

The ventralis group of *Edaphus*: Neotropical Euaesthetines with special abdominal characters (Coleoptera, Staphylinidae) (95th Contribution to the knowlegde of Euaesthetinae)

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ABSTRACT

The Neotropical *Edaphus* with special abdominal characters are revised; ten new species are described, one taxon is invalidated and a key to species is included. *Edaphus ashei* **sp. nov.** (Ecuador); *E. boops* **sp. nov.** (French Guyana); *E. denticollis* **sp. nov.** (Ecuador); *E. falini* **sp. nov.** (Ecuador); *E. hoppi* **sp. nov.** (Brazil); *E. liliputanus* **sp. nov.** (Panama); *E. marsupifer* **sp. nov.** (Costa Rica and Panama); *E. ventralis* **sp. nov.** (Costa Rica, Panama and Nicaragua); *E. ventricula* **sp. nov.** (Peru and Ecuador); and *E. schatzorum* **sp. nov.** (Costa Rica) are described; *E. rishwani* Makhan 1995 **sp. propr.**

KEY WORDS: Coleoptera, Staphylinidae, Euaesthetinae, special abdominal characters, Neotropical Region

RESUMEN

Se hace una revisión de las especies neotropicales del género *Edaphus*; se describen diez especies, un taxón se revalida y se incluye un clave para las especies. Se describe a las siguientes especies: *Edaphus ashei* **sp. nov.** (Ecuador); *E. boops* **sp. nov.** (French Guyana); *E. denticollis* **sp. nov.** (Ecuador); *E. falini* **sp. nov.** (Ecuador); *E. hoppi* **sp. nov.** (Brasil); *E. liliputanus* **sp. nov.** (Panama); *E. marsupifer* **sp. nov.** (Costa Rica y Panamá); *E. ventralis* **sp. nov.** (Costa Rica, Panamá y Nicaragua); *E. ventricula* **sp. nov.** (Perú y Ecuador); y *E. schatzorum* **sp. nov.** (Costa Rica). *E. rishwani* Makhan 1995 es considerada como especie válida.

PALABRAS CLAVE: Coleoptera, Staphylinidae, Euaesthetinae, caracteres abdominales especiales, Región Neotropical

INTRODUCTION

The genus *Edaphus* Motschulsky is the largest in the subfamily Euaesthetinae. Together with the species described here the genus currently include nearly 400 species, most of them in the Southern hemisphere. Special characters of the exoskeleton, as horns on the frons (e. g. *Edaphus tricornis* Szekessy) or denticles on the pronotum (e. g. *E. denticollis* **sp. nov.**) are rare, but found in different monophyletic groups. Special characters of the dorsal side of abdomen were known from the group of *E. dentiventris* Fauvel (Oriental region; Puthz, 1979) and *E. franzi* Puthz (Ethiopian region, Puthz, 1992), where they represent special male sexual characters.

The Neotropic species have modifications on their first tergites in both sexes. Modifications are connected to the respective spiracles. When I described the first species of this kind in 1973 (*E. humeralis* Puthz), I did not notice this special character since the unique specimen had a retracted abdomen. Twelve years later, having more material at hand, I first observed these characters and called them "atrium-pockets". More species with such characters were later found amongst material from Cuba (Puthz, 1997). Having become aware of the taxonomic significance of those special abdominal characters in these minute insects (of which the function is unknown) and having large new materials from Latin America for study more new species were identified, which are described here.

In the Neotropics two species complexes can be distinguished: one with broad atrium-pockets (Figs. 15, 16-18, 25) and one with oblique atrium-pockets (Figs. 1-4). Both are treated here as the "ventralis-group". In the genus *Edaphus* these atrium-pockets are a derived characters. This paper is dedicated to the late James S. Ashe.

ABBREVIATIONS AND MEASUREMENTS

Abbreviations (see Fig. 4 in Puthz, 2006a): alff = antero-lateral furrows of frons; alpF = antero-lateral portions of frons; ampF = antero-medial portion of frons; dE = distance between eyes; dlbc = distance of latero-basal carinae of pronotum; FIT = flight interception trap; HT = holotype; lbc = latero-basal carina at pronotum; lbf = latero-basal fovea of pronotum; |El| = greatest length of elytra; lE = length of eyes; lG = length of genae; lP = length of pronotum; lS = length of suture; lT = length of temples; mbc = medio-basal carina of pronotum; mbct3

= medio-basal carina on posterior portion of tergite 3; mbf = medio-basal foveae of pronotum; PM = proportional measurements (1 unit = 0.0085 mm); PT/PTT = paratype/paratypes; ptfF = postero-transverse furrow of frons; shC = special humeral characters; SpP = sperm pump; vs = vesica seminalis; wEl = greatest width of elytra; wH = width of head; wP = width of pronotum.

Acronyms for museums and private collections:

CNC Canadian National Collection, Ottawa
 FMNH Field Museum of Natural History, Chicago, IL
 MCZH Museum of Comparative Zoology, Harvard University, Cambridge, Mass.
 MHNG Muséum d'histoire naturelle, Genf
 SEMC Natural History Museum University of Kansas, Lawrence, KS
 MZUSP Museu de Zoologia da Universidade de São Paulo, SP
 cP private collection V. Puthz, Schlitz

TAXONOMIC PART

Edaphus ventralis sp. nov.

Figs. 1-8

Description: Reddish brown, shiny, punctation microscopically fine (insertions of setae), pubescence moderately long, dense, mostly semierect. Antennae, maxillary palpi and legs brownish. Tergite 3 with an oblique atrium-pocket (Figs. 1-4).

Length: 1.1-1.3 mm (forebody: 0.6-0.7 mm).

PM of HT: wH: 30.5; dE: 19; IE: 11; IT: 0; IG: 3; wP: 32; IP: 27; dIC: 25; wEl: 50; IEl: 46; IS: 36.

Male: Sternite 8 with a moderately narrow notch in posterior third (Fig. 8). Sternite 9 with a distinctly projection apicomedian tip. SpP three times as long as the median lobe, sclerotized double trumpet absent, vs about one third as long as the median lobe. Aedeagus (Fig. 5) very small, parameres simple with one long apical seta.

Head distinctly narrower than pronotum, eyes very large in the male (dE: 19; IE: 11), much smaller in the female (dE: 19; IE: 7.5), no temples in the male, short oblique temples in the female (IT: ca. 2), ptfF deep and distinct, no distinct alfF, alpF convex, about as broad as ampF anteriorly, clypeus simple. Antennae sexually dimorph (Figs. 6, 7). Pronotum much broader than long, lbc distinct, two narrow transverse impressions separated by a narrow elevation (no mbc); pubescence erect, dense. Elytra broader than long, shoulders simple. Mbct3 absent.

