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Three new species of the genera *Helotrephes* and *Hydrotrepes* (Heteroptera: Nepomorpha: Helotrephidae: Helotrephini) from Thailand

M. PAPÁČEK & D. KOVAC

A b s t r a c t : *Helotrephes senckenbergi* sp. n. (*semiglobosus*-group) from the Chiang Mai Province, North Thailand, *Hydrotrepes maculatus* sp.n. (*bouvieri*-group) and *Hydrotrepes mixtus* sp. n. (*mirus*-group) from the Narathivat Province, South Thailand, are described. Differential characters of the *Hydrotrepes mirus* and *H. sarawakensis* species groups are discussed.

Key words : Heteroptera, Helotrephidae, *Helotrephes senckenbergi* sp. n., *semiglobosus* group, *Hydrotrepes maculatus* sp. n., *bouvieri* group, *Hydrotrepes mixtus* sp. n., *mirus* group, *sarawakensis* group, new species, Thailand.

Introduction

Species of *Helotrephes* STÅL 1860 live in running water and occur in the eastern part of the Oriental Region. This genus has been recently revised by ZETTEL & POLHEMUS (1998). Since then five new *Helotrephes* species were described: three from Borneo (ZETTEL 2000b) and two from the Chiang Mai Province, North Thailand (KOVAC & PAPÁČEK 2000; ZETTEL 2000a). A further new species from the Chiang Mai Province is described in the present paper.

Species of the genus *Hydrotrepes* live in streams and lakes and are confined to the Oriental Region and Wallacea. ZETTEL (1998, 2000b) has defined four species groups in this genus. Recently, eight new species were described from Sulawesi (POLHEMUS 1997; NIESER & CHEN 1999) and thirteen new species from Borneo (ZETTEL 2000b). Four species are known from Thailand (ZETTEL 1998, 2000a). In the present paper we describe two new species from South Thailand belonging to the *bouvieri* and *mirus* groups and discuss the diagnostic characters of the *mirus* and the closely related *sarawakensis* groups.

Terminology, measurements and abbreviations

Terminology follows ZETTEL (1998) and ZETTEL & POLHEMUS (1998). All measurements are in millimetres. All available specimens were measured.

micr.	micropterous morph (with micropterous, e.g. strongly reduced hindwings)
macr.	macropterous morph
SMF	Forschungsinstitut und Museum Senckenberg, Frankfurt am Main, Germany (collection of D. Kovac)
UCBC	University of South Bohemia, České Budějovice, Czech Republic (collection of M. Papáček)
ZRC	Zoological Reference Collection, National University of Singapore, Republic of Singapore (collection of C. M. Yang)

Helotrephes senckenbergi sp. n. (Figs 1-6)

Type material: holotype (micr. ♂): Thailand, Chiang Mai Province, Doi Suthep, stream further up the Montatham waterfall, between submerged tree roots or fallen leaves, 10 Apr. 1999, A10/99, leg. D. Kovac (SMF); paratypes: 1 ♂, 2 ♀ (macr.), 5 ♂ ♂ (1 completely dissected), 6 ♀ ♀ (1 completely dissected) (micr.), same data as holotype; 1 ♂, 1 ♀ (micr.), same locality data as holotype, A17/99, leg. D. Kovac (SMF).

Note: For the comparison further material was studied: *Helotrephes shepardi* ZETTEL & POLHEMUS 1998: 5 ♂ ♂, 5 ♀ ♀ (micr.), 2 ♂ ♂, 2 ♀ ♀ (macr.) N. Vietnam, Vinh Phu Province, Tam Dao N.P., Suoi Bac stream, further up the water fall in the Tam Dao village, 25.5.1995, leg. M. Papáček (UCBC).

Description: It is not possible to distinguish reliably micro- and macropterous morphs by body size. Some micropterous specimens are larger than the macropterous ones in the same population. Body length of ♂ ♂: 2.94–3.36, of ♀ ♀: 3.10–3.39; maximum body width (at cephalonotal hind corners) of both sexes: 2.01–2.25. Colouration relatively variable, especially in micropterous specimens. Ground colour light brown, pattern brown (light specimens) or dark brown with black marking (dark specimens; all macropterous specimens). Hemelytra darker than cephalonotum. Venter, coxae, and trochanters, darkly brown to black; propleura light brown to yellowish; segments of legs except coxa and trochanter yellowish brown.

