in 1994 and to Luzon and Catanduanes in 1999, where he collected type material of this and other species of *Hydrotrepes*.

Species without recognized group affiliations

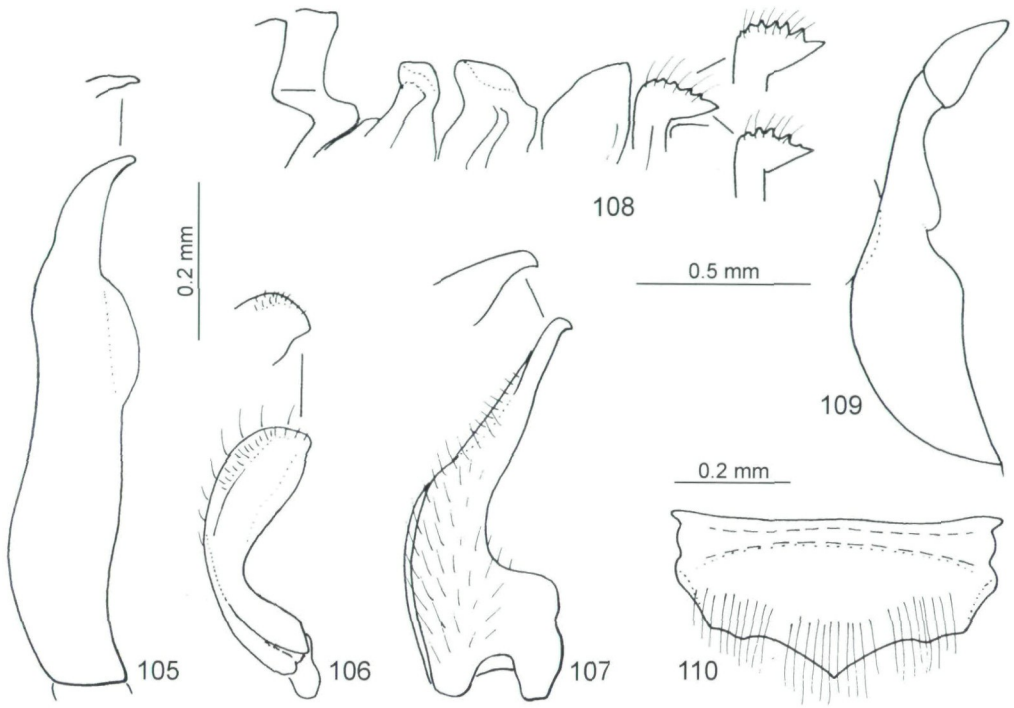
Hydrotrepes ornatus sp.n. (Figs. 1, 105 - 110, 125)

Holotype (macropterous male): "Philippinen: LZ, Mount.Pr.\ NE Sagada, Banga'an\ Bomod-ok Wf., 22.2.1999\ 1500 m, leg.H.Zettel (185)" (UPLB); **paratypes:** 2 ♂♂ (macropterous) same label data as holotype (CZW); 1 ♂, 2 ♀♀ "Philippinen: LZ, Mount.Pr.\ Chico River, Gonogon\ 1100 m, 21.2.1999\ leg. H. Zettel (184)" (CZW, UPLB).

Description:

Macropterous male: Body size: length 2.65 - 2.80 mm, width 1.90 - 2.00 mm; dorsal ground-colour yellow; large blackish brown marks well delimited, larger than in brachypterous morph; cephalonotum with broad dark transverse stripe at hind margin of head and anterior half of pronotum, extended anteriorly into two short parallel stripes between eyes and posterolaterally up-to posterior corners; anterior half of head without or with small central dot; posterior half of pronotum with few large dots; mesoscutellum predominantly blackish, with U-shaped yellow mark posteriorly; hemelytron with large confluent dark marks, with pseudomembrane pitch-black; venter light to medium brown; legs and antennae yellow; rostrum brown.

Cephalonotum close to weakly rounded hind corners with very indistinctly elevated area; entire dorsal surface set with large punctures of approximately same size; cephalonotum, except on midline of head and on very small area in posterior half of pronotal disk, with distances between punctures as long as their diameters or shorter, laterally densely set and nearly confluent; head anteriorly and along inner eye margins between punctures with numerous micropunctures; pronotal plate with small, shallow incision, anteriorly broad (Fig. 109); inner corner of propleural plate truncate; eye index: 2.5 - 2.6; fourth rostral segment 2.0 times as long as segment 3; mesoscutellum approximately 1.0



Figs. 105 - 110: *Hydrotrepes ornatus* sp.n.: (105 - 107) genitalia of males (right aspect): (105) aedeagus, (106) right paramere; (107) left paramere; (108) ventral carinae (venter turned upward, right view; with variations of carinae of prosternum and sternite 3); (109) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen; (110) subgenital plate of female in ventral view (pilosity partly omitted).

times as long as wide, between punctures mainly smooth and shining, only laterally weakly rugulose; hemelytron between punctures weakly rugulose, weakly shining, with well developed claval and embolar suture, lateral margin without row of short stout bristles.

Ventral carinae (Fig. 108): prosternal carina with right-angled or weakly acute posterior corner, with posterior edge concave; mesosternal and metasternal carinae high, distally with small thin lamina; carina of sternite 3 triangularly produced, with distinct, usually large denticles, relatively pilose; sternite 4 without carina.

