

## Redescriptions of three poorly known Helotrephini (Insecta: Heteroptera: Helotrephidae)

H. Zettel\* & M. Papáček\*\*

### Abstract

Three Helotrephini are redescribed. *Heterotrepes admorsus* ESAKI & MIYAMOTO, 1959, so far only known from southern Japan, is the type species of the monotypic genus *Heterotrepes* ESAKI & MIYAMOTO, 1959. Based on material collected with the type series, this species is redescribed and illustrated in details to complete a data set for a phylogenetic analysis of the Helotrephini. Newly recognized characteristics confirm the presently uncertain position of *H. admorsus* among the other genera of Helotrephini. Detailed descriptions of the female holotypes of *Hydrotrepes kirkaldyi* (ESAKI & CHINA, 1928) from Sri Lanka and *Hydrotrepes martini* (KIRKALDY, 1904) from Sumatra are provided.

**Key words:** Heteroptera, Helotrephidae, Helotrephini, *Heterotrepes admorsus*, *Hydrotrepes kirkaldyi*, *Hydrotrepes martini*, redescription.

### Zusammenfassung

Drei wenig bekannte Helotrephini werden wiederbeschrieben. *Heterotrepes admorsus* ESAKI & MIYAMOTO, 1959, ist bisher nur aus dem südlichsten Japan bekannt und Typusart des monotypischen Genus *Heterotrepes* ESAKI & MIYAMOTO, 1959. Basierend auf Material, welches zusammen mit der Typenserie gesammelt worden ist, wird die Art detailliert beschrieben und abgebildet, um ein Merkmalsset für eine phylogenetische Analyse der Helotrephini zu vervollständigen. Die neu erkannten Merkmale bestätigen die gegenwärtige unsichere systematische Stellung von *Heterotrepes admorsus* zwischen anderen Gattungen der Helotrephini. Detaillierte Beschreibungen der weiblichen Holotypen der wenig bekannten Arten *Hydrotrepes kirkaldyi* (ESAKI & CHINA, 1928) von Sri Lanka und *Hydrotrepes martini* (KIRKALDY, 1904) aus Sumatra werden vorgestellt.

### Introduction

The genus *Heterotrepes* ESAKI & MIYAMOTO, 1959 was established for the single species *Heterotrepes admorsus* ESAKI & MIYAMOTO, 1959 from Amami Oshima, part of the Ryukyu Islands in southern Japan (ESAKI & MIYAMOTO 1959). ESAKI & MIYAMOTO (1959) compared *Heterotrepes* with both large genera of Helotrephidae in the Oriental Realm, *Helotrepes* STÅL, 1860 and *Hydrotrepes* CHINA, 1935, but not with *Esakiella* CHINA, 1932 and *Pseudohydrotrepes* POISSON, 1956 from Africa and Madagascar. However, at that time knowledge of *Helotrepes* and *Hydrotrepes* was poor; *Helotrepes* was known only from the type species (*H. semiglobosus* STÅL, 1860)

\* Dr. Herbert Zettel, Natural History Museum Vienna, International Research Institute of Entomology, Burgring 7, A-1010 Vienna, Austria – herbert.zettel@nhm-wien.ac.at

\*\* Prof. Dr. Miroslav Papáček, University of South Bohemia, Pedagogical Faculty, Jeronýmova 10, CZ-371 15 České Budějovice, Czech Republic – papacek@pf.jcu.cz

from China, and *Hydrotrepes* from six species distributed from Sri Lanka to the Philippines and Sulawesi. Consequently, the vast diversity of the two genera as known today (*Helotrephes*: 26 described species; *Hydrotrepes*: 52 species; see PAPAČEK & ZETTEL 2005), could not be evaluated by ESAKI & MIYAMOTO (1959). Moreover, a fourth Oriental genus, *Ascetotrepes* POLHEMUS & POLHEMUS, 2003, has been described more recently (POLHEMUS & POLHEMUS 2003), and the genus now contains seven species (PAPAČEK & ZETTEL 2005). These six genera presently form the tribus Helotrephini (sensu POLHEMUS 1990).

