

Koleopterologische Rundschau	80	43–62	Wien, September 2010
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# New Neotropical species of *Holotrochus* ERICHSON, 1839 with special reference to the *H. simplex*-group (Coleoptera: Staphylinidae: Osoriinae)

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## Abstract

Eleven new species of the genus *Holotrochus* ERICHSON (Coleoptera: Staphylinidae: Osoriinae) from the Neotropical Region are described: *H. campanae*, *H. canalus*, *H. ecuadoriensis*, *H. jatunsachae*, *H. micans*, *H. paloettii*, *H. puntarenae*, *H. rivularis*, *H. setifera*, *H. trilobatus*, and *H. tuxtlae*. Three species have been found in Ecuador, two species in Panama, and one species each in Bolivia, Brazil, Venezuela, Costa Rica, and Mexico. Seven species are attributed to the *H. simplex*-group. This paper provides a key to all species described in this species group and an analysis of their geographical distribution.

**Key words:** Coleoptera, Staphylinidae, Osoriinae, new species, Neotropics, zoogeography.

## Introduction

According to HERMAN (2001), the genus *Holotrochus* contains 153 species and is distributed in nearly all tropical regions of the world. The genus is attributed to the tribe Osoriini that is characterised by emarginate protibiae with comb (NEWTON 1990). In the Neotropical Region, 80 species have been recorded distributed over Central and South America, from one species in Chile to nine species in Mexico. Most species have been found in countries of the central Neotropics: 28 species in Brazil, 12 species in Ecuador, and 20 species in Panama.

Recently, several private collections and the collections of several museums have been studied. This resulted in the determination of 11 new species, primarily from the *Holotrochus simplex*-group that is indicated by a medium-sized body and a laterally setiferous abdomen (IRMLER 1981). In this paper, the 11 new species are described and a key to the species of the *H. simplex*-group is provided. Finally, remarks on the geographical distribution of the species of the *H. simplex*-group are given.

## Material, acknowledgements and methods

The material studied is deposited in the following museums and private collections:

AC	Private collection of Volker Assing, Hannover, Germany
AMNH	American Museum of Natural History, New York, USA (L. Herman)
KU	Kansas University Natural History Museum, Snow Entomological Collections, Lawrence, Kansas, USA, (J.S. Ashe †)
MNHP	Museum of Natural History, Praha, Czech Republic (M. Fikáček)
QCAZ	Museo de la Pontificia Universidad Católica del Ecuador, Quito, Ecuador
UIC	Private collection of Ulrich Irmeler, Plön, Germany
ZCUC	Zoological collections University of Curitiba, Curitiba, Brazil
ZMUK	Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark (A. Solodovnikov)

Material from private collections can be loaned and will be later transferred to a public museum. I thank L. Herman, M. Fikáček, V. Assing, A. Solodovnikov, and P. Hopp for sending their material and for donating several specimens to my collection.

For the photographs, a Makroskop M 420 (Wild, Herbrugg) was used in combination with a digital camera (Nikon D100). Maps were generated by ArcView Gis 3.2 (ESRI 1999). Length was measured in the middle of tagmata, width at the widest part of tagmata. In the measurement of total length, the abdominal inter-segmental space is subtracted.

### New species of the *Holotrochus simplex*-group

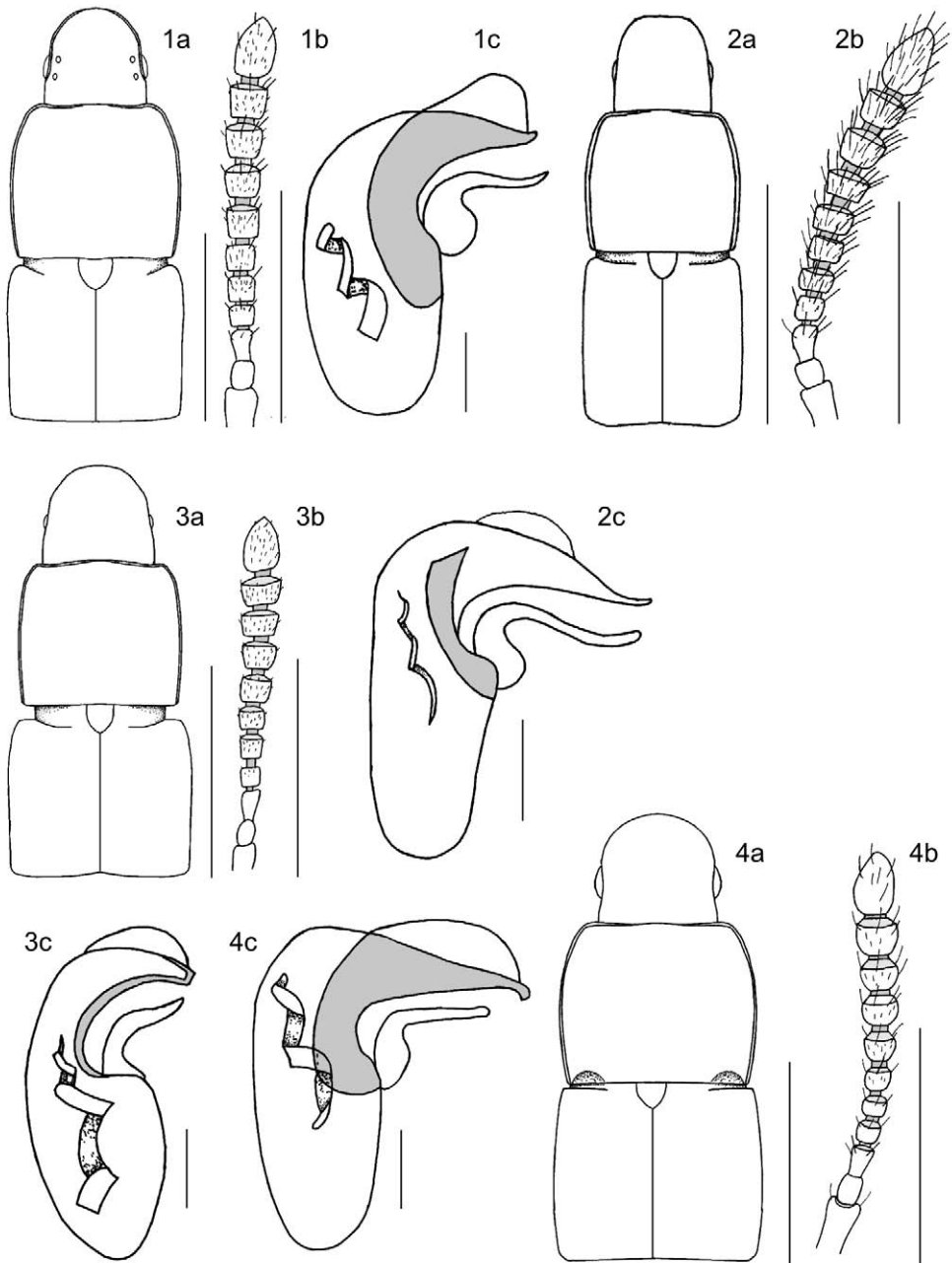
#### *Holotrochus puntarenae* sp.n.

**Holotype** ♂: Costa Rica: Puntarenas Prov., Las Cruces Biol. Stat. (08°47.14'N, 82°57.58'W), 1330 m elevation, 30.5.2004, leg. J.S. Ashe, Z. Falin, I. Hinojosa, collected under bark, #CR1AFH04 045 (KU). **Paratypes**: 1 ♀ with data as holotype, 1 ♀ with data as holotype, but sampled at 29.5.2004 under bark, #CR1AFH04 024 (KU) and 1 ♀ sampled at 28.5.2004 under old bark, #CR1AFH04 020 (UIC).