Genitalia: aedeagus (Fig. 105) weakly modified, with posterior margin in middle of length concave, but without tooth or tubercle, with distal part in lateral view finger-shaped, in posterior view very slender, with acute apex, and without apical plate; right paramere (Fig. 106) short, much shorter than left paramere, close to middle of length strongly curved, distally leaf-shaped, distoposteriorly with row of setae, apically hardly truncate, posteriorly rounded; left paramere (Fig. 107) basally relatively wide, with basal lobe, distal half wide, strongly twisted, with row of relatively short setae, and with sides strongly convergent close to acute apex.

Brachypterous female: Body size: length 2.65 - 2.75 mm, width 1.95 - 2.00 mm; similar to male; colour pattern dorsally as in Fig. 1, with dark marks smaller than in macropterous

morph; anterior half of head completely yellow; eye index: 2.5; cephalonotum without elevated area close to posterior corners; hemelytra without embolar and claval sutures; abdomen symmetrical; sternite 6 with straight hind margin; subgenital plate (Fig. 110) simple, plate-like, only with modification of posterior margin bearing one large medial angle and one pair of small lateral angles, without differentiated lamina or inner ridge, with medial surface slightly convex and posteriorly with long pilosity.

Brachypterous male: body size: length 2.60 mm, width 1.75 mm; most characteristics as in macropterous male; colour, structures of pronotum and hemelytron as in brachypterous female; eye index: 2.4.

Macropterous female: unknown.

Comparative notes: This species can be easily recognized in both sexes, both morphs, and even larvae by its characteristic vivid yellow and black colour pattern (Fig. 1) and the relatively densely set, large punctures of the cephalonotum. *Hydrotrepes sallyae* sp.n. has a similarly vivid pattern, but with smaller marks, and differs distinctly in the fine puncturation of the cephalonotum. The strongly developed denticles on the carina of sternite 3 (Fig. 108), the genitalia of the male (Figs. 105 - 107), and the shape of the subgenital plate of the female (Fig. 110) are unique within Philippine species. No relationships with previously described species are obvious, and *H. ornatus* sp.n. seems to be relatively isolated within the genus.

Distribution: Luzon (Mountain Province) (Fig. 125).

Etymology: "*ornatus*" (Latin adjective) meaning "decorated", referring to the beautiful and very clear dorsal colour pattern.

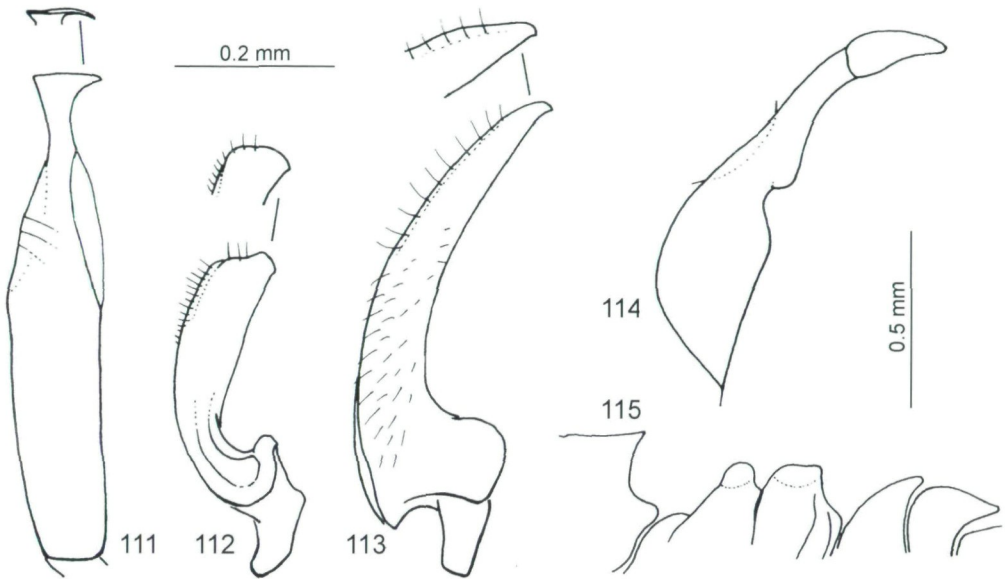
Hydrotrepes sallyae sp.n. (Figs. 111 - 115, 124, 125)

Holotype (brachypterous male): "Philippinen: Surigao d.N. [Surigao del Norte Province] Bayagnan Isl., San José Buyho Waterf., 7.2.2000 leg. H. Zettel (229)" (UPLB); **paratypes:** 1 ♂, and 1 ♂ (macropterous) same label data as holotype (NHMW).

Description:

Brachypterous male: Body size: length 2.65 - 2.70 mm, width 1.85 - 1.90 mm; dorsal ground-colour yellow; dorsal dark colour pattern consisting of clearly delimited dark brown marks; pattern of head as in Figure 124; posterior half of pronotum with numerous dark marks, those close to hind margin mostly confluent; mesoscutellum with pair of transverse marks at anterior margin; posterior half of mesoscutellum and hemelytra with numerous dark, mostly not confluent marks; pseudomembrane pitch-black; venter medium to dark brown; legs and antennae yellow; rostrum brown.