ZETTEL (1998) established the *Hydrotrepes mirus* group and two years later he noted strong similarities between the *H. mirus* group and *Heterotrepes* (ZETTEL 2000). In that study and in subsequent papers treating additional new species of the *H. mirus* group (ZETTEL 2003, 2005), the formal transfer of the *Hydrotrepes mirus* group species to *Heterotrepes* was not made, mainly because there are some "intermediate forms" in *Hydrotrepes* (especially the *H. sarawakensis* group; ZETTEL 2000) which do not allow a clean separation of *Hydrotrepes* and *Heterotrepes*. The situation is more complicated by similarities between *Heterotrepes*, *Ascetotrepes*, and *Esakiella* (briefly discussed in ZETTEL & PAPAČEK 2004). Therefore, the authors decided to leave the decision as to the validity or synonymy of *Heterotrepes* open until the results of a phylogenetic analysis of Helotrephini are available.

During the preparation of such analysis, the authors were able to study five specimens of *Heterotrepes admorsus* from the collection of the Raffles Museum, National University of Singapore, which bear the same label data as the type series. A complete description of these specimens is presented here, and because of the uniqueness of *H. admorsus* the genital structures are described in more than usual detail.

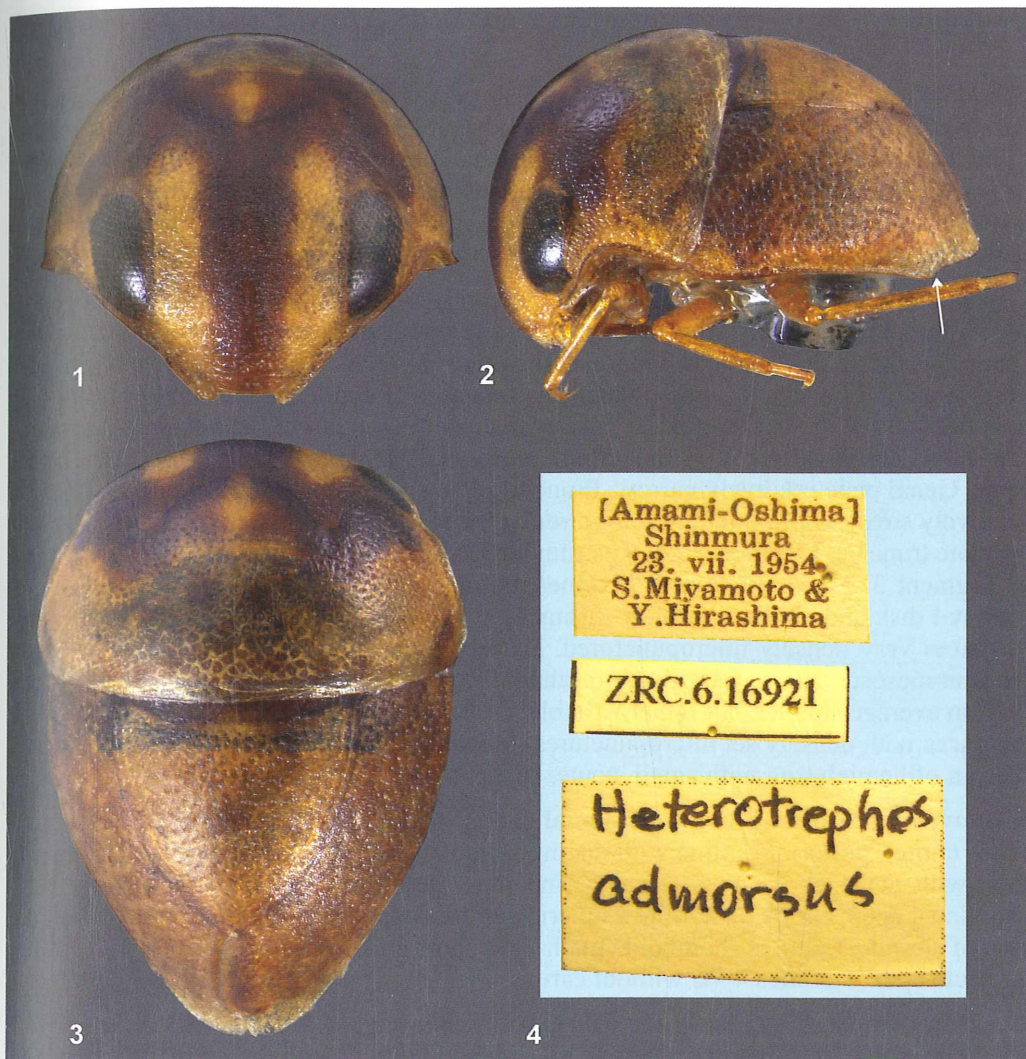
In addition, a full description of the hitherto enigmatic species *Hydrotrepes kirkaldyi* (ESAKI & CHINA, 1928) is given. This species is known only from the female holotype, the only specimen of Helotrephini ever reported from Sri Lanka. Until the male becomes known, the phylogenetic position of this species remains somewhat enigmatic, but according to the characteristics of the female it is presently placed in the *H. bouvieri* species group (see ZETTEL 1998, 2000).