Cephalonotum shining, set with small alveoli; lateral margins convex, carinate at the whole length. Frontoclypeal region with brown or black spot; pronotal part of cephalonotum light or dark brown (beige brown in some specimens) with dark brown or black markings and transversely oriented line of two or four small light spots which are joined in light specimens. Interocular distance: 1.26 (micr.), 1.18 (macr.). Eye length: 0.52–0.56; width: 0.22 (micr.), 0.25 (macr.). Eye index (minimum interocular distance: maximum eye width): 5.70 (micr.), 4.72 (macr.). Length of rostral segment 3 and 4: 0.16–0.19, 0.42–0.45. Pronotal plate with asymmetrical notch (Fig 1).

Mesoscutellum (length: 1.20, basal width: 1.05) shining, yellow to yellowish brown, with basal transversal brown or black stripe with caudally oriented medial lobe. Hemelytra shining to opaque, light or dark brown, with dark pigmented alveoli either only in proximal part or on the whole surface. Ventral midsternal carina: prosternal part with pointing blunt tip, mesosternal part with or without small ventrally pointing tip, metasternal carina rectangular, carina of the abdominal segment 2 almost as high as the metasternal one (Fig 2).

Male: Aedeagus with robust thick basal part and relatively short, thin apical part (Fig 3). Right paramere slightly regularly curved (Fig 4); left paramere relatively straight, flat and wide from dorsal view with large basal lamella, and long anteriorly oriented sharp tip (Fig 5).

Female: Abdominal sternum 7 (subgenital plate) basally broad; subparallel-sided; hind margins concave, forming an obtuse angle (Fig 6).

Comparative notes and discussion: *Helotrephes senckenbergi* sp. n. belongs to the *Helotrephes semiglobosus* species group on the ground of the shape of the male genitalia and basic form of pronotal plate and prosternal carina (see ZETTEL & POLHEMUS 1998). It is similar and probably also closely related to *Helotrephes shepardi* ZETTEL & POLHEMUS 1998.

The size of both sexes of *Helotrephes senckenbergi* sp. n. and the shape of abdominal sternum 7 in females is similar as in *Helotrephes shepardi*. Both sexes of *Helotrephes senckenbergi* sp. n. differ distinctly from *Helotrephes shepardi* by the following characters: (1) more opened notch at pronotal plate, (2) shape of ventral midsternal carina, especially the high rectangular metasternal part and also the relatively high carina of abdominal segment 2, (3) dark, brown to black colouration of venter. Following differences were found in male genitalia: (1) extremely robust basal part of aedeagus and its relatively gracile apex, (2) regularly curved left paramere, without posterobasal lobe, and (3) straight left paramere with large basal lamella and long anteriorly pointing sharp tip.

Habitat: *Helotrephes senckenbergi* sp. n. was found between submerged tree roots and fallen leaves in a stream located at the Doi Suthep mountain. It was collected together with *Helotrephes australis* which is probably the most widely distributed species of the genus. Other collectors have found *H. shepardi* in the same stream (ZETTEL & POLHEMUS 1998).

Distribution: North Thailand, Chiang Mai Province.

Etymology: Named in honour of the Senckenberg Research Institute and Museum in Frankfurt am Main.

***Hydrotrepes maculatus* sp. n. (Figs 7-14)**

Type material: holotype (macr. ♂): South Thailand, Narathivat Prov., Ban Sac, 23. Oct. 1998, (LHK 0402), leg. H. K. Lua (ZRC); paratypes: 2♂♂, 4♀♀ (macr.) (ZRC), 1♂, 1♀ (macr.) (SMF), 6♂♂, 5♀♀ (micr.) (ZRC), 1, 1 (micr., both completely dissected) (SMF), same locality data as holotype.

Description: Body length of both sexes 2.44–2.70 (macr.), or 2.40–2.57 (micr.) respectively; width of both morphs 1.57–1.65. Ground colour yellowish brown, marked by light brown to dark brown spots. Cephalonotum darker than hemelytra. Mesoscutellum mostly light. Venter light, yellowish brown; legs yellow.