Cephalonotum with weakly rounded hind corners; whole dorsal surface matt; cephalonotum with relatively fine, very densely set punctures, distances between them everywhere much shorter than their diameter; pronotal plate with shallow incision, anteriorly broad (Fig. 114); inner corner of propleural plate truncate; eye index: 2.7 - 2.8; fourth rostral segment 2.0 times as long as segment 3; mesoscutellum approximately 1.0 times as long as wide, with sparsely set, relatively fine and shallow punctures and distinct microreticulation; hemelytron similarly sculptured except with punctures slightly more distinct, lateral margin without row of short stout bristles.



Figs. 111 - 115: *Hydrotrepes sallyae* sp.n.: (111 - 113) genitalia of males (right aspect): (111) aedeagus, (112) right paramere, (113) left paramere; (114) genal and pronotal plate (ventrolateral aspect) of brachypterous specimen; (115) ventral carinae (venter turned upward, right view, pilosity omitted).

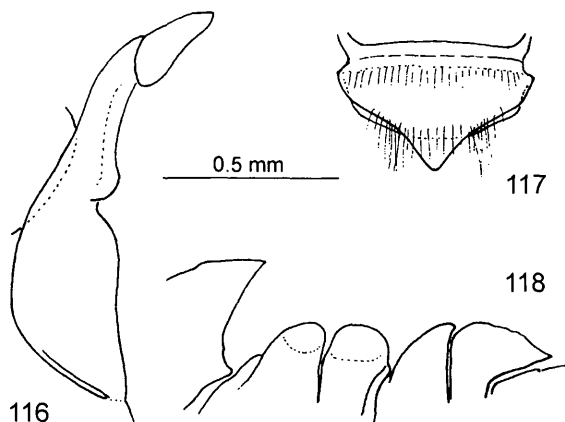
Ventral carinae (Fig. 115): prosternal carina with acute posterior corner, with posterior edge deeply concave; mesosternal and metasternal carinae high, distally with small thin lamina; carina of sternite 3 triangularly produced, without denticles, with more or less distinct pilosity; sternite 4 without carina.

Genitalia: aedeagus (Fig. 111) at posterior margin without tooth or tubercle, but with some oblique ridges, apically characteristically modified, in lateral view with subapical constriction and truncate apex, apex in posterior view very thin, lamellate, without apical plate; right paramere (Fig. 112) much shorter than left paramere, close to base strongly curved, distally weakly widened, relatively slender, distoposteriorly with row of short setae, apically weakly truncate; left paramere (Fig. 113) long and rather slender, with basal lobe, distally with row of long setae, evenly tapering towards acute apex.

Macropterous male: body size: length 2.75 mm, width 1.90 mm; most characteristics as in brachypterous male; colour slightly darker; eye index: 2.5; cephalonotum with weakly elevated area close to posterior corners; hemelytra with embolar and claval sutures.

Female: unknown.

Comparative notes: The characteristics of the aedeagus (Fig. 111) make *H. sallyae* sp.n. very distinct. The fine and very dense puncturation of the cephalonotum should allow easy recognition of the hitherto unknown female. The vivid colour pattern is similar to that of *H. ornatus* sp.n., but the sculpture of the dorsum, the denticle-less carina of sternite 3, and the very different shape of the aedeagus show, that the position of *H. sallyae* sp.n. is very isolated from all presently known species of *Hydrotrepes*.



Figs. 116 - 118: *Hydrotrepes* sp. (macropterous female from Samar): (116) genal and pronotal plate (ventrolateral aspect); (117) subgenital plate (ventral aspect); (118) ventral carinae (venter turned upward, right view, pilosity omitted).

Habitat: Collected between large amounts of plant debris at the edge of an artificial basin below a small waterfall.

Distribution: Bayagnan Island offshore Surigao, Northeast Mindanao (Fig. 125).

Etymology: Dedicated to the author's wife for her help and patience during the exhausting field work in Samar, Leyte, Dinagat, and Mindanao in 2000.

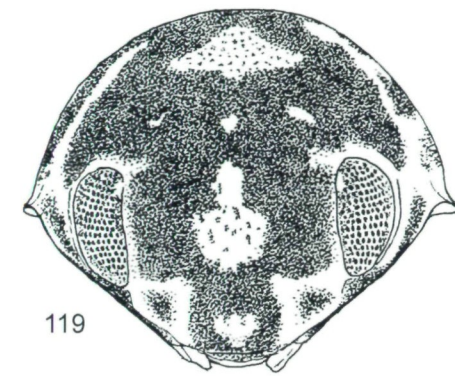
Hydrotrepes sp. (Figs. 116 - 118, 125)

Material examined: 1 ♂ (macropterous) "Philippinen: N. Samar\ Veriato, El Amigo\ Veriato Falls, 25.1.2000\ leg. H. Zettel (217)" (NHMW); 1 ♀ "Philippinen: Leyte,\ rivers at Hilusig,\ 6.3.2001\ leg. H. Zettel (295)" (NHMW).