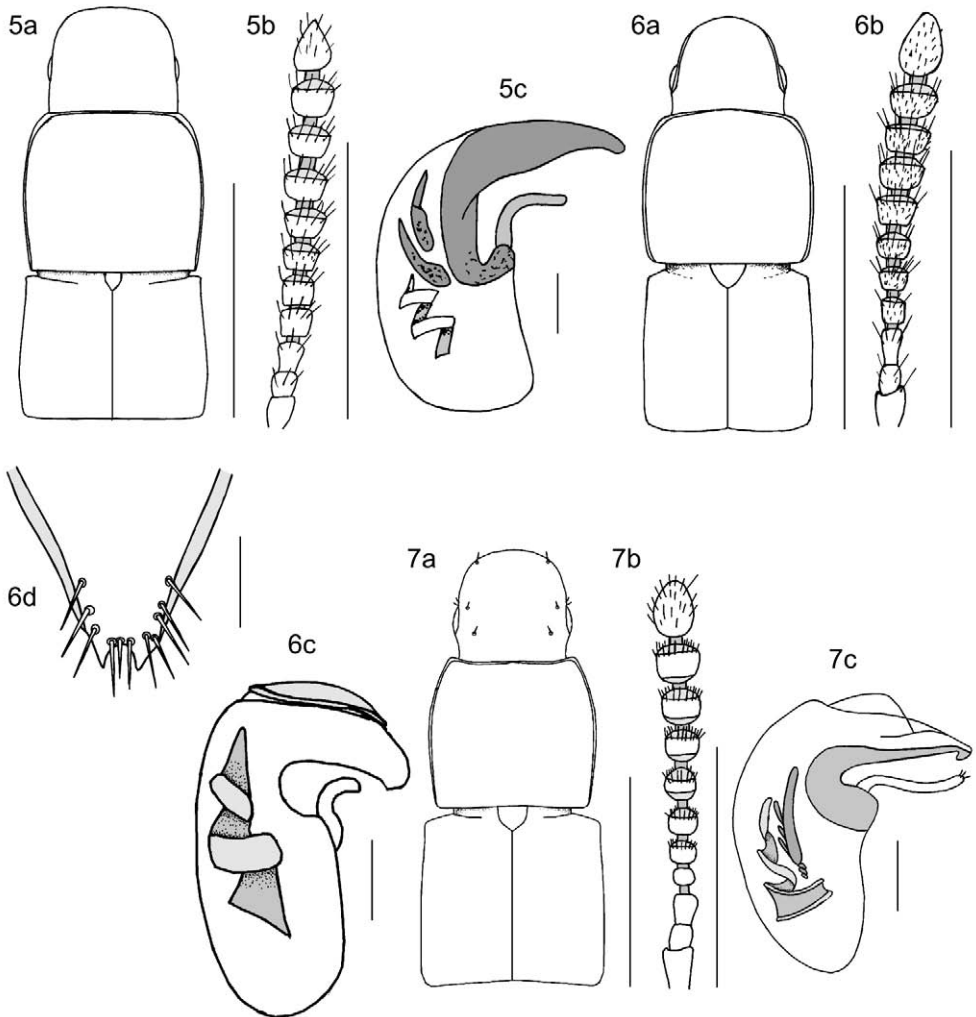
**DESCRIPTION** (Figs. 2a–c, 12A, 16): Length: 4.3 mm. Colour: black; antennae and legs dark reddish. Head: 0.45 mm long, 0.70 mm wide; eyes not prominent; a short supraocular margin ending anteriorly at base of antennae; thus, front edge of clypeus not margined; with row of short, black setae inserting in supraocular margin; punctation irregularly dense and differing in size; larger punctures fine and sparse; distance between punctures on average twice to three times as wide as diameter of punctures; between larger punctures a denser micro-punctation; a pair of large setiferous punctures close to neck; surface on disc without microsculpture, polished; only anterior half of clypeus with transversely undulate microsculpture. Antennae as long as head and half of pronotum combined; with more or less globular 2<sup>nd</sup> antennomere, only slightly longer than half of 3<sup>rd</sup> antennomere; following antennomeres increasing in width; 4<sup>th</sup> antennomere approximately quadrate; penultimate antennomeres two times as wide as long; antennomeres 3–11 with long yellow setae. Pronotum: 0.80 mm long, 1.00 mm wide; widest in middle; with fine lateral margin continuing to front edge and ending near central part; thus, central third of front edge not margined; punctation similar to punctation of head with larger punctures slightly deeper and denser than on head; distance between punctures on average two times as wide as diameter of punctures; between larger punctures a denser micro-punctation; a very weak microsculpture in some parts present, but surface, nevertheless, nearly polished and shiny; without depressions at posterior angles. Elytra: 1.00 mm long, 1.05 mm wide; with deep coriaceous ground sculpture; a large punctation scarcely visible in deep ground sculpture; surface less shiny than on pronotum and head. Abdomen with transversely reticulate microsculpture; with fine and sparse punctation; a few larger setiferous punctures laterally; last abdominal tergite bifurcate. Aedeagus with long central lobe and slender paramera nearly reaching apex of central lobe. Spiral endophallus slender.

**DIAGNOSIS**: Regarding the spiral endophallus of the aedeagus, size, margined front edge of pronotum, and abdominal setation, the species must be attributed to the *H. simplex*-group of *Holotrochus*. Antennae are similarly short as in *H. blackwelderi* IRMLER, 1981, but 4<sup>th</sup> antennomere is approximately quadrate, whereas it is distinctly wider than long in *H. blackwelderi*. Central lobe of aedeagus is also similar to that of *H. blackwelderi*, but the spiral endophallus in *H. blackwelderi* is broader, whereas it is slender in *H. puntarenae*. Moreover, *H. blackwelderi* is smaller and micro-punctation of pronotum is scarcely developed.

**ETYMOLOGY**: The specific name is derived from the name of the province in Costa Rica where the species was found.



Figs. 1–4: a: fore-body, b: antenna, c: aedeagus in lateral aspect; 1) *Holotrochus micans*; 2) *H. puntarenae*; 3) *H. paolettii*, 4) *H. rivularis*. Scale bars: a: 1 mm, b: 0.5 mm, c: 0.1 mm.



Figs. 5–7: a: fore-body, b: antenna, c: aedeagus in lateral aspect, d: 6<sup>th</sup> visible tergite; 5) *Holotrochus tuxtlae*, 6) *H. campanae*, 7) *H. ecuadoriensis*. Scale bars: a: 1 mm, b: 0.5 mm c, d: 0.1 mm.

### *Holotrochus micans* sp.n.

**Holotype** ♂: Brazil: Paraná, Guaraqueçaba (48°19'W, 25°17'S), Reserva Serra do Itaqui, moist lowland forest, sift litter, collected by Winkler method, 9.8.2007, leg. P. Hopp (ZCUC). **Paratypes**: 1 ♀ with same data as holotype; 2 ♀♀ with date as holotype, but collected at 9.9.2007 (ZCUC, UIC) and 1 ♂ and 1 ♀ Antonina (48°42'W, 25°25'S), Res. Nat. do Rio Cachoeira, Sec. moist lowland forest, sift litter, collected by Winkler method, 15.08.2007, leg. J. Bihn (ZCUC, UIC).