*Hydrotrepes martini* (KIRKALDY, 1904) is the nominal species of the *Hydrotrepes martini* group (see ZETTEL 1998, 2000, 2001). Details of the female holotype were illustrated and briefly discussed by ZETTEL (1998). Here a full description is added based on notes made by the first author in 1998 and completed in 2005.

## Material and methods

For insect specimens studied see the specific sections in the taxonomy chapters.

Terminology and methods follow previous taxonomic works by the authors. The digital photographs of specimens (Figs. 1 - 3, 14 - 16) were taken with a Leica DFC490 camera attached to a Leica MZ16 binocular microscope with the help of Image Manager IM50 and processed with Auto-Montage Pro and Adobe Photoshop 7.0 programmes. Labels (Figs. 4, 17) were photographed with a Sony Cybershot DSC-T5 digital camera.



Figs. 1 - 4: *Heterotrephe admorsus*, male specimen: (1) Frontal aspect of cephalonotum. (2) Lateral aspect; arrow: small tooth on posterolateral margin of hemielytron. (3) Dorsal aspect (legs omitted). (4) Labels of illustrated specimen.

### Taxonomy

#### *Heterotrephe admorsus* ESAKI & MIYAMOTO, 1959 (Figs. 1 - 13)

**Material examined:** 2 ♂♂, 3 ♀♀ (all hindwing-micropterous) "[Amami-Oshima] Shinmura 23. vii. 1954 S. Miyamoto & Y. Hirashima", "ZRC.6.16921 [- ZRC.6.16925]", "*Heterotrephe admorsus*" (Fig. 4), in Zoological Reference Collection, Raffles Museum for Biodiversity Research, National University of Singapore.

**Description of hindwing-micropterous male:** Body size: length 2.3 - 2.4 mm, width 1.72 - 1.74 mm.

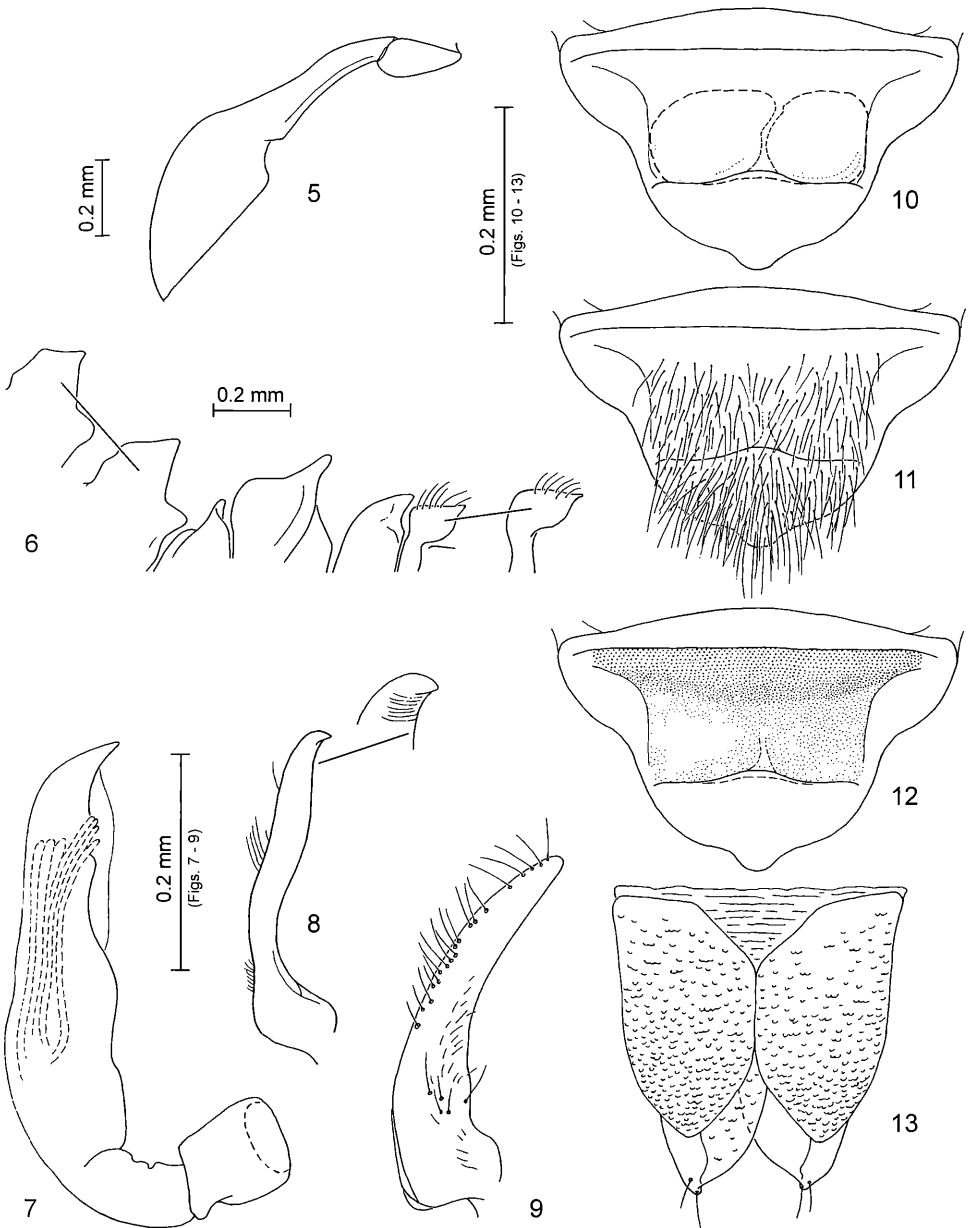
Colour (Figs. 1 - 3): Cephalonotum brownish yellow with broad, undulate, transverse, dark brown stripe along cephalonotal suture and broad, dark brown stripe along midline of head reaching anterior margin (Fig. 1); disk and posterior part of pronotum with more or less distinct, irregular, brownish marks. Mesoscutellum and hemielytra (Figs. 2, 3) brownish yellow, with small, often indistinct, brown speckles, base of mesoscutellum dark brown to varying extent. Venter yellow to brownish; legs yellowish; rostrum brown.