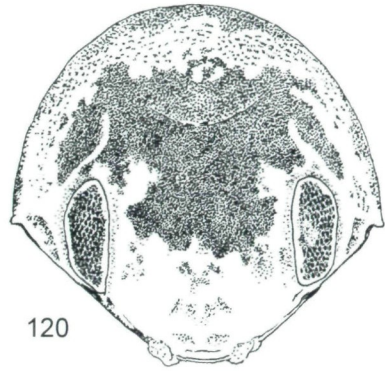
Description:

Macropterous female: Body size: length 2.75 mm, width 2.05 mm; ground-colour yellowish to light brownish; cephalonotum with transverse brownish stripe behind eyes and with transverse row of blackish dots in front of hind margin; mesoscutellum and hemelytron with indistinct irregular, partly confluent, brownish marks; venter dark brown; legs and antennae yellowish; rostrum yellowish brown, cephalonotum with slightly elevated area close to posterior corners, with lateral margins not reaching posterior corners; head densely and finely punctured, matt; pronotum with punctures slightly larger, on disk more sparsely set than on head; pronotal plate with rather shallow and narrow incision, anteriorly broad (Fig. 116); eye index: 2.8; fourth rostral segment 2.3 times as long as segment 3; mesoscutellum and hemelytron with relatively fine and sparse punctures and with very distinct microreticulation, matt; ventral carinae (Fig. 118): prosternal carina with acute posterior corner, posterior edge distinctly, but not deeply concave; mesosternal carina and metasternal carina distally with thin lamina; carina of sternite 3 with indistinct denticles; sternite 4 without dimple; subgenital plate (Fig. 117) short-triangular, with triangular apex of ventral plate surpassing dorsal lamella, with some long sublateral pilosity.

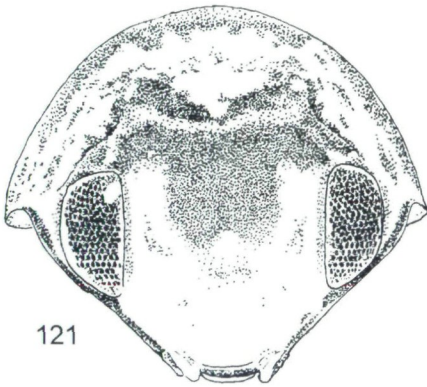
Brachypterous female: Body size: length 2.55 mm, width 1.90 mm; similar to macropterous female, but dark colour pattern slightly more distinct, puncturation on disk of pronotum slightly weaker developed, and hemelytron without embolar and claval sutures.



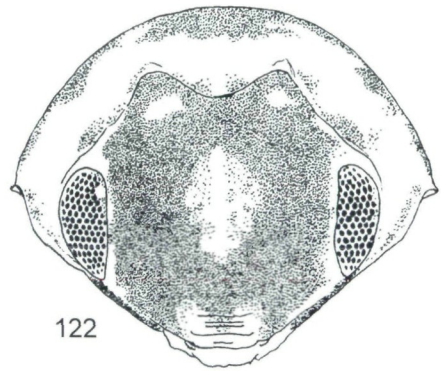
119



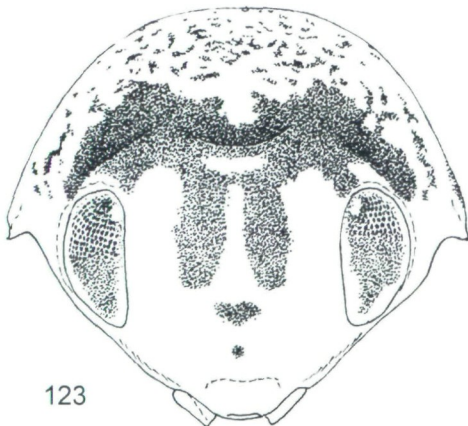
120



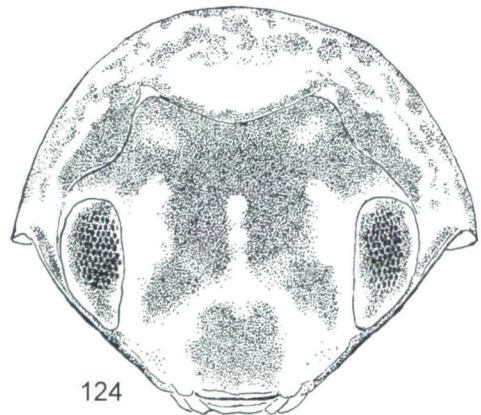
121



122



123



124

Figs. 119 - 124: Colour pattern of cephalonotum of brachypterous specimens (frontal aspect in different magnifications) of (119) *Hydrotrepes palawanensis* sp.n., (120) *H. minutus* sp.n., (121) *H. vulcanus* sp.n., (122) *H. samarensis* sp.n., (123) *H. stereoides montanus* ssp.n., (124) *H. sallyae* sp.n. (Buch del.).

Notes: These specimens obviously belong to an undescribed species, but the author prefers not to name a species of *Hydrotrepes* from a female. Its dense and fine puncturation of the cephalonotum resembles *H. samarensis* sp.n., which has been collected in the same site, and *H. sallyae* sp.n. From both species it differs strongly in the colour pattern of the cephalonotum and in size, from *H. samarensis* sp.n. further in the normal-sized eyes, the more distinctly incised prosternal carina, and the distally roundish mesosternal carina (Fig. 118). The subgenital plate (Fig. 117) is similar to that of *H. pardalos* and may indicate a closer relationship with this species.