Type Material: Holotype (♂) and 3 ♂♂, 2 ♀♀-paratypes: COSTA RICA: Puntarenas: Rincon de Osa, 50 m, 8°41.141 N, 83°31.117 W, flight interception trap, 23.-26.VI.2001, S. & J. Peck. Paratypes: Puntarenas: 3 ♂♂: Altamira Biological Station, 1510-1600 m, 9°1.76 N, 83°0.49 W, FIT, 4.-7.VI.1004, J. S. Ashe *et al.*; 1 ♂, 1 ♀: Las Alturas Biological Station, 1660 m, 8°56.17 N, 82°50.01 W, FIT, idem; 1 ♂, 1 ♀: Corcovado National Park, Sirena Station, Upper Ollas Trail, 140 m, 8°29.7 N, 83°34.39 W, FIT, 24.-28.VI.2000, Z. Falin; 1 ♂: ibidem, Corcovado Trail, 150 m, FIT, 28.VI.-1.7.2000, idem; 1 ♂: Monteverde Reserve (trail near klab), FIT, 3.VI.1993, C. Michalski; 1 ♀: Osa Penn., Fundación Neotrop. 10 km W Rincon, 20 m, 8°42.30 N, 83°31.30 W, berlese forest litter, 21.VI.1997, R. Anderson; Guanacaste: 1 ♂: Maritza Biological Station, 550 m, 22.V.1993, FIT, J. S. & K. Ashe; 2 ♀♀: Patilla Biological Station, 810 m, 10°59.22 N, 85°25.33 W, FIT, 13.-15.VII.2000, Ashe *et al.*; 3 ♂♂: Heliconias Biological Station, 600 m, 10°42.916 N, 85°02.377 W, FIT, 20.-23.XI.2001, R. Brooks; Heredia: 1 ♂, 4 ♀♀: La Selva, 3.2 km SE Puerto Viejo, 100 m, FIT, 19.II.1992, W. Bell; 1 ♂: ibidem 80 m, FIT, 19.V.1993, J.S. & A.K. Ashe; 3 ♀: ibidem, 3 km S Puerto Viejo, 80 m, 10°25.0 N, 84°00 W, FIT, 2.-15.VI., 4.-15.VI.1997, S. & J. Peck; 1 ♂: ibidem, FIT, 8.-11.VI.2001, S. Chatzimanolis; San José: 1 ♂: km 117 Pan-American Hwy, 19 km N San Isidro, 1800 m, 9°28.0 N, 83°42.20 W, FIT, 20.-25.VI.1997, S. & J. Peck; 1 ♀: Carpintera, 16.VI.1940, A. Bierig; 2 ♀♀: Alajuela: E. B. San Ramon, R. B. San Ramon, 27 km N & 8 km W San Ramon, 810 m, 10°13.4 N, 84°35.46 W, FIT, 8.VII.2000, Ashe *et al.*. NICARAGUA: 1 ♂: Rio San Juan Dept., 60 km SE San Carlos, Refugio Bartola, 100 m, 10°58.40 N, 84°20.30 W, FIT, 25.-28.V.2002, R. Brooks *et al.*; 1 ♂: Granada Dept., Res. Nat. Volcan Mombacho, 1210 m, 11°50.05 N, 85°58.83 W, FIT, 1.-5.VI.2002, S. Chatzimanolis. PANAMA: Canal Zone: 1 ♂, 1 ♀: Achiote Road 9 mi SW Gatun, leaf litter forest floor, 19.VI.1976, A. Newton; Panama: 1 ♂: Cerro Campana (Capira), 8°44 N, 79°57 W, 790 m, FIT, 5.VI.1995, J. Ashe & R. Brooks; 3 ♂♂, 3 ♀♀: Barro Colorado Island, 40 m, 8°11.0 N, 79°51.0 W, FIT, 18.-22.VI., 22.-25.VI., 25.-30.VI., 10.-17.VII.2000, S. Chatzimanolis; 1 ♀: ibidem, FIT, 6.VIII.1994, D. Banks; 2 ♂♂: Colón: Parque Nacional Soberania, Pipeline Road km 6.1, 40 m, 9°07 N, 79°45 W, FIT, 7.-21.VI.1995, J. Ashe & R. Brooks; 1 ♀: Coclé: 7.2 km NE El Copé, 730 m, 8°37 N, 80°35 W, FIT, 20.V.-7.VI.1995, idem; Chiriqui: 3 ♂♂, 1 ♀: 20 km N Gualaca, Finca La Suiza, 350 m, 8°39 N, 82°12 W, FIT, 24.V.-9.VI.1996, idem; 1 ♂: 27.7 km W Volcan Hartmann's Finca, 1450 m, 8°45 N, 82°48 W, 14.-17.VI.1996, idem.- HT and PTT in NHMK, PTT also in FMNH, MCZH and cP.

Discussion: *Edaphus ventralis* **sp. nov.** may be easily identified by the oblique atrium-pocket on tergite 3 and the two transverse impressions near posterior margin of the pronotum. It is distinguished from *E. ventricula* **sp. nov.** by smaller eyes and different pubescence, from *E. falini* **sp. nov.** by shorter body length and from *E. ashei* **sp. nov.** by the almost impunctate elytra, from all by the male sexual characters.

Etymology: The name refers to the special characters on the abdomen (Lat. *ventralis* = distinguished by the abdomen).

***Edaphus ventricula* sp. nov.**

Figs. 9-11

Description: Reddish brown, shiny, punctation microscopically fine (insertions of setae), pubescence moderately long, recumbent (except three long erect setae on each side of the pronotum and two semierect elytral setae laterally). Antennae, maxillary palpi and legs yellowish brown. tergite 3 with an oblique atrium-pocket.

Length: 1.0-1.3 mm (forebody: 0.6-0.7 mm).

PM of the HT: wH: 28.5; dE: 18; IE: 10; IT: 0; IG: 2; wP: 29.5; IP: 25; dLC: 23; wEl: 44; IEI: 40; IS: 31.

Male: Antennae with a 3-segmented club (Fig. 10). Sternite 8 with a moderately broad notch in about posterior quarter. Sternite 9 as in *E. ventralis*. SpP three times as long as the median lobe, sclerotized double trumpet absent, vs about one third as long as the median lobe. Aedeagus (Fig. 9) narrower than that of *E. ventralis*, parameres with one strong apical seta.

Female: Antennae with a 2-segmented club (Fig. 11).

Type Material: Holotype (♂): PERU: Loreto: Teniente Lopez, 2°35.66 S, 76°06.92 W, 210-240 m, FIT, 28.VII.1993, R. Leschen. **Paratypes:** 2 ♂♂: *ibidem*, 24.VII.1993, *idem*; 1 ♀: 1.5 km N Teniente Lopez, 20.VII.1993, *idem*. ECUADOR: 1 ♂, 3 ♀♀: Napo: Jatun Sacha Lodge, 0°28.14 S, 76°27.35 W, 270 m, FIT, 21.-24.III.1999, R. Brooks; 1 ♂ *ibidem* 20.VII.1994, *idem*; 1 ♂, 3 ♀♀: Sucumbios: Sacha Lodge, 9°28.14 S, 76°27.35 W, 270 m, FIT, 21.-24.III.1999, *idem*; 1 ♀: Esmeraldas: Bilsa, 0°20.0 S, 79°43.0 W, FIT, 5.VI.-7.VII.1996, P. Hibbs; 2 ♀♀: Napo: Yuturi Lodge, Rio Napo, 0°32.54 S, 76°2.28 W, 270 m, FIT, 21.-21.III.1999, R. Brooks & D. Brzoska. - HT and PTT in NHMK, PTT also in cP.

Discussion: In most respects as *E. ventralis* but the pubescence is different, the pronotal pubescence recumbent except the three long lateral setae. *E. ventricula* **sp. nov.** may be distinguished from *E. ventralis* by larger eyes and different pubescence, from *E. falini* **sp. nov.** by shorter length and from *E. ashei* **sp. nov.** by the almost impunctate elytra, from all by the male sexual characters.

Etymology: The name refers to the close relationship to *E. ventralis* (Lat. *ventricula* = a glutton).

***Edaphus falini* sp. nov.**

Fig. 12

Description: Brown, shiny, punctation microscopically fine (insertions of setae), pubescence dense, moderately long, recumbent. Antennae, maxillary palpi and legs yellowish brown. Tergite 3 with an oblique atrium pocket.

Length: 1.3-1.5 mm (forebody: 0.8-0.85 mm).

PM of the HT: wH: 37; dE: 20; IE: 14.5; IT: 0; IG: 1; wP: 39; IP: 32; dLC: 29; wEl: 64; IEI: 60; IS: 49.

Male: Antennae with a 3-segmented club (about as in *E. ventricula*). Sternite 8 with a moderately broad notch in posterior quarter (broader than in *E. ventralis* and *E. ventricula*). Sternite 9 as in the related species. SpP about twice as long as the median lobe, no distinctly sclerotized double trumpet present, vs less than half as long as the median lobe. Aedeagus (Fig. 12) with median lobe triangularly narrowed, parameres strong with two long apical and one short preapical seta.

Type Material: Holotype (♂): ECUADOR: Napo: Cosanga, 4.2 km S Baeza. Tena Road then 1.5 km W on pipeline access road, 2150 m, 0°37.19 S, 77°50.1 W, FIT, 5.-7.XI.1999, Z. H. Falin: in the NHMK.

Discussion: In most respects as *E. ventralis* but larger and in the male with a 3-segmented antennal club. Pubescence of the pronotum less dense and mostly recumbent. The new species may be distinguished from its close relatives by the greater length and the male sexual characters (see also key).

Etymology: This new species is dedicated to Dr. Z. H. Falin (Kansas Natural History Museum), who collected this and many other Neotropical Staphylinidae.

***Edaphus ashei* sp. nov.**

Description: Reddish brown, moderately shiny, elytra and abdomen very finely and very densely punctate, pubescence moderately long, mostly semierect. Antennae, palpi and legs brown. Tergite 3 with an oblique atrium-pocket.

Length: 1.2-1.5 mm (forebody: 0.75 mm).

PM of the HT: wH: 32.5; dE,: 21.5; IE: 10.5; IT: 0; IG: 3; wP: 38; IP: 30; dLC: 28; wEl: 58; IEl: 47; IS: 37.

Male: Unknown.

Type Material: Holotype (♀): ECUADOR: Esmeraldas: Bilda, 0°20.0 S, 79°43.0 W, FIT, 28.IV.-10.V.1996, P. Hibbs: in the NHMK.

Discussion: In most respects as *E. ventralis* but the elytra and the abdomen distinctly, very finely and densely punctate, interstices smaller than diameters of punctures. Although the male is unknown, this new species may be easily identified by the group-specific atrium-pocket and the dense punctation of elytra and abdomen.

Etymology: This new species is dedicated to the late James S. Ashe, who was a great encourager for young Staphylinidologists and brought together an amazing amount of Latin American Staphylinidae.