Cephalonotum partly shining; head with relatively fine, irregular punctures; punctures medially sparse, laterally towards inner eye margins denser, partly confluent; interspaces in anterior half of head and medially almost to level of posterior eye margin with very fine micropunctures; pronotum with punctures of similar size as on head, only on disk finer and with distances ca. 2 - 5 times diameter of punctures; lateral areas of pronotum more densely punctured (punctures partly confluent) and with some micropunctures. Genal plate relatively narrow. Pronotal plate anteriorly narrow, at midlength with relatively small, approximately semi-circular incision (Fig. 5). Inner corner of propleural plate truncate. Eye index: 2.5. Rostrum long, fourth rostral segment 3.0 times as long as segment 3. Mesoscutellum 0.95 times as long as wide, with fine punctures as on pronotal disk and similarly sparse, distances ca. 2 - 4 times diameter of punctures; interspaces very densely micropunctured. Hemielytron with punctures anteriorly larger than on mesoscutellum, posteriorly of almost same size, distances of punctures anteriorly on average smaller, but rather variable, ca. 1 - 3 times diameter of punctures; all interspaces with densely set micropunctures. Mesoscutellum and hemielytra dull. Lateral margin of hemielytron with small, acute, subapical tooth (Fig. 2: arrow).

Medioventral carinae (Fig. 6): Prosternal carina with rectangular to slightly acute posterior corner, posterior outline with distinct, angular concavity; mesosternal carina very low, with acute apex; metasternal carina long, anteriorly rounded, posteriorly with prominent apex; carina of sternite 2 anteriorly rounded, posteriorly pointing caudad; carina of sternite 3 almost rhomboid small, with short pilosity, ventroposteriorly forming an acute apex; sternites 4 - 6 without carinae.

Genitalia of male (Figs. 7 - 9; see also ESAKI & MIYAMOTO 1959: p. 86, pl. 9, figs. D-F): Aedeagus (Fig. 7) simply shaped, long, subcylindrical, straight, broad at basal half, only slightly narrowed in distal half; apically unmodified, slightly curved anteriorly and terminating in acute tip (not distinctly protruding). Internal structures of aedeagus visible as long folds parallel to axis of phallosoma; these are ductus ejaculatorius and large, folded vesica (comp. ESAKI & MIYAMOTO 1959: fig. G, illustrating inflated aedeagus). Left paramere (Fig. 9) broad, slightly curved anteriorly and tapering towards apex, posterobasally flattened and curved, forming short lamina visible only as very narrow and short stripe in strictly right view. Right paramere (Fig. 8) slender, club-shaped, only slightly shorter than right one, antero-subapically with small area of distinct serration, apex oriented anteriorly, acute.