**DESCRIPTION** (Figs. 1a–c, 12C, I, 16): Length: 3.7 mm. Colour: black; antennae and legs dark reddish. Head: 0.27 mm long, 0.60 mm wide; eyes not prominent; with supraocular margin ending anteriorly at base of antennae; thus, front edge of clypeus not margined; punctuation fine and sparse; distance between punctures at least two to three times as wide as diameter of punctures; a pair of setiferous punctures close to neck and a group of 3–4 setiferous punctures

between disc and eyes; disc without microsculpture, surface polished; only short part at front edge of clypeus with weak transversely reticulate microsculpture. Antennae as long as head and two-thirds of pronotum combined; 2<sup>nd</sup> antennomere short and oval; 3<sup>rd</sup> antennomere conical and only slightly longer than 2<sup>nd</sup>; following antennomeres slightly increasing in width; 4<sup>th</sup> antennomere quadrate; penultimate antennomeres only slightly wider than long. Pronotum: 0.67 mm long, 0.90 mm wide; widest slightly in front of middle; with fine lateral margin continuing to front edge and ending close to middle; thus, central third of front edge without margin; punctation slightly deeper and larger than on head, but as sparse as on head; distance between punctures at least two to three times as wide as diameter of punctures; an extremely weak isodiametric microsculpture visible, but surface, nevertheless polished. Elytra: 0.73 mm long, 0.90 mm wide; with coriaceous ground sculpture and deep punctures; punctation distinctly deeper than on pronotum and, in spite of coriaceous ground sculpture, distinctly visible. Abdomen distinctly and densely punctate; with setiferous punctures laterally; tergites with net-like microsculpture except a small space along posterior edge and a central space; 5<sup>th</sup> visible segment with denser and larger punctures than preceding segments; last tergite bifurcate. Aedeagus with moderately long central lobe; paramera nearly reaching apex of central lobe; endophallus spiral decreasing in width from base to apex.

**DIAGNOSIS:** *Holotrochus micans* can certainly be attributed to the *H. simplex*-group based on the spiral endophallus of the aedeagus, the laterally setiferous abdomen and the margined front edge of the pronotum. It resembles *H. hanagarthi* IRMLER, 1981 and *H. uncinatus* IRMLER, 2005 in size. However, these two species are slightly smaller, with 3.5 mm length on average. Compared to *H. uncinatus*, *H. micans* differs by the absence of depressions at the posterior angles. *Holotrochus micans* is slightly larger, colour is darker and pronotum more sparsely punctate than in *H. hanagarthi*. Moreover, both species can only be correctly distinguished by comparing the aedeagus. In *H. micans* the paramera are as long as the apex of the central lobe, whereas they are distinctly shorter in *H. hanagarthi*. The endophallus provides no significant characters to differentiate the two species.

**ETYMOLOGY:** The specific name *micans* (Latin) means “shiny” and refers to the polished surface of head and pronotum.

### *Holotrochus rivularis* sp.n.

**Holotype** ♂: Ecuador: Napo (21), 4.4 km NWW of El Chaco (0°18.48'S, 77°50.21'W), 1690 m elevation, 28.–30.11.2006, leg. M. Fikáček & J. Skuhrovec, collected in primary cloud forest near stony stream, sifting of very wet litter in the rain, near tree trunks along the trail (QCAZ). **Paratypes:** 3 ♀ with data as holotype; Napo (20), 5.3 km NW El Chaco (0°18.31'S, 77°50.42'W), 1680 m elevation, 1 ♂, 3 ♀, 28.11.2006, leg. M. Fikáček & J. Skuhrovec, collected in sparse and low cloud forest on very steep slope of gorge with stream, with small amount of leaf litter above tree trunks and dense understory veget. (sifting); Napo (16), 6.9 km E of Puerto Napo (1°01.48'S, 77°43.58'W), 500 m elevation, 1 ♀, 24.11.2006, leg. M. Fikáček & J. Skuhrovec, collected in primary forest with sparse understory vegetation, shady, sifting of leaf litter and rotten branches at various sites along the trail (QCAZ, MNHP, UIC).

**DESCRIPTION** (Figs. 4a–c, 12D, H, 16): Length: 3.5 mm. Colour: black; antennae and legs dark reddish. Head: 0.30 mm long, 0.60 mm wide; eyes not prominent; with supraocular margin ending anteriorly at base of antennae; thus, front edge of clypeus not margined; punctation moderately deep and dense; distance between punctures 1.5–2.0 times as wide as diameter of punctures; on disc, a pair of larger setiferous punctures close to neck; in supraocular margin a few finer setiferous punctures; fine and sparse micro-punctation between normal punctures present; disc without microsculpture; surface polished; clypeus with weak transversely reticulate microsculpture. Antennae as long as head and two third of pronotum combined; with 2<sup>nd</sup> antennomere oval and longer than wide; 3<sup>rd</sup> conical antennomere only slightly longer than 2<sup>nd</sup>;

following antennomeres slightly increasing in width, with 4<sup>th</sup> antennomere quadrate and penultimate antennomeres only slightly wider than long. Pronotum: 0.73 mm long, 0.90 mm wide; widest shortly behind front angles; slightly narrowed to posterior angles; front angles smoothly rounded; fine lateral margin continuing to front edge and ending close to central part; thus, central third not margined; punctuation deeper than on head, but as dense as on head; distance between punctures 1.5–2.0 times as wide as diameter of punctures; punctures slightly differing in size; a very sparse micro-punctuation between larger punctures present; an extremely weak isodiametric microsculpture visible, but surface nevertheless polished. Elytra: 0.75 mm long, 0.95 mm wide; shoulders shortly prominent by a small tooth; with deep coriaceous ground sculpture; deep and irregular punctuation in ground sculpture scarcely visible; surface less shiny than on pronotum. Abdomen weakly and sparsely punctate and with distinct net-like microsculpture; with setiferous punctures laterally. Aedeagus with long central lobe ending in a hook-like apex; paramera distinctly shorter than central lobe; only reaching two-third of central lobe; spiral endophallus broad with two torsions.

DIAGNOSIS: The species certainly can be attributed to the *H. simplex*-group regarding the spiral endophallus of the aedeagus, laterally setiferous abdominal tergites and the margined front edge of pronotum. It is similar in size to *H. micans*, *H. hanagarthi* and *H. uncinatus*. Comparing these four species, *H. rivularis* differs in the shape of the pronotum, with its widest part being shortly behind the anterior angles, whereas it is more to the middle in the other three species. The aedeagus is similar to that of *H. uncinatus* in the hook-like apex of the central lobe and relative length of the paramera. However, the apex of the central lobe is distinctly acute in lateral aspect of *H. uncinatus*, whereas it is broader in *H. rivularis*. The shape of the endophallus is similar in all four species.

ETYMOLOGY: The specific name *rivularis* is derived from the Latin word rivus for “creek” or “stream”, meaning living in or at running water. The name refers to the habitat where the species was found.

### *Holotrochus paoletti* sp.n.

**Holotype** ♂: Venezuela: Prov. Miranda (68°23'W, 10°08'N), Guatopo, Agua Blanca, bromeliads, humid tropical forest, Feb.1987, leg. M.G. Paoletti (AMNH). **Paratypes**: 4 ♂♂, 5 ♀♀, Venezuela: with same data as holotype (AMNH, UIC); 1 ♂, Carabobo, Mun. Bejuma (68°15'W, 10°10'N), Via Palmichal, 750–850 m elevation, November 2005, leg. Brachat (AC); 1 ♂, 2 ♀♀, Carabobo, Mun. Bejuma (68°15'W, 10°10'N), Via Palmichal, 22.11.2005 and 21.01.2007, leg. V. Brachat (AC, UIC).