***Edaphus denticollis* sp. nov.**

Description: Chestnut brown, shiny, pronotum with a posterolateral denticle, finely and moderately densely punctate, elytra and abdomen microscopically finely and densely punctate; pubescence moderately long, semierect or recumbent. Antennae, maxillary palpi and legs brown. Elytra with a short prehumeral carina and a distinct oblong humeral impression behind the basal carina. Tergite 1-4 with broad transverse atrium-pockets.

Length: 1.0-2.2 mm (forebody: 1.3 mm).

PM of the HT: wH: 53; dE: 40; IE: 13.5; IT: 0; IG: 5; wP: 68 [66]; IP: 50, dLC: 49; wEl: 93; IEl: 80; IS: 68.

Male: Unknown.

Head much narrower than elytra, eyes large, no temples, ptfF distinct, ampF concave, about as broad as each of the alpF, clypeus simple; no punctation except one puncture on alpF anteriorly. Antennae with a 2-segmented club, segment 10 about as long as broad. Pronotum much broader than long (wP with posterolateral denticles: 68; wP without denticles: 66; IP: 50), anterior angles with a narrow, prominent emargination, two lateral denticles in about posterior third; base with distinct lbc and six foveae (no mbc), of which the two paramedial foveae are distinctly larger than the other four foveae; punctation distinct, fine and moderately dense, interstices mostly larger than diameter of punctures. Elytra much broader than long with special humeral characters (see above); punctation distinctly finer than that on pronotum, interstices distinctly larger than diameter of punctures. Abdomen finely and densely punctate and pubescent, mbct3 distinct, as long as the whole tergite.

Type Material: Holotype (♀): ECUADOR: Pichincha: Bellavista Reserve, Ridge Trail 12 km S Nanegalito, 2250 m, 0°0.54 S, 78°40.56 W, cloud forest litter, 28.X.1999, R. Anderson: in the NHMK.

Discussion: This new species may be easily identified by the atrium-pockets of the first tergites, the pronotal denticles and the distinct punctation of the pronotum.

Etymology: Named after the pronotal denticles (Lat. *denticollis* = having denticles at the pronotum).

***Edaphus boops* sp. nov.**

Figs. 13, 15, 30

Description: Brownish, shiny, punctation microscopically fine (insertions of setae), pubescence short, dense, mostly semierect. Antennae, maxillary palpi and legs yellowish brown. Tergites 1-4 with broad lateral atrium-pockets (Fig. 15).

Length: 1.1-1.4 mm (forebody: 0.75-0.8 mm).

PM of the HT: wH: 39; dE: 20; IE: 14; IT: 0; IG: 2; wP: 37; IP: 31.5; dLC: 28; wEl: 63; IEl: 51; IS: 39.

Male: Eyes very large with coarse ommatidia (Fig. 13). Sternite 8 with a triangular notch in about posterior fifth. Sternite 9 with a distinctly projecting apicomedian tip. SpP about ¼ longer than the median lobe, double trumpet distinct, moderately weakly sclerotized, vs about ¼ as long as the median lobe. Aedeagus (Fig. 19) with median lobe with two strong lateral and two smaller medial setae ventrally, parameres long with one moderately strong apical seta and one thin and short seta basally.

Female: Unknown.

Head (in the male) broader than the pronotum, ptfF distinct, ampF twice as broad as narrow alpF, concave, clypeus simple; no punctation. Antennae with a 2-segmented club. Pronotum distinctly broader than long, with distinct lbc, mbc and 6 large basal foveae about equal in size, pubescence erect. Elytra much broader than long with a distinct humeral furrow. Abdomen sparsely punctate and pubescent.

Type Material: Holotype (♂) and 2 ♂♂-paratypes: FRENCH GUYANA: Saül: 7 km N Les Eaux Claires, 220 m, 3°39.46 N, 53°13.19 W, FIT, 30.V.- 4.VI.1997, J. Ashe & R. Brooks. 1 ♂-PT: ibidem 31.V.-3.VI.1997, idem.- HT and PTT in NHMK, 1 PT in cP.

Discussion: This new species resembles most *E. humeralis* Puthz and *E. rishwani* Makhan; from both it may be distinguished in the male by the very large and coarsely faceted eyes and the genitalia.- At about the same place as the type locality a male of *E. humeralis* has been found. Therefore the identification of a single female from the same

locality as the type series must be doubtful (“cf. *humeralis*”). I cannot distinguish this female from *E. humeralis* (this female is distinguished from the male of *E. boops* by narrower head ([wH: wP = 41: 44]) and by smaller eyes ([IE: 12, dE: 28]).

Etymology: Named after the large eyes (Lat. *boops* = cow-eyed).

***Edaphus humeralis* Puthz, 1973**

Figs. 14, 20, 21, 24

Edaphus humeralis Puthz, 1973: 55; 1985: 352 ff. falsus; 1997: 138 falsus

Edaphus humeralis; Makhan, 2005: 60

Male: Eyes smaller than in *E. boops* with less large ommatidia (Fig. 14). Sternite 8 with a subtriangular notch in about posterior fifth (Fig. 24). SpP twice as long as the median lobe, vs strongly sclerotized somewhat more than one third as long as the median lobe. Aedeagus (Figs. 20, 21) with parameres much shorter than median lobe, completely fused with it, each with one strong apical and one fine medial seta.

Female: Spermatheca (HT!) consisting of two distally swollen pieces connected by a narrow tube and is similar to that of females of the above listed material.

Material studied: HT (♀): BRAZIL: Para: Faz. Pirelli Belem, 30.-31.III.1970, J.M. & B.A. Campbell (CNC). SURINAME: Marowijne: 3 ♂♂, 3 ♀♀: Perica, 70 km E Paramaribo, on East-West Road, 5 m, 5°40.28 N, 54°36.31 W, FIT, 31.V.-5.VI.1999, Z. H. Falin (NHMK, cP); 1 ♀: Palumen, ca. 160 m, 3°20.56 N, 55°26.18 W, FIT, idem (NHMK); 1 ♀: Saramacca: West Suriname Road, 178 km WSW Zanderij Airport, 25 m, 4°59.06 N, 58°18.48 W, FIT, 12.-14.VI.1999, Falin & DeDiyu (NHMK); 1 ♀ (cf. det.): Commewijne Akintosoela, CELOS Camp, 39 km SE Suriname river bridge, Road to Redi Doti, 40 m, 9°16.17 S, 54°55.15 W, FIT, idem (NHMK). GUYANA: 1 ♀ (cf. det.): Wet Savannah, R.Mazaruni, VIII-IX.1935, N. A. Weber (MCZH); Region 8 Iwokrama Forest, 1 km W Kurupukari: 12 ♂♂, 4 ♀♀: Iwokrama Field Station, 4°40.19 N, 58°41.04 W, 60 m, FIT, 20.V.-2.VI.2001, R. Brooks & Z. Falin (NHMK, cP); 1 ♀: Kabocalli Field Station, 4°17.04 N, 58°30.35 W, 60 m, FIT, 3.-5.VI.2001, idem (NHMK); 1 ♂, 1 ♀: Pakatan Hills, 4°43.49 N, 59°01.35 W, 300 m, FIT, 26.-29.V.2001, idem (NHMK). FRENCH GUYANA: Roura: 3 ♀♀: 8.4 km SSE, 220 m, 4°40.41 N, 52°13.25 W, 29.V.-10.VI.1997, FIT, J. S. Ashe & R. Brooks (NHMK); 1 ♂: 27.4 km SSE, 280 m, 4°44.20 N, 52°13.25 W, FIT, (NHMK); 1 ♀: ibidem, 39.4 km SSE, 270 m, 4°32.43 N, 52°08.26 W, FIT, 29.V.-10.VI.1997, idem (cP); 1 ♀: ibidem, 18.4 km SSE, 240 m, 4°36.38 N, 52°13.25 W, 29.V.-10.VI.1997, idem (NHMK); 1 ♂, 3 ♀♀: Matoury: 41.5 km SSW on Hwy N 2, 4°37.22 N, 52°22.35 W, 50 m, FIT, 29.V.-9.VI.1997, idem (NHMK, cP); 1 ♂, 1 ♀: Saül: 7 km N Les Eaux Claires, along Rue de Belizen trail, 280 m, 3°39.46 N, 53°13.19 W, FIT, 4.-8.VI.1997, idem (NHMK); 6 ♂♂, 4 ♀♀: Cayenne: 33.5 km S and 8.4 km NW of Hwy N 2 on Hwy D 5, 30 m, 4°48.18 N, 52°28.41 W, 29.V.-9.VI.1997, idem (NHMK, cP).