Head with relatively constant pattern formed by brown and yellow spots: frontoclypeus mostly brown with yellow spots between eyes, 4 located dorsally and 2 ventrally. In some specimens the four dorsally localized spots fuse into two (see Figs 7, 8); anterior part of clypeal area and postocular area mostly yellow. Interocular distance: 0.70 (micr.), 0.67 (macr.). Eye length: 0.42 (micr.), 0.48 (macr.); width: 0.21 (micr.), 0.23 (macr.). Eye index 3.3 (micr.), 2.9 (macr.). Length of rostral segment 3 and 4: 0.18–0.19, 0.45–0.48. Pronotal part of cephalonotum mostly brown with transversal trapezoidal or elliptic yellow spot connecting caudal corners of cephalonotal suture. Propleural plate relatively narrow, with broad symmetrical notch (Fig 9).

Mesoscutellum (length: 0.9–1.05, width: 0.97–1.02) yellow with sparse light brown spots. Hemelytra with sparse (micr.) or dense (macr.) brown spots. Ventral midsternal carina: prosternal part with blunt apex, concave posteroventral margin and convex posteroventral submarginal lamella; meso- and metasternal carinae apically round, subapically with sinuate lamella, both shorter than the prosternal one (Fig 10).

Male: Aedeagus relatively short, slender, slightly curved, with hammer-like apical part. Apex narrowed, elongately rounded; posterosubapical spine-like lamina triangular (Fig 11). Right paramere short, only slightly curved, apically blunt (Fig 12). Left paramere very slender, regularly curved, subparallel, posterobasally round, without any lobe; with tip-shaped apex (Fig 13).

Female: Abdominal sternum 7: basal margin of proximal lamella deeply sinuate, ventral plate weakly sinuate with tip-shaped posteromedial lobe, distal lamella subtriangular with sinuate convex sides (Fig 14).

Comparative notes: Characters of *Hydrotrepes maculatus* sp. n. are similar to those of the species belonging to the *Hydrotrepes bouvieri* group (cf. ZETTEL 1998). This species is similar to *H. yupae* and *H. septentrionalis* and is very likely closely related to *H. yupae*. It is not possible to differentiate these three species by body size. Nevertheless, both sexes of *Hydrotrepes maculatus* sp.n. differ unambiguously from all other species (1) in the dark pattern with six or four yellow spots on frontoclypeal region of the head, and (2) the shape of ventral midsternal carina, especially the concave posteroventral margin of its prosternal part. The male of *Hydrotrepes maculatus* sp.n. differs from the males of the above mentioned similar species in (1) possessing a symmetrical posterior spur-like lamella of the aedeagus, (2) nearly parallel anterior and posterior margins of right paramere, and (3) left paramere without a posterobasal process. The hind margin of the female abdominal sternum 7 of *Hydrotrepes maculatus* sp.n. is more convex than in *H. yupae*. The sharp medial tip of the hind margin of ventral plate differs from both from *H. yupae* and *H. septentrionalis*.

Habitat: *H. maculatus* was collected in an open stream in a kampong (village) at the Thai-Malaysian border. The stream was about 6 meter wide and 1 meter deep, fast flowing and clean, with sandy bottom mixed with some pebbles. The specimens were collected near a muddy bank covered with vegetation and leaf litter together with *Hydrotrepes mixtus* sp.n.

Distribution: South Thailand, Narathivat Province.

Etymology: The name *maculatus* (L., adjective) means spotted; named after four or six yellow spots on the frontoclypeal region of the head.

***Hydrotrepes mixtus* sp. n. (Figs 15-22)**

Type material: holotype (macr. ♂): South Thailand, Narathivat Prov., Ban Sac, 23 Oct. 1998, (LHK 0402), leg. H. K. Lua (ZRC); paratypes: 2 (macr.) (ZRC), 1 ♂ completely dissected (macr.) (SMF), 1 ♀ (micr.) (ZRC), same locality data as holotype.