**Description of hindwing-micropterous female:** Body size: length 2.4 mm, width 1.76 - 1.79 mm. Colour pattern and most structural characteristics as in male. Eye index 2.3 - 2.4. Hemielytron with small subapical tooth at lateral margin similar to that of male. Abdominal sternites 4 - 6; abdomen symmetrical; sternite 6 with straight hind margin.



Figs. 5 - 13: *Heterotrepbes admorsus*: (5) Pronotal and genal plate. (6) Medioventral carinae, lateral view (venter upward, prosternum left), with variations of prosternal carina and carina of abdominal sternum 3. (7 - 9) Genitalia of male: (7) Aedeagus; dashed line indicating internal structures of folded vesica and/or ductus ejaculatorius (see text). (8) Right paramere, with apex enlarged. (9) Left paramere. (10 - 12) Subgenital plate (= abdominal sternum 7) of female, ventral aspect: (10) Structures (sculpture); pilosity and colour omitted. (11) Chaetotaxy. (12) Intensity and extent of colouration. (13) Ovipositor: sclerite complex of the abdominal ventrite 8 (= first valvifers and first valvulae); sparse pilosity on surface of first valvulae omitted.

Female terminalia (Figs. 10 - 13; see also ESAKI & MIYAMOTO, 1959: pp. 86, 87; pl. 9, figs. I - J): Subgenital plate (Figs. 10 - 12) broad; outlines subtriangular, with sinuate lateroposterior margin forming an indistinct, laminate mediiodistal lobe; posteromedial margin produced into minute lobulus. Ventral surface of the sclerite (Figs. 10, 12) only slightly sculptured by mediobasal brown swelling, this basally sharply delimited by transversal impression and by paired, shallow, nearly imperceptible basolateral depressions for receiving laterotergites 8. Remarkable translucent structures (Fig. 10) are a transversal phragma-like structure near base of distal lobe and paired, asymmetrical, subcircular to subquadrangular structures separated by a thin channel. Posteromedial part of subgenital plate covered by long hairs (Fig. 11). Ventral laterotergites 8 broad, leaf-shaped, posterolaterally fringed by long thin hairs. Ovipositor (Fig. 13) subsymmetrical, connected with abdominal segment 7 by extent membrane, basally without intersternite; first valvifers longer than broad, posteriorly pointed, forming distinct corners; their surface covered by numerous minute tubercles and very sparse long hairs; first (ventral) valvulae wide round, extremely flattened, symmetrical to subsymmetrical in ventral view, each with two long terminal setae; right one overlapping left one in area of intervalvular coupling apparatus; ventral surface of inner part of valvula 1 (at area of coupling apparatus) tuberculate.

**Comparative notes and discussion:** Without attempting to anticipate phylogenetic considerations in Helotrephini, here some important features are listed which characterize *Heterotrepes admorsus*, type species of the genus *Heterotrepes*: The eyes are conspicuously large in the brachypterous morph (macropterous morph unknown). The rostrum is long, reaching the mesocoxae. The anterior part of the pronotal plate is slender and bears a distinct ridge along its posterior margin. The medioventral mesosternal carina is conspicuously low (much lower than the prosternal and metasternal carinae); laminate areas are not present on meso- and metasternal carinae. On abdomen, the mid-sternal carinae are present on sternites 2 and 3 only. The costal margin of the hemielytron bears a small, sharp tooth subapically (Fig. 2). It is interesting to note that such a tooth is rarely found in *Hydrotrepes*, too: in both sexes of *H. schillhammeri* ZETTEL, 1998 of the *H. mirus* species group and in the male of *H. mexon* NIESER & CHEN, 1999 of the *H. mexon* species group.

In the following the importance of genital structures in *Heterotrepes admorsus* is emphasized: The genitalia of the male of *H. admorsus* have some features like the unmodified apex of the aedeagus and both parameres of approximately the same length. These features, which are probably plesiomorphic, are found also in some (basic?) species in the genera *Helotrepes* (*H. jendeki* group), *Ascetotrepes*, *Esakiella*, and *Hydrotrepes* (*H. mirus* group, *H. sarawakensis* group). However, there are other, different, modifications in some of these clades: e.g., males of *Ascetotrepes* have strongly modified right parameres. In minor, species-specific characteristics of genitalia, *H. admorsus* differs also from all other known Helotrephini.