Discussion: This is a vexatious taxon. When I first described it I did not notice the atrium-pockets, since the abdomen of the holotype was retracted. After having studied new material from Paraguay including males and having observed for the first time its extraordinary atrium-pockets I did not imagine that there could be more than one *Edaphus* with this exceptional character. The increasing amount of material sent for study made clear, that atrium-pockets are present in different species. So I had to revise again the types of Makhan’s insufficiently described taxa. In his 2005 paper Makhan tells something concerning the genitalia of *E. humeralis* and of two of his taxa without having seen the holotype nor my 1985-paper (including figures of the aedeagus). His figures 4-5 (“spermatheca”) are taken from the dissections, which I made from his types and show the distal portion of the sperm pump + vesica seminalis!

Careful study of the above quoted material and that of *E. rishwani* (see below) leads to the result, that both taxa are similar concerning their exoskeleton but different in the male genitalia. Whether there are constant differences in the females (spermatheca) remains open, mainly because of the minuteness of that organ. Unfortunately both taxa seem to be widely distributed (mainly caught in flight interception traps) and probably live together. So every male has to be dissected. *E. humeralis* is distinguished from *E. rishwani* by the deeper notch of sternite 8 and by the parameres, which are fused with the median lobe (compare Fig. 22).

***Edaphus rishwani* Makhan, 1995 sp. propr.**

Figs. 16-18, 22

Edaphus rishwani Makhan, 1985: 35; Makhan, 2005: 60

Edaphus aschnae Makhan, 1985: 36

Edaphus humeralis; Puthz, 1985: 352 ff.; 1997: 138

Male: Sternite 8 with a moderately broad, rounded notch in about posterior fifth (Fig. 23). SpP and vs same as in *E. humeralis*. Aedeagus (Fig. 22) with parameres free apically with one apical and one basal seta.

Female: About as in *E. humeralis*.

Material studied: HT (♂) of *E. rishwani*: Suriname, Commewijne distr, 7.VIII.1992, D. Makhan (Zool. Mus.

Amsterdam); HT (♂) of *E. aschnaee*: same as *E. rishwani* (Zool. Mus. Amsterdam). TRINIDAD: 1 ♂, 1 ♀: St. Augustine, 3.VIII.1935, N. A. Weber (MCZH, cP). VENEZUELA: 2 ♂♂: Bolivar: 10 km N Corocito, R. caura rainforest, FIT, 18.VI.-3.VIII.1987, S. & J. Peck (MHNG, cP); 4 ♀♀: Bolivar: 20 km N Upata, 21.VI.-12.VIII.1987, evergreen forest, FIT, idem (MHNG); 1 ♀: Delta Amacure, 1 km W Piacoa, 14.-31.VII.1987, idem (MHNG); 1 ♂: Sucre: 20 km SE Rio Caribe, forest over cacao, treebase litter, 28.VII.1987, idem (MHNG). BRAZIL: 1 ♂: Serra do Mar, Rio Cachoeira, VI. 2003, P. Hopp (SMNK). ECUADOR: 1 ♀ (cf. det.): Napo: Yasumi Research Station on mid. Rio Tiputini, 0°40.5 S, 76°24 W, FIT, 4.-17.VII.1999, C. Carlton & A. Tishechkin (NHMK); PERU: 2 ♂♂, 2 ♀♀: Loreto: Teniente Lopez, 2°35.66 S, 76°06.92 W, 210-240 m, FIT, 28.VII.1993, R. Leschen (NHMK, cP). PARAGUAY: 1 ♂: Neembucu, 5 km NW Pilar, 18.X.1982, F. Baud (cP); 1 ♂: Itapua: 10 km S de Sta. Maria, 25.X.1982, F. Baud (MHNG) and the material quoted in Puthz, 1985.

Discussion: This taxon has been synonymized by me in 1985 (explanation: see discussion at *E. humeralis*). Repeated study of the types of both Makhan's taxa and of *E. humeralis* made clear that there are two very similar species, which only can be distinguished by the male sexual characters. In *E. rishwani* sternite 8 has a shallower apical emargination as in *E. humeralis* and the parameres are free apically, whereas they are fused with the median lobe in *E. humeralis*.

Edaphus schatzorum sp. nov.

Figs. 25-27

Description: Brownish, shiny, punctation microscopically fine (insertions of setae), pubescence fine, moderately dense, recumbent. Antennae, maxillary palpi and legs yellowish brown. Tergite 1-4 with small transverse atrium pockets (Fig. 25).

Length: 0.9-1.1 mm (forebody 0.6-0.65 mm).

PM of the HT: wH: 25.5; dE: 16; IE: 9; IT: 0; IG: 4; wP: 28.5; IP: 25.5; dLC: 20; wEl: 43; IEl: 42; IS: 34.

Male: Sternite 8 (Fig. 27). Sternite 9 with a distinctly projecting apicomedian tip. SpP twice as long as the median lobe, double trumpet distinct, vs 1/3 as long as the median lobe. Aedeagus (Fig. 26), median lobe with four small dorsal setae, only apex of parameres free with one long apical seta.

Head distinctly narrower than pronotum, eyes large, in both sexes temples absent, pttF distinct, ampF concave, less than two times as broad as each of the alpF, clypeus simple; no punctation except one setiferous puncture on alpF anteriorly. Antennae with a 2-segmented club, segment 10 nearly as long as broad. Pronotum broader than long with distinct lbc and six mbf, the lateral ones smaller than the paramedial ones. Elytra about as long as broad with a distinct narrow humeral impression; pubescence (insertion of setae) rather sparse. Mbct3 distinct, nearly as long as the tergite.

Type Material: Holotype (♂) and 1 ♂, 3 ♀♀-paratypes: COSTA RICA: Cordillera de Talamanca, Refugio Nacional Tapanti at Mirador, 1400 m, Mountain Rain Forest, 5.II.1995, I. & S. Schatz; 1 ♂-paratype: C. R.: Alajuela: Rio Peñas Blancas, 800 m, 10°19 N, 84°43 W, wet forest, sifted litter, 27.IV.1988, J. Longino.- HT and PTT in cP (in MHNG), 1 PT in FMNH.

Discussion: Amongst the species with short transverse atrium pockets on tergites 1-4 this new species can only be confounded with *E. liliputanus* sp. nov., from which it may be distinguished by the narrower pronotum, of which the four paramedial foveae are of about the same size, by the distinct mbct3, longer body and the male sexual characters.

Etymology: Named after Irene & Helmut Schatz (Innsbruck) who collected this species and donated it to my special collection.

Edaphus liliputanus sp. nov.

Figs. 28, 29

Description: Generally same as *E. schatzorum*.

Length: 0.8 mm (forebody 0.5 mm).

PM of the HT: wH: 24; dE: 15; IE: 8; IT: 0; IG: 2.5; wP: 25; IP: 20; dLC: 19; wEl: 34; IEl: 34; IS: 27.

Male: Sternite 8 (Fig. 28). Sternite 9 as in *E. schatzorum*. SpP nearly two times as long as the median lobe, double trumpet weakly sclerotized, vs one third as long as the median lobe. Aedeagus (Fig. 29, note: partly damaged), median lobe with four small setae dorsally, parameres free in apical third with one short seta in apical third (apical setae are probably broken in the HT).

Head about as in *E. schatzorum*, but ampF less broad, at most 1.5x as broad as each of the alpF. Antennae with a 2-segmented club, segment 10 slightly broader than long. Pronotum distinctly broader than long, rather flat, with lbc and six mbf, of which the two lateral and the two paramedial ones are smaller than the intermedial foveae, mbc absent. Elytra as broad as long with a short humeral stria, pubescence (insertions of setae) moderately dense (elytra therefore less shiny than in *E. schatzorum*). Abdomen with short transverse atrium pockets on tergites 1-4 (as in *E. schatzorum*), mbct3 absent.

Type Material: Holotype (♂): PANAMA: Barro Colorado Island, 40 m, 9°11.0 N, 79°51.0 W, FIT, 18.-22.VI.2000, S. Chatzimanolis; 1 ♀-paratype (abdomen lost during dissection): ibidem 22.-25.VI.2000, idem: in the NHMK.

Discussion: This new species may be distinguished from *E. schatzorum* **sp. nov.** by shorter length, flat pronotum with differently shaped mbf, by the absence of mbct3 and by the male sexual characters.

Etymology: Named after the lilliputians of Swift's "Gulliver's travels".

***Edaphus marsupifer* sp. nov.**

Fig 19

Description: Brown, shiny, punctation microscopically fine (insertion of setae) and sparse, pubescence moderately dense, semierect on pronotum, recumbent on elytra and abdomen. Antennae, maxillary palpi and legs yellowish brown. Tergites 1-4 with broad atrium pockets (about as in Fig. 15).

Length: 1.1-1.5 mm (forebody 0.7-0.8 mm).

PM of the HT: wH: 32; dE: 19; lE: 10; lT: 0; lG: 3; wP: 37; lP: 29; dLC: 27; wEl: 53; lEl: 50; lS: 40.