Description: Body length of ♂♂ (macr.): 2.20–2.25, of ♀ (micr.): 2.17; maximum body width of both sexes and morphs: 1.56. Ground colour relatively light, yellow brown to light brown, marked by brown to blackish spots. Venter and coxae yellowish brown, segments of legs except coxae yellow. Rostral segments 3 and 4 black.

Head with densely set small alveoli and punctures, matt (shining in posterior part). Pattern formed by brown to red brownish spots in frontoclypeal region variable, regularly with two parallel dark spots between eyes in ventromedian region, and two parallel yellow spots dorsally from eyes in dorsomedial region (Figs 15, 16). Interocular distance: 0.67. Eye length/width: 0.52/0.23 (macr.), 0.45/0.22 (micr.). Eye index: 2.9. Length of rostral segment 3 and 4: 0.13, 0.28. Cephalonotal suture deeply sinuate; pronotal part of cephalonotum mostly

brown with medial transversally oriented yellow spot connecting hind lobes formed by this suture. Pronotal plate narrow, with broadly opened shallow notch (Fig 17).

Mesoscutellum (length/width: 0.80/1.01 (macr. ♂♂), 0.85/0.90 (micr. ♀♀) marginally yellow, with light brown marking in central region. Hemelytra darker than mesoscutellum, yellowish brown with darker spots of varying densities in different specimens. Ventral midsternal carina: prosternal and metasternal parts with relatively long tip-shaped postero-apical lobes; prosternal part with posterosubapical small incision; mesosternal part with two minute (anterior and posterior) ventrally produced lobes, abdominal parts distinctly lower than sternal ones (Fig 18).

Male: Aedeagus relatively small, subapically broader and more robust than basally, with short upright tip-shaped apex, oriented parallelly to longitudinal axis of aedeagus (Fig 19). Parameres distinctly shorter than aedeagus. Right paramere undulate with minute, sharp anteriorly produced tip (Fig 20). Left paramere somewhat longer than the right one, distally distinctly more slender than proximally; with longitudinal posterobasal lamella in basal half, and with simply rounded apex (Fig 21).

Female: Abdominal sternum 7 relatively small, with sinuate lateroposterior margins, anteriorly broad, posteriorly narrow; hind margin of narrow posterior part (lobe) with medially angulate hind margin (Fig 22).

Comparative notes and discussion: *Hydrotrepes mixtus* sp. n. belongs to the *Hydrotrepes mirus* group (= *H. mirus*, *H. schillhammeri*, both from North Thailand and *H. hybridus*, *H. yangae*, both from Sabah, Borneo) (see ZETTEL 1998, 2000b) on the ground of the similar external male genitalia. But there are also morphological similarities to the *H. sarawakensis* group (= *H. sarawakensis* from Sarawak, Borneo and *H. kalimantanensis* from Kalimantan) (see ZETTEL 2000b), e. g., the shape of the pronotal and genal plate.

Hydrotrepes mixtus sp.n. differs distinctly from:

- (a) all other mentioned species by (1) very narrow pronotal plate, (2) long, posteriorly produced posteroapical lobe of prosternal carina and (3) extremely narrowed distal part of left paramere in males;
- (b) species of the *H. sarawakensis* group by (1) absence of posterosubapical long process of midsternal carina of abdominal sternum 2, and also by absence of midsternal tip shaped carina of abdominal sternum 4, (2) male aedeagus without small apical lamella, and (3) by distribution on mainland;
- (c) *H. mirus* and *H. schillhammeri* by (1) very narrow pronotal plate, (2) robust distal part of aedeagus with upright small tip shaped apex, (3) both right and left parameres being shorter than the aedeagus, (4) more undulate "S" shaped right paramere with minute posteroapical sharp tip, and (5) by quite different buckler shaped female abdominal sternum 7.
- (d) *H. hybridus* and *H. yangae* by (1) distribution on mainland, (2) abdominal sternum 4 without midsternal tip shaped process, (3) aedeagus without small apical lamella, and also by (4) undulate "S" shaped right paramere in males.