The shape (outline) of the female subgenital plate of *H. admorsus* is more or less unmodified; the wide, symmetrical sclerite with its caudally projecting, broadly tongue-shaped lobe is probably plesiomorphic in Helotrephini, as it is widely distributed among species of *Esakiella* (e.g., *E. chinai* POISSON, 1949 and related species), *Helotrepes* (e.g., *H. australis* group), *Hydrotrepes* (e.g., *H. balnearius* group), and *Ascetotrepes*

(e.g., *A. edmundsorum* POLHEMUS & POLHEMUS, 2003). However, an important diagnostic feature of *H. admorsus* is the presence of subcircular sclerites which are separated by a narrow medial channel and lie beyond the ventral surface. Similar, but asymmetrical, eventually homologous structures are described in some species of *Ascetotrepes* (see ZETTEL 2004). The subsymmetrical ovipositor has some characters (e.g., the flat first valvulae with symmetrical outlines; the tuberculate microsculpture on the right part of the intervalvular coupling apparatus) that are unique among those species of Helotrephini which have already been studied for ovipositor structures and are presently regarded as diagnostic.

### *Hydrotrepes kirkaldyi* (ESAKI & CHINA, 1928) (Figs. 14 - 23)

**Holotype** (macropterous female): "Type", "3608", "Ceylon Ntr.", "Helotrephes\ kirkaldyi E. + C.\ Type", "Zoolog. Museum\ BERLIN (ZMB)\ Germany", "Hydrotrepes\ kirkaldyi E. & C.\ det. H. Zettel 2007" (Fig. 17), in Zoologisches Museum, Humboldt Universität, Berlin, Germany.

**Description of holotype:** Body size: length 2.58 mm, width 1.80 mm. Ground colour brownish yellow. Head and anterior part of pronotum with characteristic brown mark (Fig. 14). Mesoscutellum with transverse brown stripe at base; other parts of dorsum nearly evenly light coloured or with small brownish speckles (Figs. 15, 16). Venter yellow, partly brownish. Legs and antennae yellowish. Rostrum light brown.

Cephalonotum in dorsal view of total insect about 1.6 times as wide as long, with small angular extensions close to posterior corners; lateral margin almost straight in dorsal view. Head with densely set, fine punctures, matt (Fig. 14). Disk of pronotum (Fig. 16) with sparse, fine punctures and intermixed micropunctures, somewhat shining; sides of pronotum densely punctured, almost rugous, matt. Pronotal plate (Fig. 18) with distinct, roundish incision, anteriorly stout; genal plate relatively wide. Inner corner of propleural plate slightly concave. Eye index: 2.4. Fourth rostral segment 2.7 times as long as segment 3.

Mesoscutellum 1.05 times as long as wide (Fig. 16). Mesoscutellum and hemielytron set with sparse fine punctures, with delicate shagreen, both matt except dorsally slightly shining (Figs. 15, 16).

Medioventral carinae (Fig. 19): Prosternal carina with blunt posterior corner (broken?), posterior edge weakly concave; mesosternal carina distinctly lower than metasternal carina, both with thin, rounded distal lamina; carina of sternite 2 with narrow apical tooth; carina of sternite 3 robust, bird-head shaped, only with weak indications of denticles.