Distribution: Northern Samar, Leyte (Fig. 125).

Check-list of Philippine species and subspecies of *Hydrotrepes*

Hydrotrepes mirus species group:

<i>palawanensis</i> sp.n.	Palawan
<i>busuanganus</i> sp.n.	Busuanga
<i>minutus</i> sp.n.	Busuanga

Hydrotrepes balnearius species group:

<i>balnearius</i> (BERGROTH, 1918)	Luzon
<i>vulcanus</i> sp.n.	South Luzon

Hydrotrepes philippinus species group:

<i>philippinus</i> sp.n.	North and Central Luzon
<i>samarensis</i> sp.n.	Samar
<i>visayasensis</i> sp.n.	Masbate, Panay, Negros, Cebu, Leyte, Samar
<i>masbatensis</i> sp.n.	Masbate
<i>pardalos</i> NIESER & CHEN, 1999	Mindanao

Hydrotrepes stereos species group:

<i>stereoides stereoides</i> sp.n.	Central Luzon
<i>stereoides montanus</i> ssp.n.	North Luzon
<i>stereoides mindoroensis</i> ssp.n.	Mindoro
<i>bicolanus bicolanus</i> sp.n.	South Luzon
<i>bicolanus seyferti</i> ssp.n.	Catanduanes, South Luzon
<i>milanae</i> sp.n.	Leyte, Biliran
<i>stereos</i> NIESER & CHEN, 1999	Mindanao

Species not included in species groups:

<i>ornatus</i> sp.n.	North Luzon
<i>sallyae</i> sp.n.	Bayagnan
sp. (♀)	Samar, Leyte

Acknowledgements

This study is the result of ten years of field work in the Philippines. I am very much obliged to numerous persons who made and still make this work possible and successful. First of all I am indebted to those who provided logistic help in the Philippines: Prof. Dr. A. Sumalde (Vice Dean of UP Los Baños and former Head of the Museum of Natural History), Prof. Dr. Victor P. Gapud (Department of Entomology in UP Los Baños), Prof. Dr. Ma. Juliet Ceniza (Head of the Department of Tropical Ecology, ViSCA, Baybay), Prof. Dr. Paciencia Milan (President of ViSCA, Baybay), and Prof. Raul B. Ruiz (Entomological Department, CSSAC, Pili). An uncounted number of Filipinos generously helped me in my traveling in the countryside.

Dr. Victor P. Gapud (UPLB, CVPG), Dr. Larry Hulden (ZMUH), Dr. Nico Nieser (CNT), and Dr. Tamas Vasarhelyi (MTMB) provided important specimens from the collections under their care. Dr. Manfred A. Jäch, Dr. Harald Schillhammer, Dr. Stefan Schödl, Mag. Franz Seyfert (all Vienna) accompanied me during field research in the Philippines and contributed important materials for this study. Remelie V. Almazar, Ivy C. Fabricante, Irene P. Ibo, Ryan B. Ruiz, Avegail Dizon, and Allan B. Del Rosario (all CSSAC) provided me with large series of *H. bicolanus bicolanus* from their studies. Matthias Buch (Vienna) made parts of the illustrations (Figs. 1, 119 - 124). Prof. Dr. Carl W. Schaefer (University of Connecticut) linguisti-