A brief analysis of the diagnostic characters of the *H. mirus* and *H. sarawakensis* species groups shows, that only the absence (*H. mirus*-group) or presence (*H. sarawakensis*-group) of a small apical lamella of the aedeagus can, more or less arbitrarily, be used to differentiate these two groups. Another diagnostic character used by ZETTEL (2000b) is the absence (*H. mirus*-group) or presence (*H. sarawakensis*-group) of posteriad directed spines of

midventral carina on abdominal sternum 3. However, these spines which also occur in other species groups of *Hydrotrepes* are quite variable in shape at intraspecific level and may even be lacking (see ZETTEL 2000b, Figs 41, 42, 74-76; M.P., unpublished data). Thus, it is doubtful if this character is of any diagnostic value for the differentiation of the *H. mirus* and *H. sarawakensis* groups.

Other possible differential characters show a mixed distributional pattern or they are similar in both groups. For example, the shape of the ventral midsternal carina in *H. hybridus* and *H. yangae* (*mirus* group) is similar to the ones in both species of the *sarawakensis* group. In three species of the *mirus* group (*H. hybridus*, *H. yangae*, *H. mixtus*.) the shape of the female abdominal sternum 7 is similar the one of the species of the *sarawakensis* group. Furthermore, the parameres of all species of the *mirus* and *sarawakensis* groups have a similar shape and in our opinion, the differences are not larger than at the interspecific level. Thus, the separation of the *H. sarawakensis* from the *H. mirus* group seems to be questionable and needs a more detailed analysis.

Habitat: This species was collected at the same location as *Hydrotrepes maculatus* sp.n. (see above).

Distribution: South Thailand, Narathivat Province.

Etymology: The name *mixtus* (L., adjective) means mixed and refers to the fact that some characters of the species may be assigned to the *H. mirus* others to the *H. sarawakensis*-species groups.

Zusammenfassung

Helotrephes senckenbergi sp. n. (*H. semiglobosus*-Gruppe) aus Nord Thailand, *Hydrotrepes maculatus* sp. n. (*H. bouvieri*-Gruppe) und *Hydrotrepes mixtus* sp. n. (*H. mirus*-Gruppe) aus Süd Thailand werden neu beschreiben. Differentialmerkmale der *Hydrotrepes mirus*- und *H. sarawakensis*-Artengruppen werden diskutiert.