DESCRIPTION (Figs. 3a–c, 12E, 16): Length: 3.5 mm; Colour: dark brown, posterior edge of pronotum dark reddish, posterior edge of abdominal tergites lighter reddish, antennae red, legs yellow. Head: 0.35 mm long, 0.55 mm wide; eyes small, not prominent; temples behind eyes at least as long as eyes; punctuation irregularly sparse and fine; on average, distance between punctures two times as wide as diameter of punctures; between normal fine punctures a sparse micro-punctuation with punctures approximately half as large as normal punctures; without microsculpture on disc; surface polished and shiny; transverse microsculpture present on clypeus. Antennae as long as head and half of pronotum combined, with short oblong 2<sup>nd</sup> antennomere; 3<sup>rd</sup> conical antennomere only slightly longer than 2<sup>nd</sup> antennomere; following antennomeres increasing in width; 4<sup>th</sup> antennomere more or less quadrate; 5<sup>th</sup> antennomere already slightly wider than long; penultimate antennomeres nearly two times as wide as long. Pronotum: 0.70 mm long, 0.80 mm wide; with sides nearly parallel; slightly narrowed to smoothly-curved anterior angles; lateral margin fine through most of its length; slightly thicker at anterior angles; punctuation fine and sparse; distance between punctures on average two to three times as wide as diameter of punctures; even sparser micro-punctuation present with micro-



punctures nearly half as large as normal punctures; without microsculpture, surface polished and shiny. Elytra: 0.70 mm long, 0.83 mm wide; with deeper and coarser punctation as on pronotum; surface between punctures with coriaceous ground sculpture; thus, surface slightly shiny. Abdomen with normal setiferous punctation as being characteristic for the species group; with net-like microsculpture between punctures; thus, surface slightly shiny; less shiny than on elytra; last abdominal tergite bifurcate.

**DIAGNOSIS:** The species certainly belongs to the *H. simplex*-group which is characterised by the laterally setiferous abdomen and the endophallus of the aedeagus. It resembles the species described above and without investigation of the aedeagus certain identification is impossible. It is, furthermore, characterised by the more or less parallel sides of the pronotum and a sparse and fine punctation.

**ETYMOLOGY:** The species is named after its collector, Mr. Paoletti.

### *Holotrochus tuxtlae* sp.n.

**Holotype** ♂: Mexico: Chiapas, 6 mi. S. of Tuxtla Gutierrez (93°7'W, 16°45'N), August 21, 1966, leg. J. & W. Ivie (AMNH). **Paratype:** 1 ♀ with same data as holotype.

**DESCRIPTION** (Figs. 5a–c, 12B, 16): Length: 3.5 mm. Colour: brown, posterior edge of elytra and of abdominal segments reddish; antennae and legs red. Head: 0.35 mm long, 0.57 mm wide; with eyes small, not prominent; a narrow supraocular carina with four setiferous punctures, continuing to front, but ending in front of anterior edge of clypeus; punctation irregularly dense and deep; on average, distance between punctures twice as wide as diameter of punctures; a very sparse micro-punctation present; surface without microsculpture; polished and shiny. Antennae stout; 2<sup>nd</sup> antennomere globular; 3<sup>rd</sup> conical antennomere slightly longer than 2<sup>nd</sup>; 4<sup>th</sup> antennomere as wide as 3<sup>rd</sup>, but quadrate; two following antennomeres not wider, but even slightly smaller than 4<sup>th</sup> antennomere; 6<sup>th</sup> antennomere nearly twice as wide as long; following antennomeres slightly wider and thicker. Pronotum: 0.65 mm long, 0.80 mm wide; widest shortly behind anterior angles; sides nearly parallel, only very slightly narrowed to the smoothly rounded posterior angles; sides with narrow margin continuing to the front edge and ending shortly in front of central part; anterior angles smoothly rounded and with thicker margin than at sides and anterior edge; punctation deeper than on head, but with similar irregular density; distance between punctures partly more than twice as wide as diameter of punctures, partly shorter than diameter of punctures; without impunctate midline; surface without microsculpture, polished and shiny. Elytra: 0.65 mm long, 0.82 mm wide; with coarse punctation and coriaceous ground sculpture; punctures partly in irregular rows; surface only slightly shiny, less shiny than on pronotum. Abdomen with irregular weak microsculpture at base of tergites; with fine setiferous punctures laterally; surface less shiny than on pronotum; male with deep oval depression on 6<sup>th</sup> visible sternite; last tergite bifurcate. Aedeagus with rectangular deflected apical part of central lobe; apical part nearly as long as basal part; paramera only half as long as apical part.

**DIAGNOSIS:** *Holotrochus tuxtlae* must be certainly attributed to the *H. simplex*-group in consideration of the laterally setiferous abdomen and the development of the aedeagus. It can be distinguished from the similar *H. newtoni* of the same region by the thicker margined anterior angles of the pronotum and the shorter paramera in comparison to the length of the apical part of the aedeagus. However, punctation and lack of microsculpture of the fore-body is similar in both species.

**ETYMOLOGY:** The specific name *tuxtlae* is derived from the city of Tuxtla in Mexico where the species was found by J. & W. Ivie.

***Holotrochus campanae* sp.n.**

**Holotype** ♂: Panama: Panama Prov., road to Cerro Campana (8°41'01"N, 79°55'13"W), 730 m elevation, male, 01.01.2002, leg. L. Herman, collected in leaf litter and leafmold above stream (AMNH). **Paratypes**: 4 ♂♂ and 5 ♀♀ with same data as holotype (AMNH, UIC).

**DESCRIPTION** (Figs. 6a–d, 12F, 16): Length: 3.3 mm. Colour: brown, posterior edge of elytra and of abdominal tergites dark reddish. Head: 0.35 mm long, 0.55 mm wide; eyes small, not prominent; temples behind eyes as long as eyes; narrow supraocular carina not covering eyes in dorsal aspect, ending at base of antennae; at front edge of clypeus with a transverse row of 7 to 9 setae; punctation moderately dense and deep; distance between punctures on clypeus as wide as diameter of punctures; punctation sparser on disc; distance between punctures two to three times as wide as diameter of punctures; two large setiferous punctures on each side of middle near neck; surface without microsculpture, polished. Antennae as long as head and half of pronotum combined; 2<sup>nd</sup> antennomere oblong, slightly longer than wide; 3<sup>rd</sup> antennomere conical, at least 1/3 longer than 2<sup>nd</sup> antennomere; 4<sup>th</sup> and 5<sup>th</sup> antennomeres more or less quadrate; the following antennomeres wider than long and increasing in width; penultimate antennomeres nearly twice as wide as long. Pronotum: 0.60 mm long, 0.77 mm wide; widest shortly behind anterior angles; anterior angles widely rounded; sides slightly and straightly narrowed to posterior obtusely rounded angles; sides margined; margin at anterior angles thicker than behind or at front edge; margin continuing to front edge, but ending shortly in front of middle; punctures slightly denser than on head, but punctures distinctly deeper and punctation irregular; distance between punctures on average slightly shorter than diameter of punctures; a very sparse micro-punctation between normal punctures; surface without microsculpture, polished. Elytra: 0.70 mm long, 0.80 mm wide; with coriaceous ground sculpture; dense punctation scarcely visible in deep ground sculpture; surface without microsculpture, but due to deep ground sculpture moderately dull and less shiny than head and pronotum. Abdomen with fine and sparse punctation; at sides with setiferous punctures; surface with distinct net-like microsculpture; moderately dull; last abdominal tergite bifurcate; last abdominal sternite with distinct globular depression. Aedeagus with thick central lobe and very short paramera; endophallus with spiral torsion as in other species of the *H. simplex*-group.