Male: Sternite 8 with a notch in about posterior quarter. Sternite 9 with a prominent apicomedian tip. SpP two times as long as the median lobe, double trumpet weakly sclerotized, vs one third as long as the median lobe. Aedeagus (Fig. 19), median lobe with two (four ?) small dorsal setae, parameres short, coalescent with the median lobe, with three apical and one preapical setae.

Head distinctly narrower than elytra, eyes moderately finely faceted, large, temples absent in both sexes, ampF concave, 1.5 x as broad as each of the alpF; no punctation except one setiferous puncture on alpF anteriorly. Antennae with a 2-segmented club, segment ten slightly broader than long. Pronotum much broader than long, strongly constricted behind, with long lbc and six large mbf of nearly the same size. Elytra trapezoid, broader than long with a long, narrow humeral impression. Mbct3 $\frac{3}{4}$ as long as the tergite.

Type Material: Holotype (♂): COSTA RICA: Heredia: La Selva, 80 m, FIT, 19.V.1993, J.S. & A. K. Ashe. Paratypes: Puntarenas: 1 ♂: Rincon de Osa, 50 m, 8°41.141 N, 83°31.117 W, FIT, 23.-26.VI.2001, S. & J. Peck; 1 ♂: Wilson Botanical Garden (Las Cruces Biol. Sta.), 1200 m, FIT, 27.V.1993, J.S. & A.K. Ashe; 1 ♂: Las Cruces Biological Station, 1330 m, FIT, 8°47.14 N, 82°57.58 W, 28.-30.V.2004, J.S. Ashe *et al.*; 1 ♂: Las Alturas Biological Station, 1660 m, 8°56.17 N, 82°50.01 W, FIT, 31.V.-3.VI.2004, J.S. Ashe *et al.*; 2 ♀♀: Osa Penn., Fundación Neotrop. 10 km W Rincon, 20 m, 8°42.30 N, 83°31.30 W, berlese forest litter, 21.VI.1997, R. Anderson. 1 ♀: Hamburgfarm bei Squirres, F. Reimoser. PANAMA: Barro Colorado Island, 40 m, 8°11.0 N, 79°51.0 W, FIT, 22.-25.VI.2000 [3 ♂♂, 1 ♀], 30.VI.-5.VII.2000 [1 ♀], S. Chatzimanolis; 1 ♂, 1 ♀: Panama: Old Gamboa Road, 9°04 N, 70°40 W, FIT, 12.V.1994, D. Windsor. 1 ♂: Darien: Cana Biological Station, 1200 m, Serrania de Pirre, 7°45.18 N, 77°41.6 W, FIT, Ashe & Brooks; 1 ♂: Cana Biological Station, 1330 m, FIT, 7.-9.VI.1996, idem. Colón: 3 ♀♀: 14 km N junction Escobal & Piña Roads, ca. 30 m, FIT, 2.-11.VI.1996, idem; 3 ♀♀: 15 km N ibidem, idem; 1 ♀: Parque Nacional Soberania, Pipeline Road km 2.0, FIT, 9°07 N, 79°45 W, idem. 1 ♂: Chiriqui: La Fortuna, 1200 m, Continental Divide Trail, 8°46.0 W, 82°12.0 W, berlese forest litter, 9.VI.1995, R. Anderson. GUATEMALA: 1 ♀: Guatemala City, 1 km SE Pueblito 1880 m, wet oak forest litter, 10.VI.1991, R. Anderson.- HT and PTT in NHMK, PTT also in NHMW and cP.

Discussion: This new species may be distinguished from most of its relatives by the broad atrium pockets on tergites 1-4 and the absence of mbc, from *E. hoppi* **sp. nov.** by the larger size, very finely punctate pronotum, longer mbct3 and the aedeagus.

Etymology: Named after the atrium pockets (Lat. *marsupifer* = carrying small bags).

***Edaphus hoppi* sp. nov.**

Fig. 31

Description: Light brown, shiny, punctation microscopically fine (insertions of setae) and sparse, pubescence moderately dense, recumbent. Antennae, palpi and legs yellowish brown. Tergites 1-4 with broad atrium pockets.

Length: 1.0-1.2 mm (forebody 0.65 mm).

PM of the HT: wH: 27.5; dE: 18; lE: 7.5; lT: 0; lG: 5; wP: 32; lP: 28; dLC: 23; wEl: 45; lEl: 42; lS: 33.

Male: Sternite 8, SpP, vs about as in *S. marsupifer*. Aedeagus (Fig. 31), median lobe with four distinct setae dorsally, parameres long with one strong apical seta and one short and thin basal seta.

Head and antennae as in *E. marsupifer*. Pronotum less broad with distinct lbc and six small mbf, the lateral foveae smaller than the paramedial ones; no mbc, punctation at 60 x invisible. Elytra with a short humeral impression, sparse punctures at 60x barely noticeable. Mbct3 about half as long as the tergite.

Type Material: Holotype (♂): BRAZIL: Parana: Municipality of Antonina, Reserva Natural do Cachoeira, 25°19.2 S, 48°42.02 W (Gl-1-A-4), sifted forest litter, VI, 2003, J. Bihn (MZUSP).

Discussion: This new species may be distinguished from *E. marsupifer* **sp. nov.** by shorter length, narrower pronotum, shorter mbct3 and the aedeagus.

Etymology: Named after Mr. Philipp Hopp, Aachen, with thanks for his cooperation.

Key to the species of the *ventralis* group of *Edaphus*

1. Tergite 3 with a narrow, oblique atrium-pocket (Figs. 1-3). Base of pronotum with 2 transverse foveae2
- Tergites 1-4 with transverse atrium-pockets. Base of pronotum different.....5
2. Elytra almost impunctate. ♂: Parameres of aedeagus with 1 apical seta..... 3
- Elytra very finely and densely punctate. ♂: unknown. 1.2-1.5 mm (forebody: 0.75 mm). Ecuador.....
.....*E. ashei* sp. nov.
3. Shorter, 1.0-1.3 mm (forebody: 0.6-0.7 mm).....4
- Longer: 1.3-1.5 mm (forebody: 0.8-0.85 mm). ♂: Parameres of aedeagus with 2 apical setae, aedeagus (Fig. 12)...
Ecuador.....*E. falini* sp. nov.
4. Eyes smaller (Figs. 6, 7). ♂: Antennal segment 11 nearly 4x as long as broad. Aedeagus (Fig. 5). ♀: Head with
short oblique temples (Fig. 7). Costa Rica, Panama, Nicaragua..... *E. ventralis* sp. nov.
- Eyes larger (Figs. 10, 11). ♂: Antennal segment 11 about 1.5x as long as broad. Aedeagus (Fig. 9). ♀: Head
without temples (Fig. 11). Peru, Ecuador..... *E. ventricula* sp. nov.
5. Pronotum distinctly punctate with two postero-lateral denticles. 1.9-2.2 mm (forebody: 1.3 mm). Ecuador.
.....*E. denticollis* sp. nov.
- Pronotum impunctate and without lateral denticles.....6
6. Base of pronotum with a medio-basal carina extending to base.....7
- Base of pronotum without a medio-basal carina extending to base.....9
7. ♂: Eyes very large with coarse ommatidia (Fig. 13), dE ≤ ½ wH. Aedeagus (Fig. 30). 1.1-1.4 mm. French
Guyana.....*E. boops* sp. nov.
- ♂: Eyes smaller with smaller ommatidia (Fig. 14), dE > ½ Wh8
8. Shorter: forebody 0.7-0.8 mm. ♂: Apical notch of sternite 8 less deep (Fig. 23). Aedeagus (Fig. 22), apical part of
parameres free. 1.3-1.6 mm. Suriname, Trinidad, Brazil, Peru, ?Ecuador, Paraguay..... *E. rishwani* Makhan.
- Longer: forebody 0.85-0.95. ♂: Apical notch of sternite 8 deeper (Fig. 24). Aedeagus (Figs. 20, 21), apical part of
parameres fused with the median lobe 1.3-1.8 mm. Brazil, French Guyana, Suriname, Guyana.....
.....*E. humeralis* Puthz.
9. Atrium pockets of tergites 1-4 slightly broader than long (Fig. 25).....10
- Atrium pockets of tergites 1-4 much broader than long (Figs. 15-18).....11
10. Longer: 0.9-1.1 mm, pronotum narrower, medio-basal carina of tergite 3 absent. ♂: Sternite 8 (Fig. 27). Aedeagus
(Fig. 26). Costa Rica..... *E. schatzorum* sp. nov.
- Shorter: 0.8 mm, pronotum broader, medio-basal carina of tergite 3 present. ♂: sternite 8 (Fig. 28). Aedeagus
(Fig. 29). Panama: Canal Zone..... *E. liliputanus* sp. nov.
11. Latero-basal carinae of pronotum distinct and longer than basal foveae.....12
- Latero-basal carinae of pronotum indistinct or at most as long as basal foveae (species from Cuba).....13
12. Longer: forebody 0.7-0.8 mm. mbf larger, longer than broad. ♂: Aedeagus (Fig. 19). 1.1-1.5 mm. Costa Rica,
Panama, Guatemala..... *E. marsupifer* sp. nov.
- Shorter: forebody 0.65 mm. mbf smaller, almost as long as broad. ♂: Aedeagus (Fig. 31). 1.0-1.2 mm. Brazil.....
.....*E. hoppi* sp. nov.
13. Longer, forebody 1.0 mm, eyes larger, genae almost missing. ♂: Unknown 1.6-2.0 mm. Cuba.....
.....*E. ferdinandae* Puthz.
- Shorter, forebody less than 0.1 mm in length, eyes smaller, genae distinct..... 14
14. Pronotum and elytra with both: fine + distinct and very fine + shallow punctuation..... 15
- Punctuation of pronotum and elytra simple. ♂: Sternite 8 (Fig. 10, Puthz, 1997). 1.9-1.3 mm. Cuba.....
.....*E. juanae* Puthz.
15. Eyes larger, genae less long. ♂: Sternite 8 (Fig. 6, Puthz, 1997), aedeagus (Fig. 5, l.c.) 1.1-1.5 mm. Cuba.....
.....*E. cubanus* Puthz.
- Eyes less large, genae longer. ♂: Sternite 8 (Fig. 1, Puthz, 1997), aedeagus (fig. 8, l.c.) 1.4-1.9 mm. Cuba.....
.....*E. infidus* Puthz.