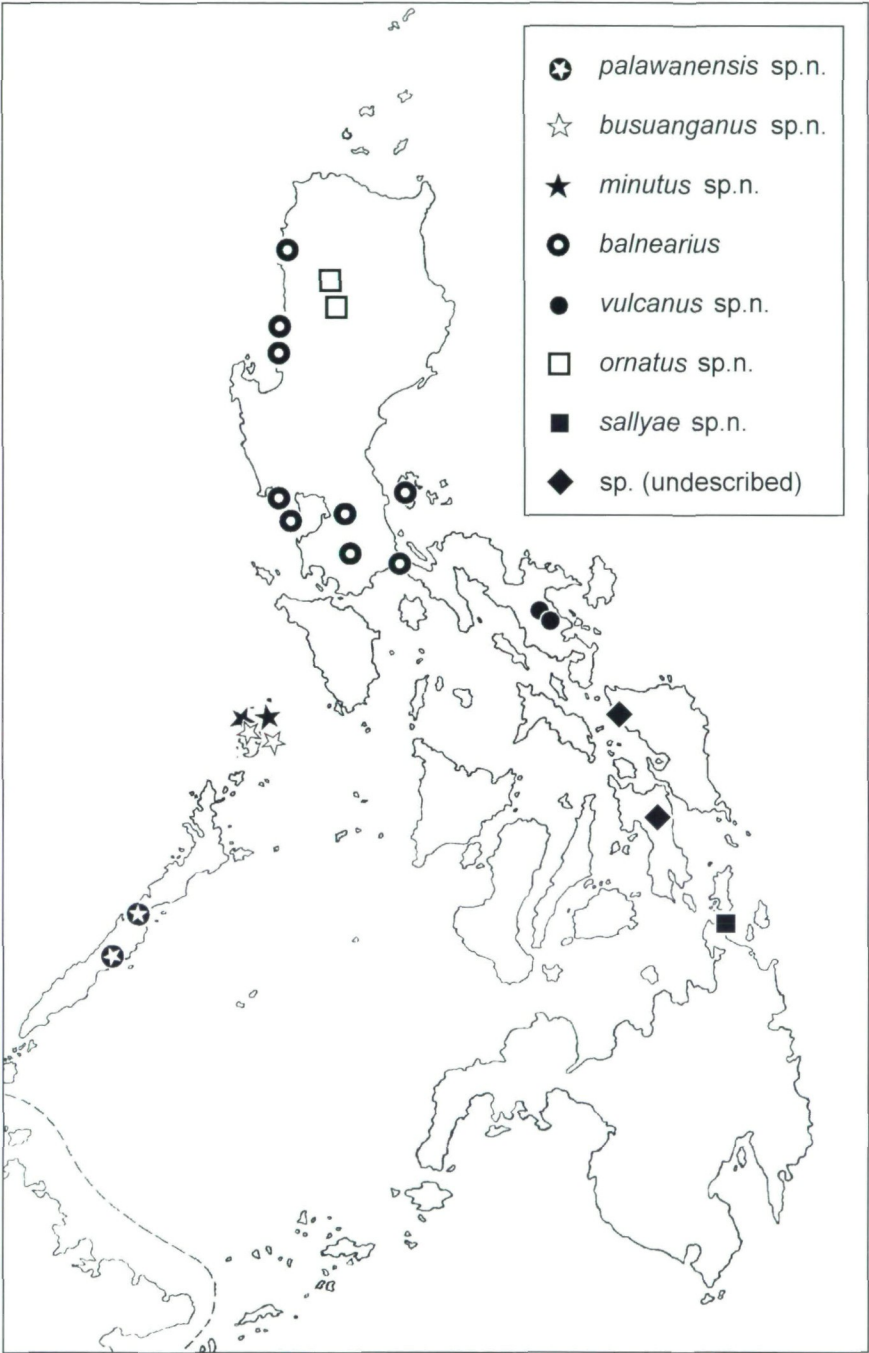


Fig. 125: Distribution of the species of *Hydrotrepes* in the Philippines: *H. mirus* species group (asterisks); *H. balnearius* species group (circles); and species without recognized group affiliations (squares).