**DIAGNOSIS**: The species must be attributed to the *H. simplex*-group due to the laterally setiferous abdomen and the development of the aedeagus. It strongly resembles *H. micans* in size and shape of pronotum and elytra. In contrast to *H. micans*, the penultimate antennomeres are distinctly wider than long in *H. campanae*. Moreover, in *H. campanae* long setae are found at the front edge of the clypeus, but not in *H. micans*.

**ETYMOLOGY**: The specific name is derived from the region of Cerro Campana in Panama where the species was found by Lee Herman.

***Holotrochus ecuadoriensis* sp.n.**

**Holotype** ♂: Ecuador: Cotopaxi Prov., N. of San Francisco de las Pampas, vic. Rio Esmeraldas, 1450–1650 m elevation, collected in litter and debris, male, 14.5.–15.5. 1993, leg. L. Herman (AMNH). **Paratypes**: 2 ♂♂ with same data as holotype; 1 ♀, Pichincha Prov, W of Alluriquin, 3.3.–5.3 km SW road to Cooperativa Bolivar, near Tinalandia, in litter near stream, 1000–1100 m elevation, 20.5.1993, leg. L. Herman (AMNH, UIC).

**DESCRIPTION** (Figs. 7a–c, 12G, 16): Length: 3.8 mm. Colour: brown; pronotum slightly lighter brown; abdominal tergites reddish at posterior edge; legs and antennae dark yellow. Head: 0.40 mm long, 0.65 mm wide; with eyes short, as long as temples; with short supraocular margin starting behind base of antennae and ending at posterior edge of eyes; front edge of clypeus not margined and with four short central setae; punctation very sparse and fine; distance



between punctures at least four to five times as wide as diameter of punctures; without microsculpture; surface polished. Antennae short; as long as head plus half of pronotum; 1<sup>st</sup> antennomere thick; 2<sup>nd</sup> oval and 2/3 as long as 1<sup>st</sup>; 3<sup>rd</sup> antennomere as long as 2<sup>nd</sup>, but conical; antennomeres 4–6 slightly increasing in width; more or less quadrate; antennomeres 7–10 distinctly thicker than preceding antennomeres, 1.5 times as wide as long; last antennomere slightly longer than 10<sup>th</sup>. Pronotum: 0.70 mm long, 0.95 mm wide; laterally and apically margined; widest slightly in front of middle; more distinctly narrowed to front angles than to posterior angles; thus, sides behind middle nearly parallel; front angles obtuse and prominent; posterior angles widely rounded; punctuation sparse and fine; distance between punctures at least 3–4 times as wide as diameter of punctures; without microsculpture; surface polished. Elytra: 0.80 mm long, 0.95 mm wide; more deeply and densely punctate than pronotum; distance between punctures less than half as wide as diameter of punctures; with coriaceous ground sculpture; surface distinctly matter than pronotum, but slightly shiny. Abdomen with very sparse and fine punctuation and dense net-like microsculpture; surface matter than elytra; last abdominal sternite of male with indistinct oval depression. Aedeagus with antennomeres as long as central lobe; with hook-like apical structure and spiral endophallus.

DIAGNOSIS: The species is very similar to *H. nationes* IRMLER, 1987, but elytra are slightly shorter and punctuation of head and pronotum sparser and finer, similar to that of *H. paolettii*. However, the differences in punctuation and relationship between length and width of elytra are very small between the species of this group so that certain identification can only be performed by an analysis of the aedeagus. The aedeagus of *H. ecuadoriensis* is characterised by the straight shape of the central lobe which is similar to *H. rivularis*. The aedeagus of *H. rivularis* also differs from the aedeagus of *H. ecuadoriensis* by the shorter paramera.

ETYMOLOGY: The specific name is derived from the country of Ecuador where the species was found by Lee Herman.

#### Key to species of the *Holotrochus simplex* group

- |   |  |                                  |
|---|--|----------------------------------|
| 1 | Body 5.2 mm long .....   | <i>simplex</i> SHARP, 1887       |
| – | Body not longer than 5.0 mm .....  | 2                                |
| 2 | Antennae short and stout, 4 <sup>th</sup> antennomere wider than long .....  | 3                                |
| – | Antennae more slender, 4 <sup>th</sup> antennomere at least quadrate .....   | 4                                |
| 3 | Pronotum finer and sparser punctate, distance between punctures on average twice as wide as diameter of punctures (Figs. 13D, 14A) .....                   | <i>blackwelderi</i> IRMLER, 1981 |
| – | Pronotum coarser and denser punctate, distance between punctures on average as wide as diameter of punctures (Figs. 13G, 14F) .....                        | <i>uncinatus</i> IRMLER, 2005    |
| 4 | Smaller, 3.4–3.6 mm long .....   | 5                                |
| – | Longer than 3.6 mm .....   | 11                               |
| 5 | Pronotum finely and sparsely punctate, distance between punctures on average twice as wide as diameter of punctures (Figs. 13A, 12E) .....                 | 6                                |
| – | Pronotum with deeper and coarser punctures, distance between punctures on average as wide as diameter of punctures or shorter (Figs. 12C, D, F, 13B) ..... | 7                                |
| 6 | Sides of pronotum smoothly rounded, posterior angles of pronotum smoothly rounded (Fig. 13A, 14B) .....  | <i>hanagarthi</i> IRMLER, 1981   |
| – | Sides of pronotum more or less parallel, posterior angles of pronotum rectangular (Fig. 12E) .....   | <i>paolettii</i> sp.n.           |

- 7 Sides of pronotum widest shortly behind front angles, continuously, but slightly narrowed to posterior angles (Fig. 12D)..... *rivularis* sp.n. 8
- Sides of pronotum parallel or widest near middle (Figs. 12B, C, F, 13B) ..... 8
- 8 Sides of pronotum widest near middle (Fig. 12C, F)..... 9
- Sides of pronotum nearly parallel (Figs. 12B, 13B)..... 10
- 9 Front edge of clypeus without setae, penultimate antennomeres only slightly wider than long ..... *micans* sp.n.
- Front edge of clypeus with long setae, penultimate antennomeres twice as wide as long ..... *campanae* sp.n.
- 10 Elytra longer, length : width ratio 0.86..... *newtoni* IRMLER, 1987
- Elytra shorter, length : width ratio 0.79..... *tuxtlae* sp.n.
- 11 Elytra slightly wider than long, length : width ratio larger than 0.90..... 12
- Elytra distinctly wider than long, length : width ratio lower or equal 0.87 ..... 13
- 12 Pronotum with regular punctation, without micro-punctures between normal punctures (Fig. 13I, 14E)..... *nationes* IRMLER, 1987
- Pronotum with irregular punctation, fine and sparse micro-punctures between normal punctures (Fig. 13H)..... *puntarenae* sp.n.
- 13 Smaller, 3.8 mm long ..... *ecuadoriensis* sp.n.
- Longer than 4.0 mm..... 14
- 14 Pronotum widest in middle, smoothly narrowed to anterior and posterior angles, on average smaller, 4.0–4.1 mm long (Figs. 13C, 14C) ..... *vianai* BERNHAUER, 1939
- Pronotum widest shortly behind front angles, sides behind parallel, posterior angles more or less rectangular, on average larger, 4.2–4.3 mm long (Fig. 13E)..... 15
- 15 With weak, but distinct depression at posterior angles of pronotum, punctation of pronotum slightly deeper and denser (Figs. 13C, 14D) ..... *glabrinotus* IRMLER, 1987
- Without depression at posterior angles of pronotum, punctation of pronotum sparser and finer (Fig. 13F)..... *honduranus* IRMLER, 2005