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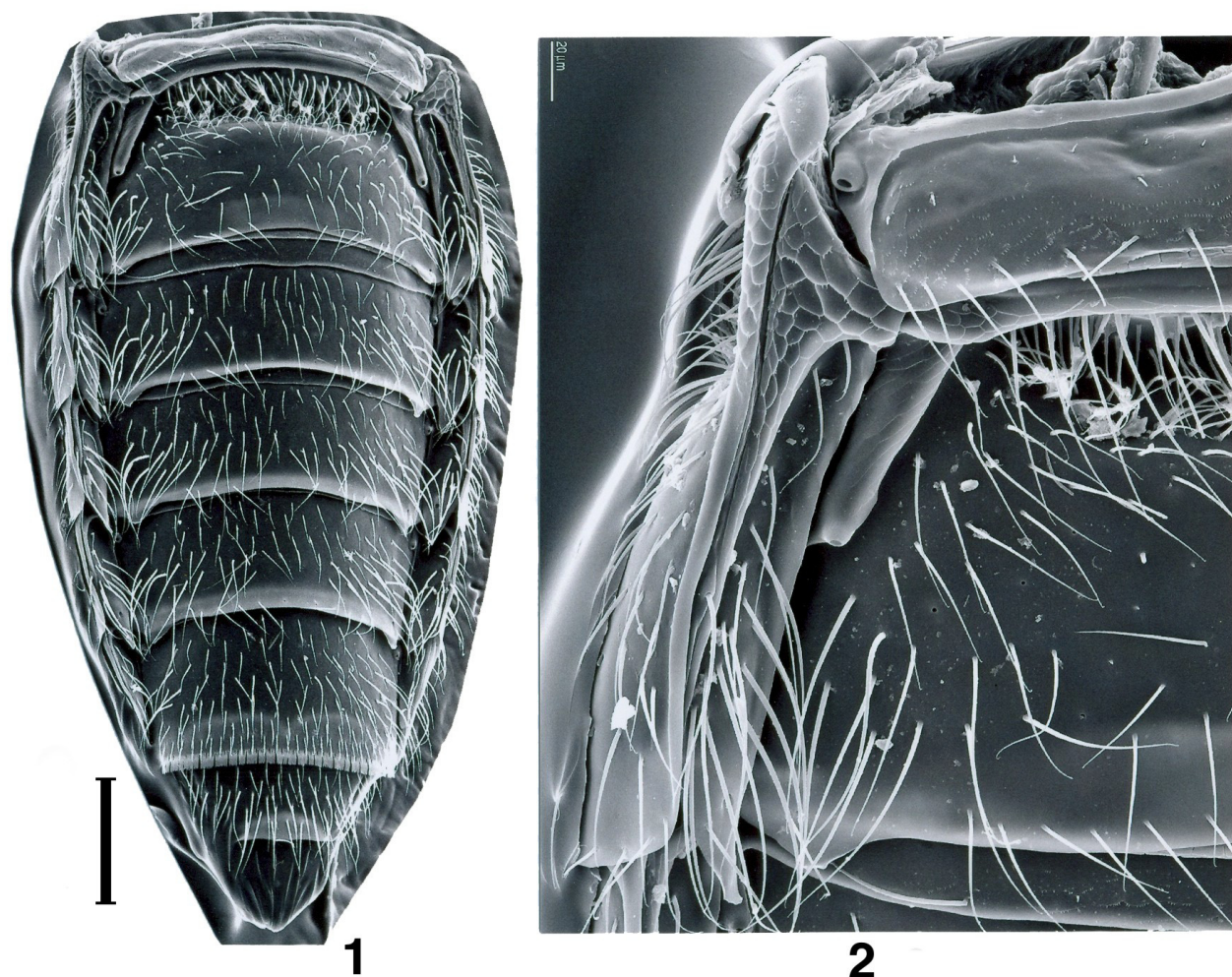
I thank the late Dr. James S. Ashe (SEMC), the curators of various institutions, mainly those of the FMNH and Drs. Heinz and Irene Schatz (University of Innsbruck) for the loan and gift of material, respectively. My thanks are also due to Prof. O. Betz and Mr. Oliver Koerner for providing REM-photographs and to José Luis Navarrete-Heredia, Universidad de Guadalajara and the reviewers for helpful comments.