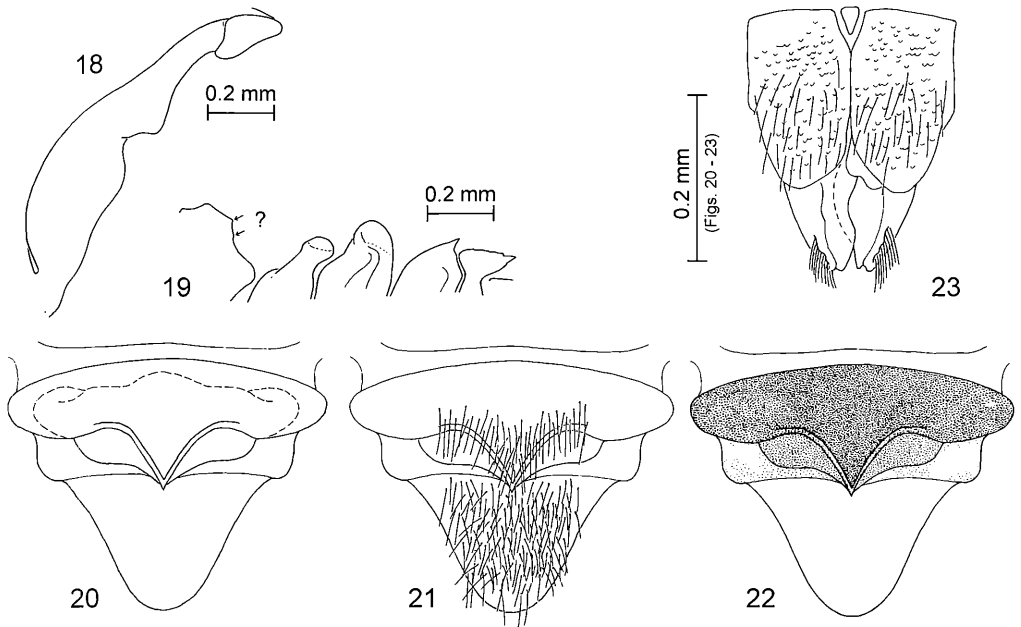
Female terminalia (Figs. 20 - 23): Sternite 6 with almost straight hind margin. Subgenital plate (Figs. 20 - 22) symmetrical, broadly subtriangular, consisting of a thick, sclerotized and sculptured basal part and a laminate, unsculptured, subtriangular posteromedial lobe. Structures of basal part (Fig. 20) complicatedly composed of three regions lying in different planes and differently pigmented (Fig. 22): (I) Basal transversely ellipsoid disc (most ventrally) with prominent and sharp posteromedial projection; this region most deeply coloured, brown, and posteromedial projection covered by long hairs. (II) Second level represented by paired, submedial, elongate areas located on both sides of apex of posteromedial tumescence of basal disc; this region lighter than first region, but pigmented brownish and hairless. (III) Paired posterolateral regions of basal



Figs. 14 - 17: *Hydrotrepes kirkaldyi*, female holotype: (14) Frontal aspect of cephalonotum. (15) Lateral aspect. (16) Dorsal aspect (legs omitted). (17) Labels.

part; yellowish brown, without hairs. Posteromedial lobe bright yellowish, covered by long hairs except at lateromarginal regions. Subgenital plate with well developed transverse, basally located internal phragma that is visible as translucent structure (see Fig. 20: dashed line). Ventral laterotegites 8 without lateral submarginal areas of long bristles that distinctly differ from other hairs covering surface of the sclerite. Ovipositor (Fig. 23) subsymmetrical in dorsal view, highly asymmetrical in ventral view, long and narrow. First valvifers longer than wide, ending posteriorly to rounded, blunt lobes. Small triangular intersternite present. First left valvifer mediodistally with covered and posteriad pointing smooth bilobate sclerite, this is probably part of intervalvular cou-

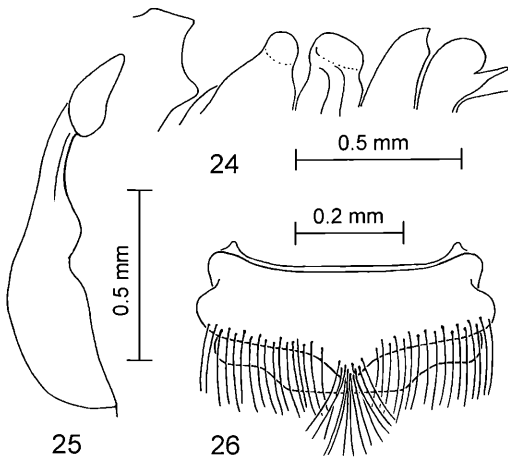




Figs. 18–23: *Hydrotrephes kirkaldyi*, female holotype: (18) Pronotal and genal plate. (19) Medioventral carinae, lateral view (venter upward, prosternum left); apex of prosternal carina between arrows possibly broken. (20–22) Subgenital plate (= abdominal sternum 7), ventral aspect: (20) Structures (sculpture); pilosity and colour omitted. (21) Chaetotaxy. (22) Intensity and extent of colouration. (23) Ovipositor: sclerite complex of the abdominal ventrite 8 (= first valvifers and first valvulae).

pling apparatus. Surface of valvifers covered by minute cuticular tubercles and sparse, long hairs. First (ventral) valvulae relatively narrow, long, extremely asymmetrical from the ventral view, each with subterminal anteroposterior row of long setae; right one overlapping left one at intervalvular coupling apparatus.