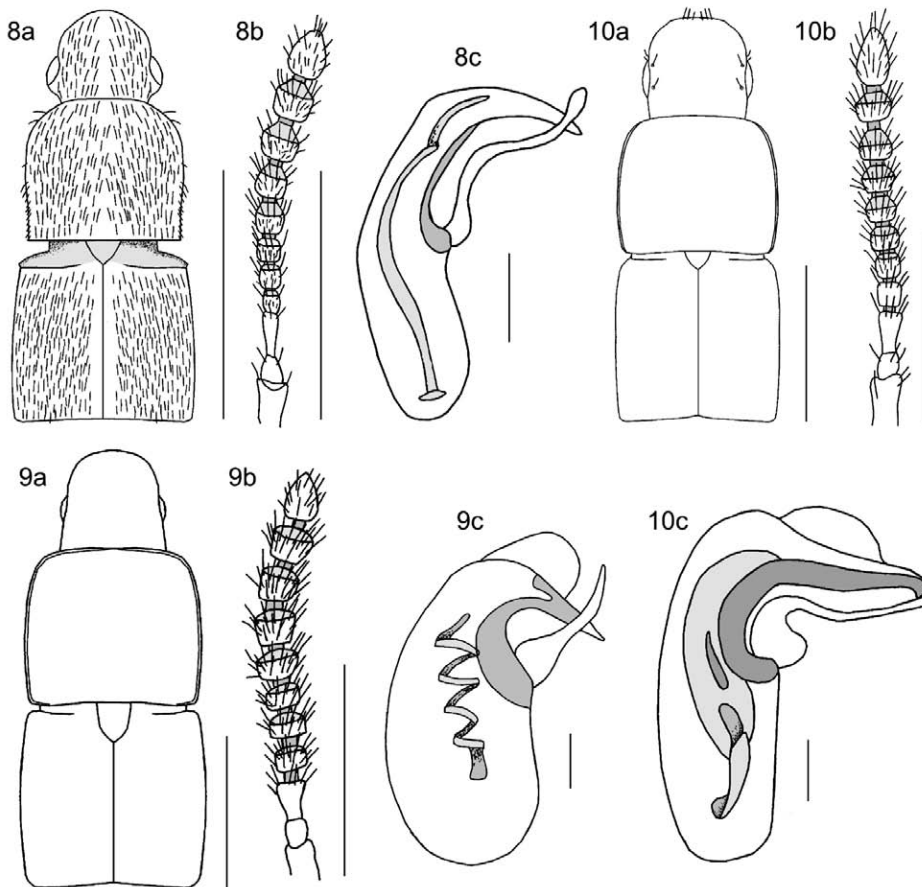
### New species from various species groups

#### *Holotrochus setifera* sp.n.

**Holotype** ♂: Bolivia: Beni, Ilha Flores, Rio Iténez, male, Aug. 7, 1964, leg. J.K. Bouseman & L. Lussenhop (AMNH). **Paratypes**: 111 specimens from the same location and with same data (AMNH, UIC).

**DESCRIPTION** (Figs. 8a–c, 15A): Length: 3.4 mm. Colour: brown; posterior angles of pronotum, posterior edge of abdominal tergites and legs reddish; antennae and tarsi yellow. Head: 0.30 mm long, 0.55 mm wide; eyes large and prominent; temples smaller than 1/4 of eye length; front edge of clypeus widely rounded; setiferous punctation fine and moderately sparse; distance between punctures on average slightly wider than diameter of punctures; setae yellow and long; more than twice as long as distance between punctures; pointing backwards; net-like microsculpture deep and dense; surface matt. Antennae long; nearly as long as head and pronotum combined; 1<sup>st</sup> antennomere thick; 2<sup>nd</sup> antennomere narrower and oblong; 3/4 as long as 1<sup>st</sup>; 3<sup>rd</sup> antennomere still narrower than 2<sup>nd</sup>, but conical and slightly longer; 4<sup>th</sup> antennomere also conical, but only half as long as 3<sup>rd</sup>, following antennomeres increasing in width; 5<sup>th</sup> antennomere still longer than wide; 10<sup>th</sup> nearly 1.5 times as wide as long. Pronotum: 0.55 mm long, 0.80 mm wide; widest near middle; slightly narrowed to anterior angles; in posterior half nearly

parallel; sides very finely margined; margin at anterior angles invisible in dorsal aspect; posterior angles slightly acute; posterior edge slightly emarginate; with distinct depression at posterior angles; setiferous punctation moderately dense and deep as on head; net-like microsculpture also similar as on head; surface matt. Elytra: 0.70 mm long, 0.85 mm wide; with similar punctation and microsculpture as on pronotum and head; surface matt; lateral margin invisible in dorsal aspect. Abdomen with similar punctation as on fore-body, but yellow setae slightly longer and microsculpture much weaker; surface slightly more shiny than on fore-body; last abdominal sternite of male with indistinct oval depression. Aedeagus with long central lobe; rounded in a smooth curve to acute apex; paramera long; longer than central lobe and S-curved; endophallus with straight basal part and spiralled apical part.



Figs. 8–10: a: fore-body, b: antenna, c: aedeagus in lateral aspect; 8) *H. setifera*, 9) *H. jatunsachae*, 10) *H. canalus*. Scale bars: a: 1 mm, b: 0.5 mm c: 0.1 mm.

DIAGNOSIS: This interesting species resembles very closely *H. gyanus* IRMLER, 2007 in the overall habitus. The prominent eyes, the setiferous punctation and the presence of depressions at the posterior angles are very similar. *Holotrochus setifera* is slightly smaller and, in particular, the front edge of the pronotum is not margined as in the *H. pubescens*-group. Thus, this species represents another intermediate species between the *H. pubescens*-group and the *H. syntheticus*-group, as was already true for *H. gyanus*. It can be distinguished from *H. gyanus* by the

distinct net-like microsculpture with matt surface and the different development of the aedeagus. The central lobe is less curved than in *H. gyanus*, and the endophallus is with straight basal part and not spiralled as in *H. gyanus*.

ETYMOLOGY: The specific name refers to the setiferous punctation of the whole body.

### *Holotrochus canalus* sp.n.

**Holotype** ♂: Panama: Barro Colorado Island, Canal Zone, 22.12.1928, leg. C.H. Curran (AMNH). **Paratype**: 1 ♀ from same location, but collected on 21.12.1928 (AMNH).