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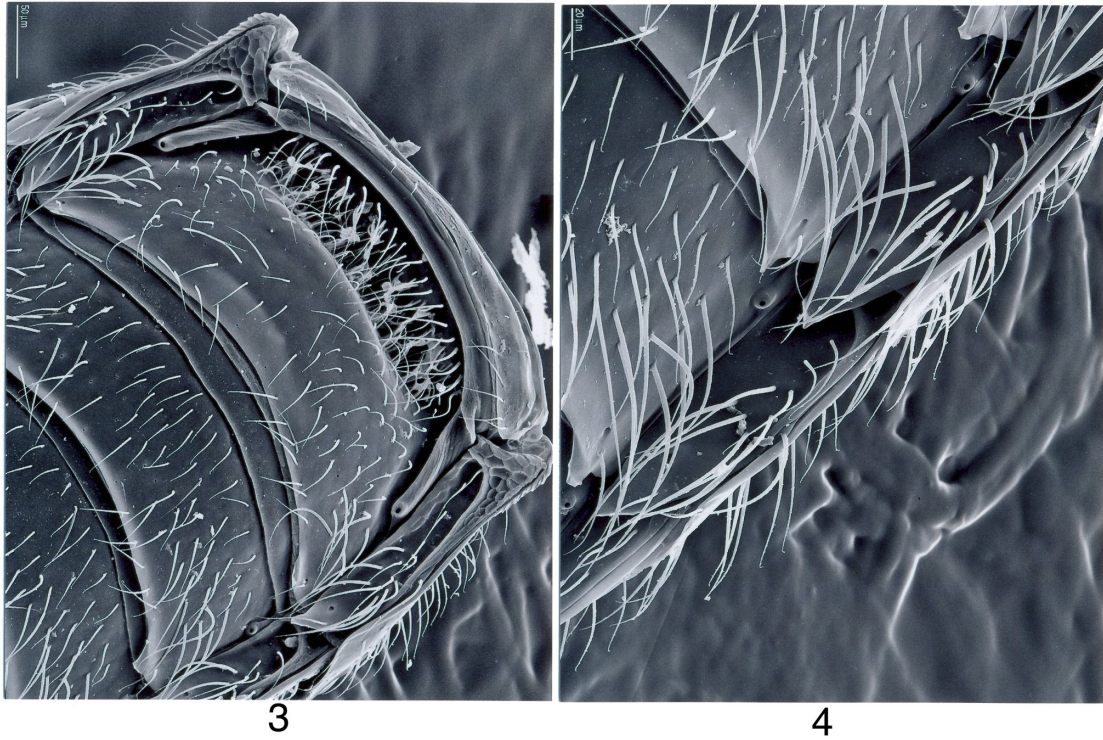
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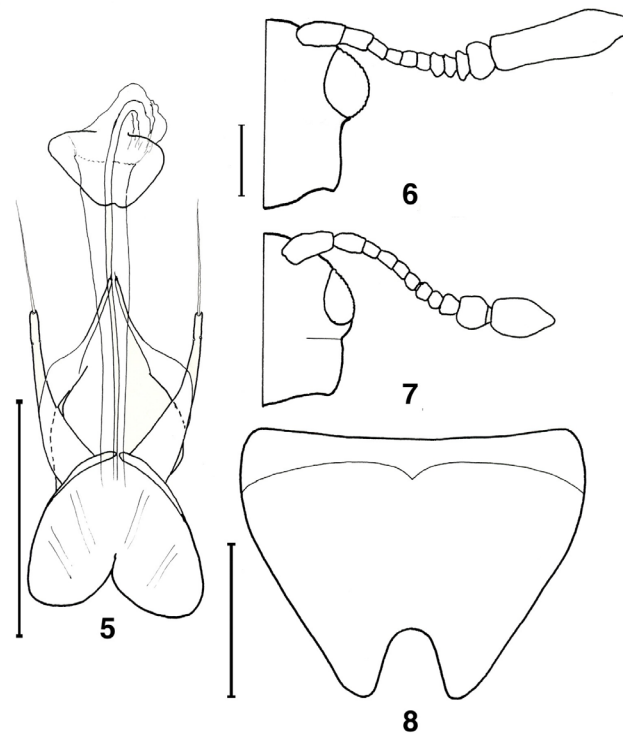
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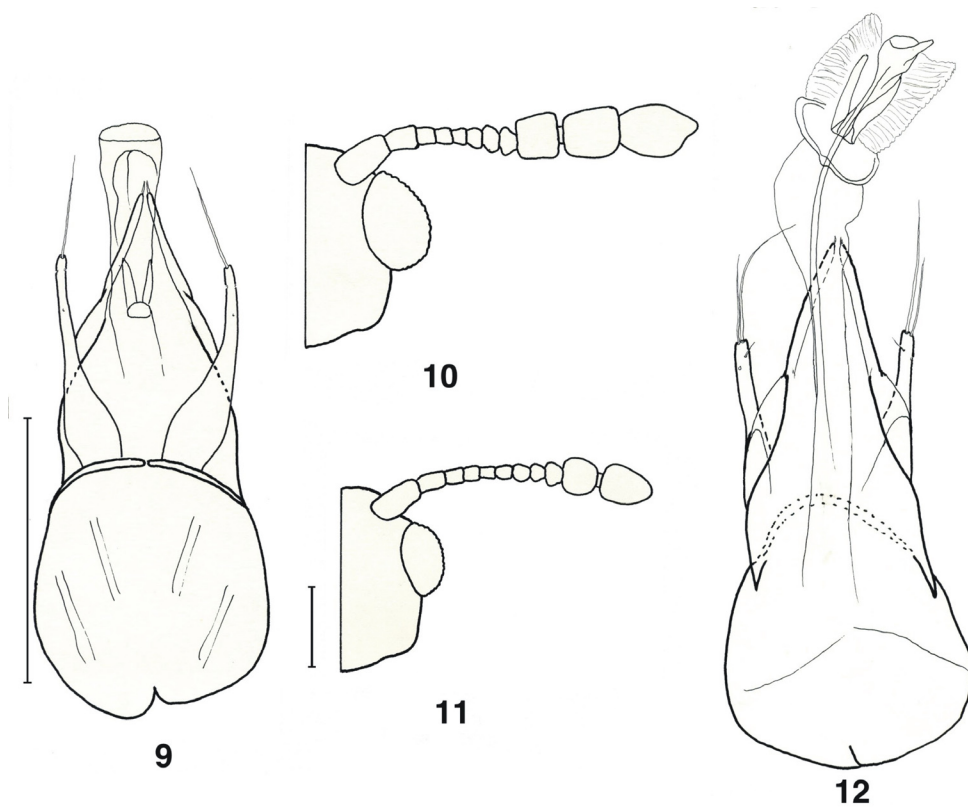
Figures 1, 2: *Edaphus ventralis* sp. nov. (♀-PT): Complete abdomen (1, scale bar = 0.1 mm), left side of tergite 2 and 3 (2).



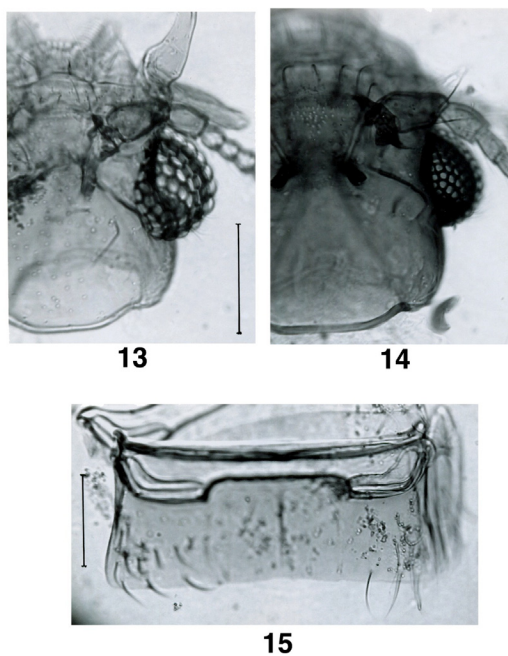
Figures 3, 4: *Edaphus ventralis* sp. nov. (PT): Base of abdomen (3), right side of tergite 4 and 5 (4).



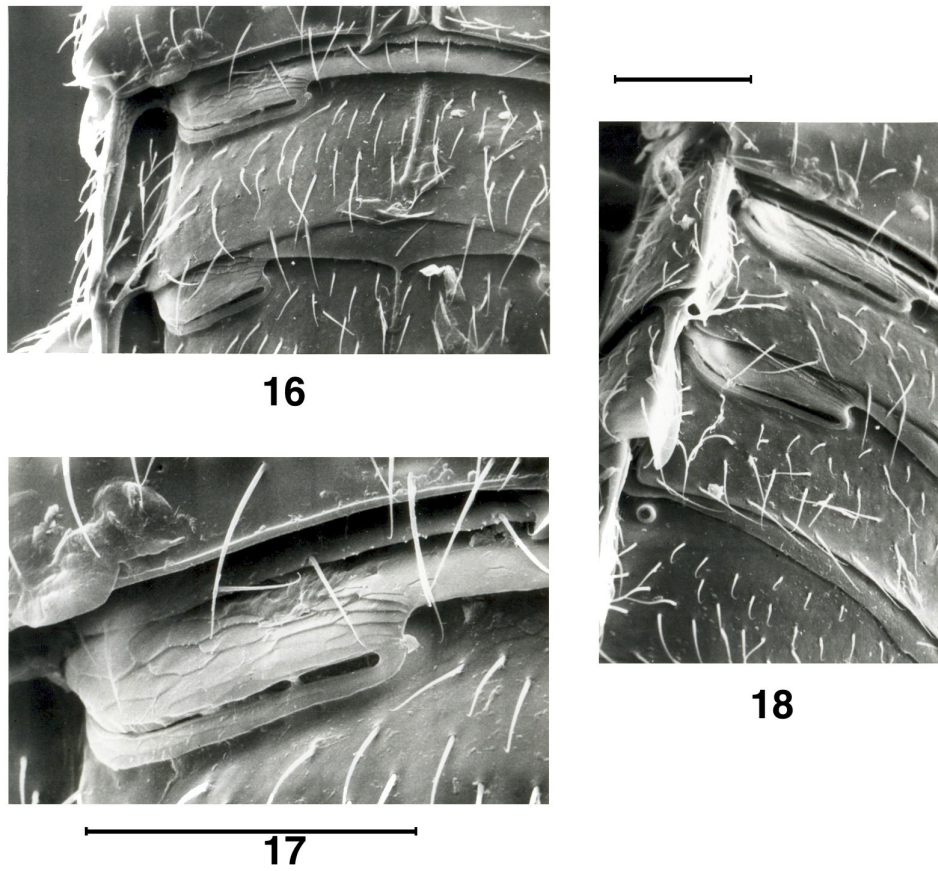
Figures 5-8: *Edaphus ventralis* sp. nov. (PTT): Dorsal aspect of aedeagus (5), head of male (6), head of female (7), sternite 8 of male (8).- Scale bar = 0.1 mm.