**Comparative notes:** *Hydrotrephes kirkaldyi* is a poorly known species, and the female holotype is the only specimen reported. It is the only Helotrephini from Sri Lanka, and its geographical isolation (next occurrence of congeners in Thailand) and the lack of knowledge of male characteristics leave this species in some way enigmatic. The female's characteristics, however, set *H. kirkaldyi* presently in the *H. bouvieri* group (see ZETTEL 1998, 2000), which is known from Southeast Asia, Sumatra, Borneo, Flores, and Sulawesi. *Hydrotrephes kirkaldyi* is very similar to *H. yupae* ZETTEL, 1998 from Thailand, e.g., by similar ventral carinae and by the densely set, relatively short, stout setae on the lateral margins of the hemielytron, and can be distinguished from this species by smaller eyes (eye index of macropterous female 2.4 in *H. kirkaldyi*, but 2.2–2.3 in *H. yupae*), slightly longer rostrum (relative lengths of fourth to third segment 2.7 in *H. kirkaldyi*, but 2.3 in *H. yupae*), and the relatively long, subtriangular apical lamella of the subgenital plate (Fig. 20). The relatively large and complicated subgenital plate of the female of *H. kirkaldyi* (Figs. 20–22) agrees well with those of other species of the *H. bouvieri* group which, however, is similarly developed in some other species



Figs. 24 - 26: *Hydrotrepes martini*, female holotype (re-drawn from ZETTEL 1998): (24) Pronotal and genal plate. (25) Medioventral carinae, lateral view (venter upward, prosternum left). (26) Subgenital plate (= abdominal sternum 7), ventral aspect.

groups. Most features of the ovipositor (Fig. 23) agree rather well with those of some other *Hydrotrepes* species examined; however it differs by an extremely developed bilobate "coupling sclerite," which is probably derived from the left first valvifer.

### *Hydrotrepes martini* (KIRKALDY, 1904) (Figs. 24 - 26)

**Holotype** (brachypterous female): "Palembang\ Sumatra", "MUS. PARIS\ SUMATRA\ Donckier 1898", "TYPE", "♀", "Helotrepes\ martini Kirk\ Type.", "Helotrepes\ martini Kirk\ Type" (Muséum National d'Histoire Naturelle, Paris, France).

**Description of holotype:** Body size: length 2.64 mm, width 1.90 mm. Ground colour yellowish to light brownish, head dark brown, especially posteriorly, anteriorly with indistinctly defined, confluent marks; pronotal part of cephalonotum lighter than head, anteriorly with dark undulate margin, posterior half with numerous small brownish spots. Mesoscutellum with transverse blackish stripe at base, other parts almost evenly light. Hemielytron with small, irregular brown marks. Venter yellowish brown. Legs and antennae yellowish. Rostrum brownish.

Cephalonotum in dorsal view of total insect about 1.4 times as wide as long, with rounded hind corners, posterior part of lateral margin slightly convex in dorsal view; head with densely set small punctures, dull; posterior half of pronotum with punctures less dense, somewhat shining. Pronotal plate (Fig. 25) with very shallow, roundish incision, anteriorly stout; genal plate relatively wide. Inner corner of propleural plate truncate. Eye index: 2.35. Fourth rostral segment 2.9 times as long as segment 3.

Mesoscutellum 0.97 times as long as wide, shining, set with sparse small punctures, between punctures with indistinct shagreen. Hemielytron dull, with rather small shallow punctures, interspaces finely but distinctly shagreened.

Medioventral carinae (Fig. 24): prosternal carina with an acute posterior corner (about 80°), posterior edge distinctly concave; mesosternal and metasternal carinae each with thin, laminate apex; carina of sternite 3 with a roundish part, this well separated from a posteriad directed spine close to surface of sternite 4.

Female terminalia: Sternite 6 with slightly convex hind margin. Subgenital plate (Fig. 26) very short, about 2.5 times as wide as long, without inner ridge, ventral plate laterally straight, medially forming a small triangle, distal lamella medially straight, laterally weakly concave, with distinct lateral corners.

**Comparative notes:** ZETTEL (1998, 2000) described the *H. martini* species group. *Hydrotrepthes martini* is so far the only species of this group known from Sumatra. As long as the male of this species is unknown, some characteristics of the female will have to be used for characterization of this species. In particular, the relatively large size, the eye index of 2.35, and the relatively long fourth rostral segment (2.9 times as long as third) distinguish it from closely related species from the islands of Siberut and Nias (ZETTEL 2004).

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