**DESCRIPTION** (Figs. 10a–c, 15B): Length: 4.8 mm. Colour: dark brown, posterior edges of 4<sup>th</sup> and 5<sup>th</sup> visible abdominal tergites, legs and antennae reddish. Head: 0.45 mm long, 0.80 mm wide; eyes slightly longer than temples; with supraocular margin beginning at base of antennae and ending at posterior edge of eyes, and with two setiferous punctures in margin, one in front of eyes and one at posterior edge of eyes; punctation fine and sparse; distance between punctures on average three to four times as wide as diameter of punctures; net-like microsculpture distinct, but not deep; surface slightly shiny. Antennae short; as long as head and half length of pronotum combined; 1<sup>st</sup> antennomere thick, 2<sup>nd</sup> antennomere oblong, only half as long as 1<sup>st</sup>; 3<sup>rd</sup> antennomere as long as 2<sup>nd</sup>, but conical; following antennomeres increasing in width; 4<sup>th</sup> antennomere quadrate; 10<sup>th</sup> antennomere 1/3 as wide as long; antennomere 4–11 densely covered with long yellow setae; antennomeres 7–10 with apical crown of very short setae. Pronotum: 0.85 mm long, 1.1 mm wide; widest shortly behind anterior angles; anterior angles obtuse, rounded in a smooth curve; posterior half straightly narrowed to obtuse posterior angles; lateral margin distinct, continuing to front edge and ending in front of middle; thus, central half of front edge not margined; punctation as sparse and fine as on head; microsculpture also similar as on head. Elytra: 1.1 mm long, 1.2 mm wide; with indistinct punctation, but distinct coriaceous ground sculpture; both lateral margins visible in dorsal aspect; shoulders with distinct hook-like prominence. Abdominal tergites with sparser punctation and wider microsculpture than on pronotum; thus, surface shinier; sternites with denser and deeper setiferous punctures than tergites. Aedeagus with long straight central lobe; apex of central lobe with short hook; paramera as long as central lobe and S-curved.

**DIAGNOSIS**: The species is extremely similar to *H. convexus* IRMLER, 1987 in its overall habitus, punctation and microsculpture. Thus, *H. canalus* can be attributed to the *H. rufopygus*-group in spite of its small size. It is slightly smaller than *H. convexus* and the widest part of the pronotum is slightly behind the anterior angles, whereas the widest part of the pronotum in *H. convexus* is in the middle. Moreover, the penultimate antennomeres are less transverse in *H. canalus* than in *H. convexus*. In *H. canalus*, the penultimate antennomeres are only 1/3 as wide as long, but in *H. convexus* they are nearly twice as wide as long. In the aedeagus, the hook-like apex is absent in *H. convexus* and the paramera are shorter than the central lobe.

ETYMOLOGY: The epithet refers to the Canal Zone where it was collected.

### *Holotrochus jatunsachae* sp.n.

**Holotype** ♂: Ecuador, Napo, Jatun Sacha (77°37.74'W, 1°03.95'S), 20 km East of Puerto Napo, rain forest under bark, 420 m elevation, 22.07.2009, leg U. Irmeler (UIC). **Paratype**: 1 ♂ with same data as the holotype (UIC).

**DESCRIPTION** (Figs. 9a–c, 15C): Length: 5.7 mm. Colour: black; legs and antennae yellow. Head: 0.50 mm long, 0.85 mm wide; eyes slightly longer than temples; with supraocular margin beginning at base of antennae and ending at posterior edge of eyes; clypeus smoothly rounded; with 8 central setae at apical edge; punctation deep and dense; distance between punctures as

wide as or smaller than diameter of punctures; surface without microsculpture, polished. Antennae as long as head and half length of pronotum combined; 1<sup>st</sup> antennomere thick; 2<sup>nd</sup> antennomere distinctly thinner and nearly globular, only half as long as conical 3<sup>rd</sup> antennomere; following antennomeres increasing in width; 4<sup>th</sup> antennomere already slightly wider than long; 10<sup>th</sup> antennomere 1/3 as wide as long. Pronotum: 1.00 mm long, 1.20 mm wide; widest shortly behind anterior angles; anterior angles smoothly rounded; posterior part of sides straightly narrowed to obtuse posterior angles; both lateral margins visible in dorsal aspect throughout their total length; continuing to front edge, but central half of front edge not margined; punctation still deeper and denser than on head; distance between punctures on average half as wide as diameter of punctures; without microsculpture; surface polished. Elytra: 1.20 mm long, 1.25 mm wide; with hook-like shoulders; punctation deep and denser than on pronotum; distance between punctures narrower than half diameter of punctures; without microsculpture; surface polished. Abdomen with distinctly sparser and weaker punctation than on pronotum and with transverse microsculpture; surface shiny, but matter than on fore-body. Aedeagus with short straight central lobe ending in an acute apex; paramera also short, but as long as central lobe; endophallus spiralled throughout.

DIAGNOSIS: The species can be attributed to the *H. rufopygus*-group regarding the glabrous surface of the abdomen and the medium-sized body. In contrast to all other known species of the group, neither a ground-sculpture nor a micro-punctation is developed on the surface of the pronotum. Thus, *H. jatunsachae* can be differentiated from the other species of the *H. rufopygus*-group by the deep and dense punctation, and the polished surface of the pronotum.

ETYMOLOGY: The specific name is derived from the location Jatun Sacha, a rain forest reserve near the Rio Napo, where the species was collected.

### *Holotrochus trilobatus* sp.n.

**Holotype** ♂: Argentina, Gran Chaco, Riacho del Oro (58°33'W, 27°03'S), male, leg. W. Sørensen (ZMUK).  
**Paratypes**: 2 ♂♂ with same data as holotype (ZMUK, UIC).

DESCRIPTION (Figs. 11a–d, 15D–E): Length: 5.8 mm. Colour: dark brown. Head: 0.70 mm long, 1.05 mm wide; with eyes not prominent; dorsum uneven with a pair of deep round depressions separated by a small ridge; depressions connected in front, thus formed like a horseshoe; on outer side bordered by thick bulges at antennal base; vertex and clypeus distinctly punctate; near neck with a pair of larger punctures on each side of middle; punctures on vertex larger than on clypeus; surface of vertex without microsculpture, polished; surface of clypeus with weak transverse lines of microsculpture; antennal bulges without punctures and microsculpture, polished. Antennae short and stout, only slightly longer than head; 2<sup>nd</sup> antennomere globular, half as long as conical 3<sup>rd</sup>, antennomeres 4–10 wider than long; 4<sup>th</sup> antennomere only slightly wider than long, 10<sup>th</sup> antennomere nearly three times as wide as long. Pronotum: 1.20 mm long, 1.40 mm wide; sides nearly parallel; shortly narrowed to anterior angles in anterior 5<sup>th</sup>; sides and front edge finely margined except in the middle of front edge; punctation dense and distinct; distance between punctures on average as wide as diameter of punctures; surface with longitudinal microsculpture; in the posterior half with moderately wide impunctate midline; less shiny than vertex of head; depressions at posterior angles even, weakly depressed. Elytra: 1.35 mm long, 1.50 mm wide; on average with larger punctures than on pronotum and head, but punctures differing in size; surface with fine longitudinal striae; without microsculpture, thus, surface more shiny than that of pronotum. Punctation of abdomen as dense and deep as that of pronotum and net-like microsculpture distinct; surface as shiny as that of pronotum; 5<sup>th</sup> and 6<sup>th</sup> visible sternite with depressions; even depression on 5<sup>th</sup> sternite circular, impunctate, and with dense microsculpture; depression on 6<sup>th</sup> visible sternite oblong and deeper

than depression on 5<sup>th</sup> visible sternite; impunctate and with distinct finely coriaceous microsculpture. Aedeagus straight at basal part of central lobe and a shortly recurved apical part; paramera not longer than apical part; endophallus with two larger and a row of smaller teeth.