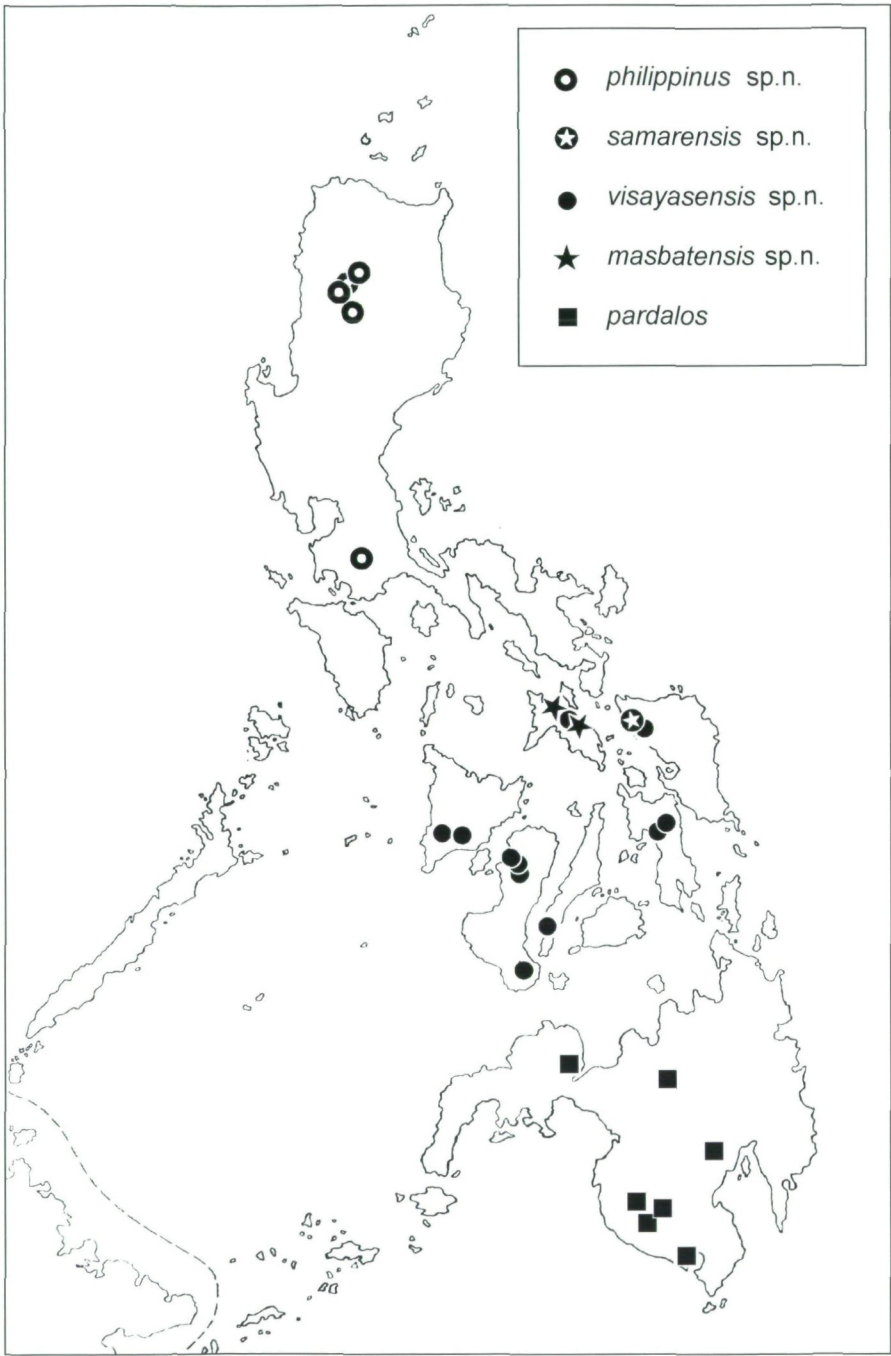


Fig. 126: Distribution of the species of the *Hydrotrepes philippinus* species group.

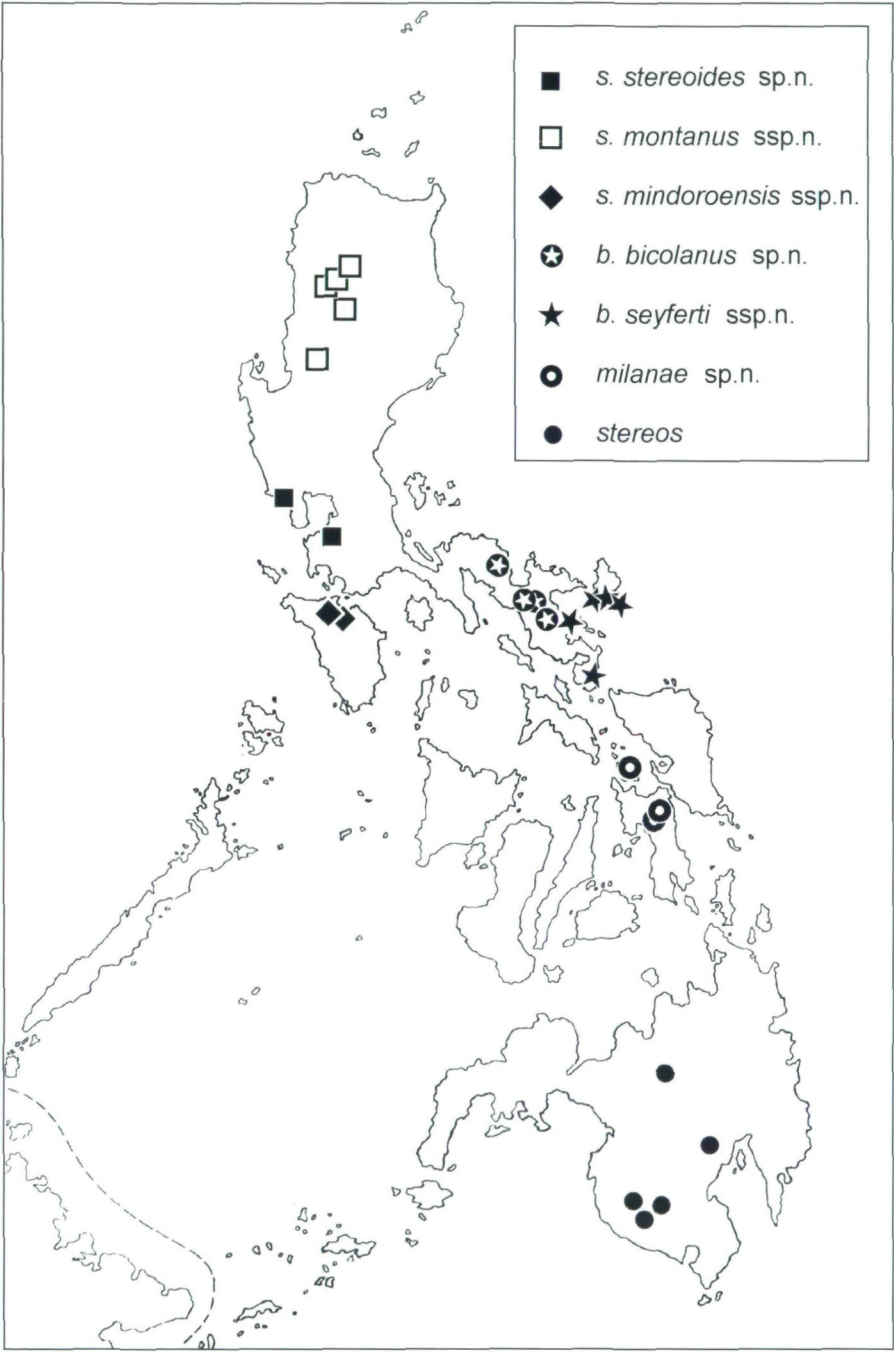


Fig. 127: Distribution of the species and subspecies of the *Hydrotrepes stereos* species group.

cally reviewed the manuscript. Dr. Miroslav Papáček (České Budejovice) gave critical remarks on the manuscript. Some of the field trips were financially supported by the Austrian Ministry of Cultural Affairs and by the society "Freunde des Naturhistorischen Museums in Wien".

Finally I have to thank also my wife Sally for her patience with her entomomaniacal husband and her willingness to spend our private money and time for entomology.