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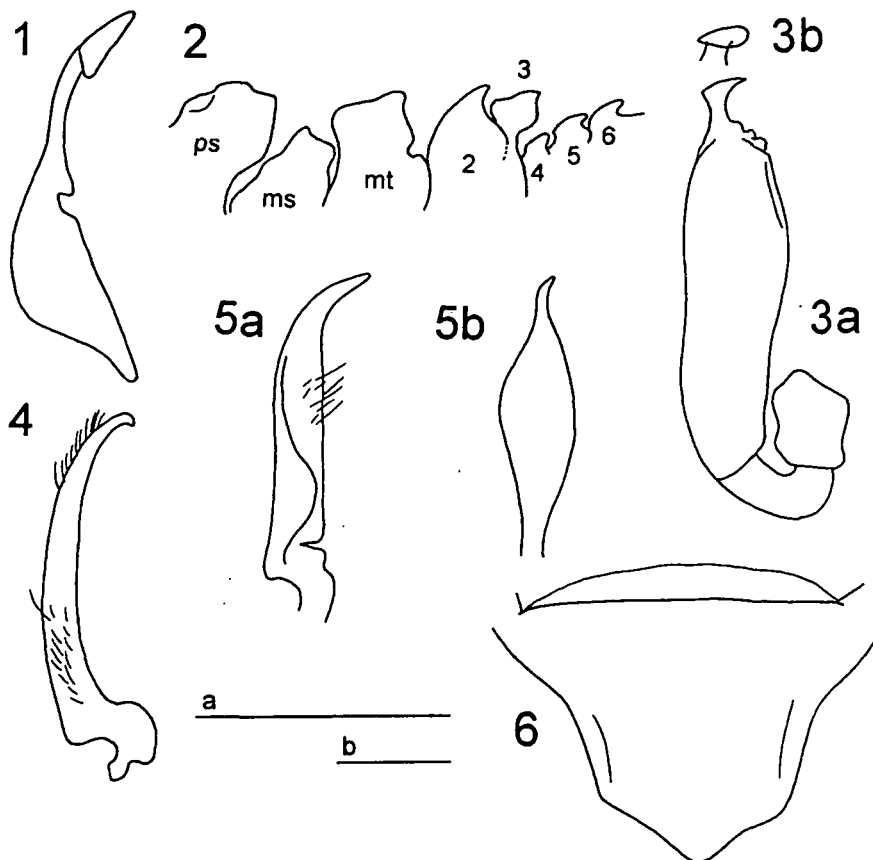
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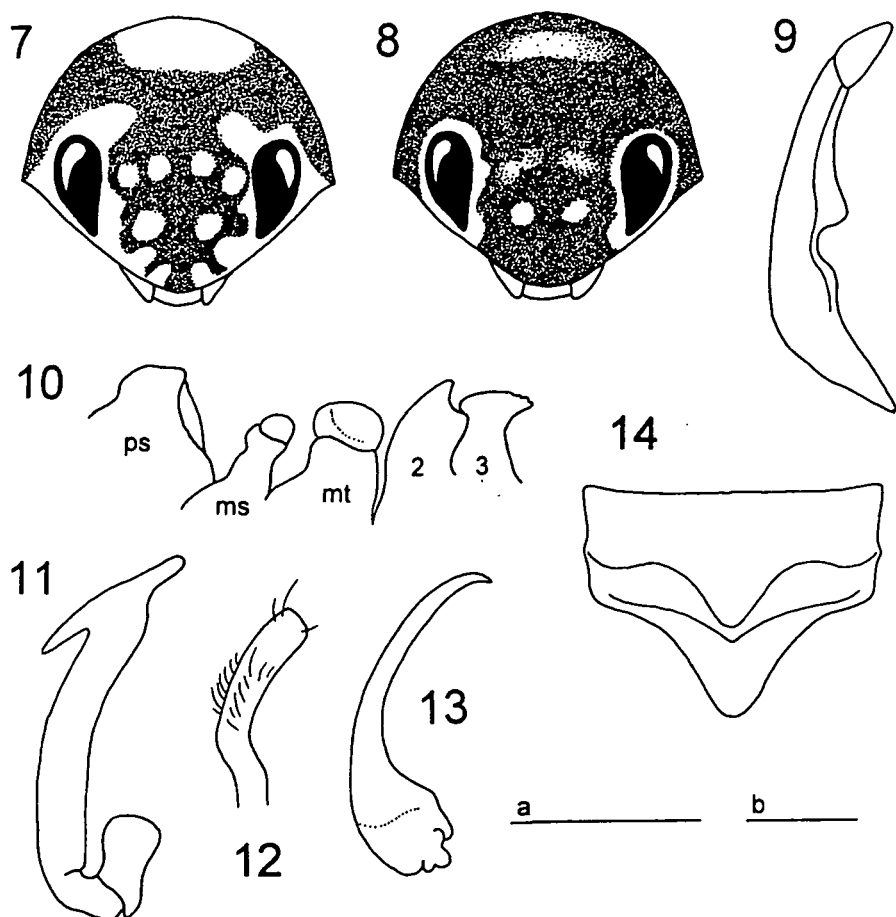
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Adresses of the authors: Miroslav PAPÁČEK
University of South Bohemia, Pedagogical Faculty
Jerónymova 10
371 15 České Budějovice, Czech Republic
E-mail: papacek@pf.jcu.cz