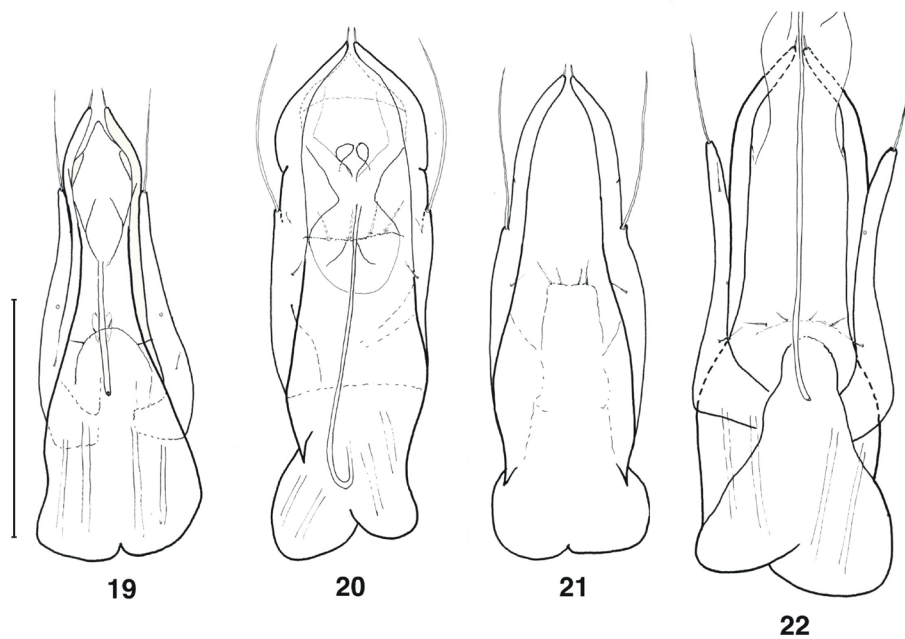
Figures 9-12: Dorsal (9) and ventral aspect (12) of aedeagus, head and antennae of the male (10) and the female (11): *Edaphus ventricula* sp. nov. (PTT; 9-11), *E. falini* sp. nov. (HT, 12).- Scale bar = 0.1 mm.



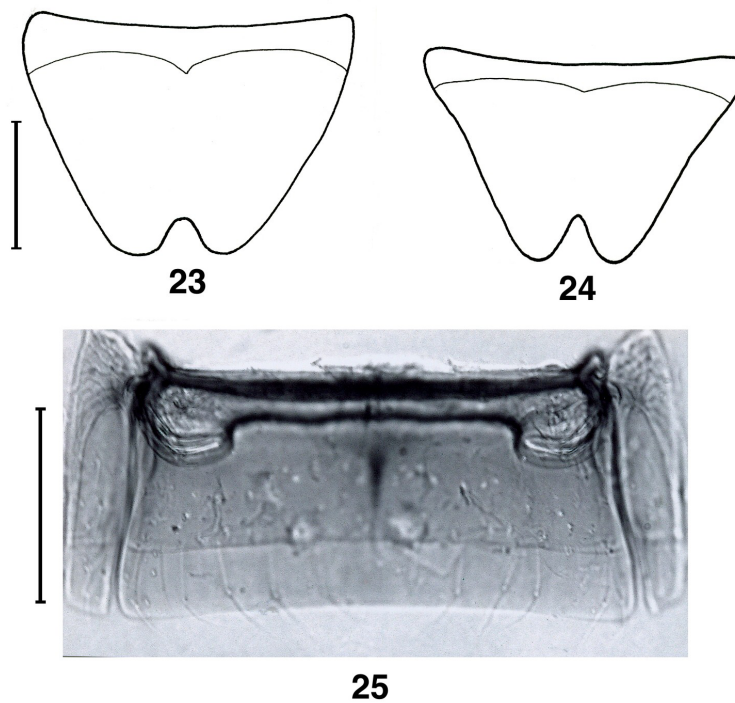
Figures 13-15: Head (eyes) (13, 14) and tergite 3 (15): *Edaphus boops* sp. nov. (PTT, 13, 15), *E. humeralis* Puthz (Guyana, 14).- Scale bar = 0.1 mm.



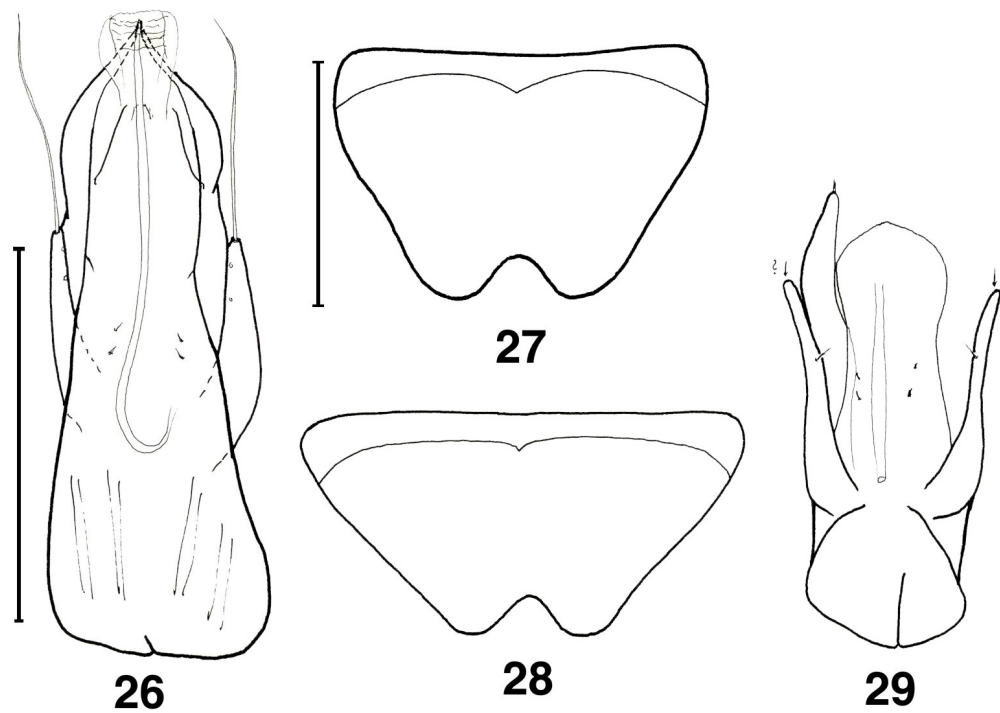
Figures 16-18: Atrium-pockets of *Edaphus rishwani* Makhan (Paraguay).- Scale bar = 0.1 mm.



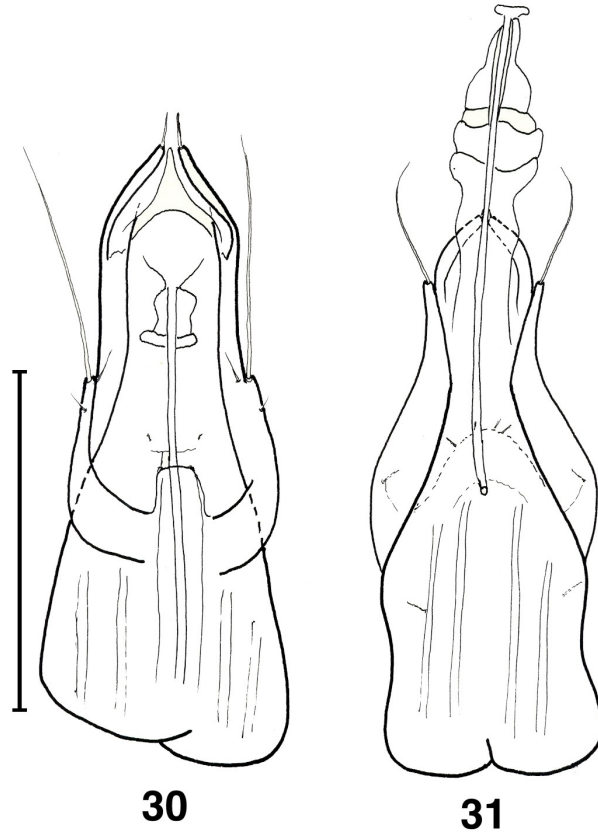
Figures 19-22: Ventral (19-21) and dorsal aspect (22) of aedeagus: *Edaphus marsupifer* sp. nov. (HT, 19), *E. humeralis* Puthz (French Guyana: Cayenne, 20, 21, two specimens from the same locality), *E. rishwani* Makhan (Paraguay, Itapua, 22).- Scale bar = 0.1 mm.



Figures 23-25: Sternite 8 of male (23, 24) and tergite 3: *Edaphus rishwani* Makhan (Paraguay, Itapua, 23), *E. humeralis* Puthz (French Guyana, Cayenne, 24), *E. schatzorum* sp. nov. (PT, 25).- Scale bar = 0.1 mm.



Figures 26-29: Ventral (26) and dorsal aspect (29) of aedeagus, sternite 8 of male (27, 28): *Edaphus schatzorum* sp. nov. (HT, 26; PT, 27), *E. liliputanus* sp. nov. (HT, 28, 29).- Scale bar = 0.1 mm.



Figures 30-31: Dorsal (30) and ventral aspect (31) of aedeagus: *Edaphus boops* sp. nov. (PT, 30), *E. hoppi* sp. nov. (HT, 31).- Scale bar = 0.1 mm.