References

- BERGROTH E., 1918: Studies in Philippine Heteroptera 1. – Philippine Journal of Sciences, Section D, 13: 43-126.
- CHINA W.E., 1935: New and little-known Helotrephidae (Hemiptera, Helotrephidae). – The Annals and Magazine of Natural History, ser. 10, 15: 593-614.
- DICKERSON R.E. (in collaboration with MERRILL E.D., MCGREGOR R.C., SCHULTZE W., TAYLOR E.H. & HERRE A.W.C.T.), 1928: Distribution of Life in the Philippines. – Manila, Bureau of Printing, 322 pp., 42 plts.
- ESAKI T. & CHINA W.E., 1928: A monograph of the Helotrephidae, subfamily Helotrophinae (Hem., Heteroptera). – EOS, Revista española de entomología 4: 129-172.
- HEANEY L.R., 1986: Biogeography of mammals in Southeast Asia: Estimates of rates of colonization, extinction, and speciation. – Biological Journal of the Linnean Society 28: 127-165.
- HEANEY L.R., 1991: An analysis of patterns of distribution and species richness among Philippine fruit bats (Pteropodidae). – Bulletin of the American Museum of Natural History 206: 145-167.
- KOVAC D. & PAPÁČEK, M. 2000: *Helotrephes steingeri* sp. n., and notes on two further Helotrephini spp. (Heteroptera: Helotrephidae) from Thailand and West Malaysia. – Linzer biologische Beiträge 32(1): 265-271.
- NIESER N. & CHEN P.P., 1999: Sixteen new species of Nepomorpha mainly from Sulawesi. Notes on Malesian aquatic and semiaquatic bugs (Heteroptera), VIII. – Tijdschrift voor Entomologie 142: 77-123.
- PAPÁČEK M. & KOVAC D., 2001: Three new species of the genera *Helotrephes* and *Hydrotrepes* (Heteroptera: Nepomorpha Helotrephidae: Helotrephini) from Thailand. – Linzer biologische Beiträge 33(1): 315-324.
- POLHEMUS J.T., 1990: A new tribe, a new genus and three new species of Helotrephidae (Heteroptera) from Southeast Asia, and a world checklist. – Acta Entomologica Bohemoslovaca 87: 45-63.
- POLHEMUS J.T., 1997: Seven new species of *Hydrotrepes* CHINA (Helotrephidae: Heteroptera) from Sulawesi. – Tijdschrift voor Entomologie 140: 43-54.
- POLHEMUS J.T. & REISEN W.K., 1976: Aquatic Hemiptera of the Philippines. – Kalikasan Philippine Journal of Biology 5(3): 259-294.
- USINGER R.L., 1937: Notes on the biology of *Hydrotrepes balnearius* (Helotrephidae, Hemiptera-Heteroptera). – Entomologists' Monthly Magazin 23: 179-180.
- ZETTEL H., 1994: Revision der philippinischen Arten der Gattung *Rhagovelia* MAYR, 1. Teil (Heteroptera: Veliidae). – Entomological Problems 25(2): 33-48.
- ZETTEL H., 1995: Revision der philippinischen Arten der Gattung *Rhagovelia* MAYR (Heteroptera: Veliidae) 2. Teil. – Entomological Problems 26(1): 43-78.

- ZETTEL, H. 1996: Revision der philippinischen Arten der Gattung *Rhagovelia*, 3. Teil (Heteroptera: Veliidae). – Entomological Problems 27(2): 111-140.
- ZETTEL H., 1998: Four new species of *Hydrotrepes* CHINA, 1935 (Heteroptera: Helotrephidae) from Thailand and Laos. – Entomological Problems 29(2): 129-137.
- ZETTEL H., 2000: The Helotrephidae (Heteroptera) of Borneo. – Entomological Problems 31(1): 1-22.
- ZETTEL H., 2001: First notes on the Helotrephidae (Heteroptera) of Kalimantan Barat, Indonesia: descriptions of three new species of *Hydrotrepes* CHINA, 1935, and first records of *Tiphotrephes* ESAKI & CHINA, 1928, from Borneo. – Entomological Problems 32(1): 59-64.
- ZETTEL H. & CHEN P.P., 2000: *Limnometra palawanensis* spec.nov. (Heteroptera: Gerridae), and a synopsis of the Philippine species of *Limnometra*. – Entomologische Berichten Amsterdam 60(5): 73-83.
- ZETTEL H., NIESER N. & POLHEMUS D.A., 1999: The Naucoridae (Insecta: Heteroptera) of the Philippine Islands. – Annalen des Naturhistorischen Museums in Wien 101B: 43-105.
- ZETTEL H. & POLHEMUS J.T., 1998: A revision of the genus *Helotrephes* STÅL, 1860 (Insecta: Heteroptera: Helotrephidae) with descriptions of twelve new taxa from the Oriental Realm. – Annalen des Naturhistorischen Museums in Wien 100B: 99-136.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Annalen des Naturhistorischen Museums in Wien](#)

Jahr/Year: 2003

Band/Volume: [104B](#)

Autor(en)/Author(s): Zettel Herbert

Artikel/Article: [The Helotrephidae \(Insecta: Heteroptera\) of the Philippine Islands. 45-97](#)