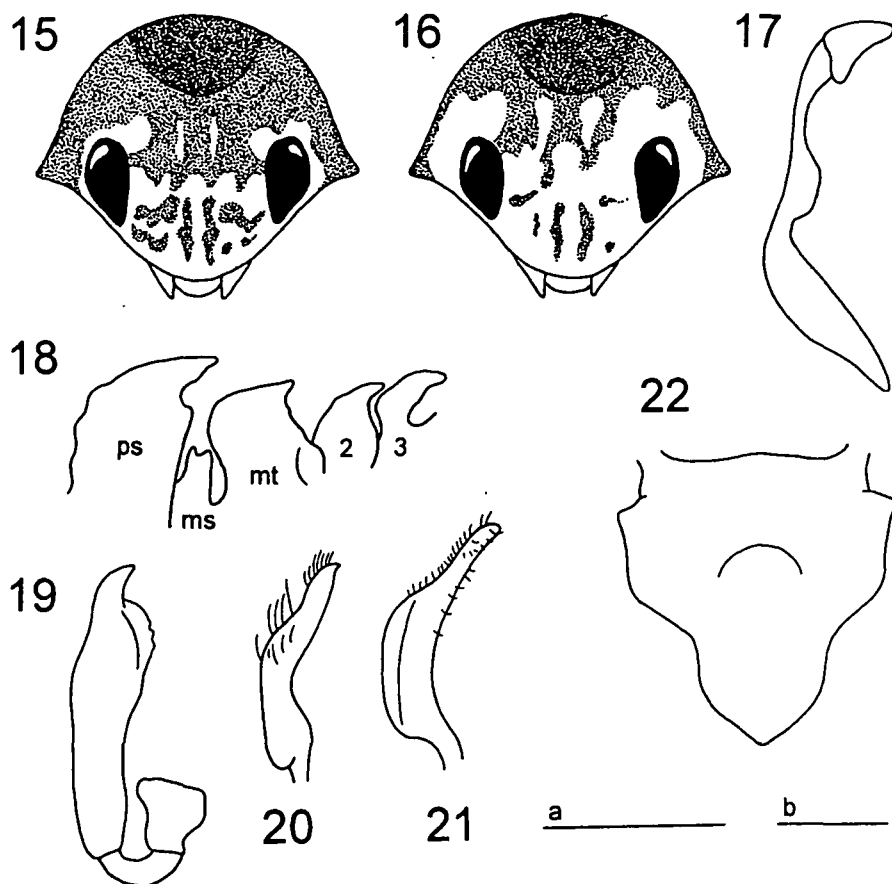
Damir KOVAC
Forschungsinstitut und Naturmuseum Senckenberg, Entomologie I
Senckenberganlage 25
60325 Frankfurt am Main, Germany
E-mail: dkovac@sng.uni-frankfurt.de



Figs 1-6: *Helotrephes senckenbergi* sp. n. 1 – propleural plate (right ventrolateral view, venter up); 2 – ventral midsternal carina (right lateral view, venter up), ps – prosternum, ms – mesosternum, mt – metasternum, 2, 3, 4, 5, 6 – abdominal segment 2, 3, 4, 5, 6; 3 – aedeagus; 4 – right paramere; 5 – left paramere (Figs 3a, 4, 5a: morphologically right view, 3b: apical view, 5b: dorsal view); 6 – female abdominal sternum 7 (= subgenital plate) (ventral view, pilosity omitted). Scale bar a = 1.0 mm (Figs 1, 2). Scale bar b = 0.2 mm (other Figs).



Figs 7-14: *Hydrotrepes maculatus* sp. n. 7, 8 – cephalonotum, most common markings of fronto-clypeal area (frontal view); 9 – propleural plate (right ventrolateral view, venter up); 10 – ventral midsternal carina (right lateral view, venter up), ps – prosternum, ms – mesosternum, mt – metasternum, 2, 3 – abdominal sterna 2, 3; 11 – aedeagus; 12 – right paramere; 13 – left paramere (Figs 11-13: morphologically right view); 14 – female abdominal sternum 7 (ventral view, pilosity omitted). Figs 7, 8 – without scale. Scale bar a = 0.5 mm (Figs 9, 10). Scale b = 0.2 mm (other Figs).



Figs 15-22: *Hydrotrepes mixtus* sp. n. 15, 16 – cephalonotum, most common markings of fronto-clypeal area (frontal view); 17 – propleural plate (right ventrolateral view, venter up); 18 – ventral midsternal carina (right lateral view, venter up), ps – prosternum, ms – mesosternum, mt – metasternum, 2, 3 – abdominal sterna 2, 3; 19 – aedeagus; 20 – right paramere; 21 – left paramere (Figs 19-21: morphologically right view); 22 – female abdominal sternum 7 (ventral view, pilosity omitted). Figs 15, 16 – without scale. Scale bar a = 0.5 mm (Figs 17, 18). Scale bar b = 0.2 mm (other Figs).

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