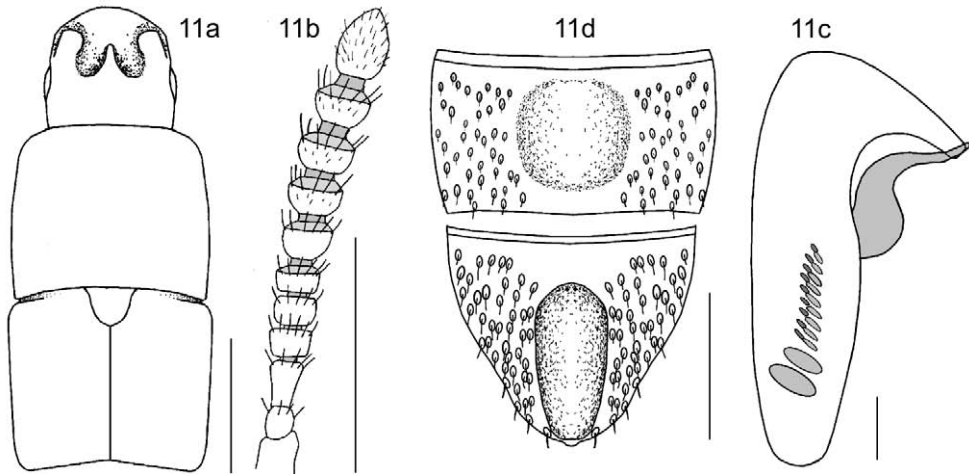


Fig. 11: *Holotrochus trilobatus*; a: fore-body, b: antenna, c: aedeagus in lateral aspect, d: 5<sup>th</sup> and 6<sup>th</sup> visible sternite. Scale bars: a: 1 mm, b, d: 0.5 mm, c: 0.1 mm.

**DIAGNOSIS:** Regarding the medium-sized body, the margined front edge of the pronotum, and the absent pubescence of the abdomen, the species can be attributed to the *H. rufopygus*-group, although the microsculpture of the pronotum resembles that in the species of the *H. cylindrus*-group. However, in the *H. cylindrus*-group the front edge of the pronotum is not margined. The species can be easily identified by the trilobate structure of the head, which is singular in the Neotropical *Holotrochus* species.

**ETYMOLOGY:** The specific name means three lobes and refers to the characteristic structure on the dorsum of head.

### Discussion and remarks on geographical distribution

*Holotrochus* species seem to prefer the litter of rain forests. From 848 specimens with information about their habitat, 91 % were found in the leaf litter of forests, either in extremely wet litter at stream sides or in drier litter of rainforests far from streams. The under bark habitat also seems to be colonised by the species, but only 6 % of the specimens have been found there. In total, 93 % of the species have been found in the leaf litter or in the under bark habitat. Nine species were found in both wet and dry litter habitats. Further habitats were as follows: with ants or termites, in the soil, in fungi, in fruit or flower fall.

Most species seem to be geographically restricted as can be seen in the species of the *H. simplex*-group. However, many species seem to be extremely rare, with very few known records. The species of the *H. simplex*-group have been found in Central America and in South America along the Andean range up to the coastal mountains of southern Brazil (Fig. 16). They have not been recorded from the West Indian islands (except Trinidad), the Amazon Basin, or north-eastern Brazil. *Holotrochus newtoni* was found in the northernmost locations in the rain forest region of the state of Veracruz along the Atlantic coast in southern Mexico.



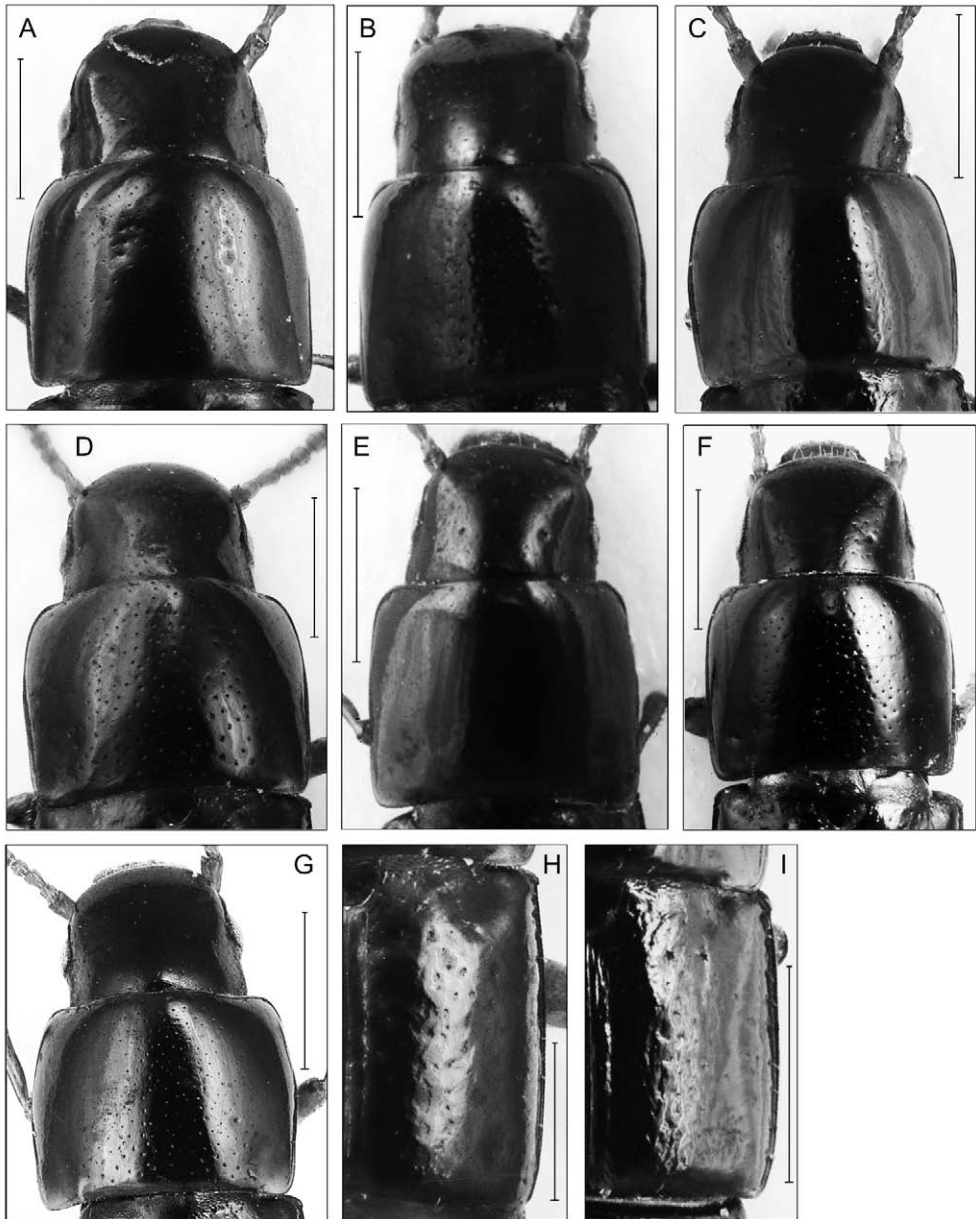


Fig. 12: Head and pronotum of *H. puntarenae* (A), *H. tuxtlae* (B), *H. micans* (C), *H. rivularis* (D), *H. paoletti* (E), *H. campanae* (F), and *H. ecuadoriensis* (G) showing punctation, and surface of right elytra of *H. rivularis* (H), and *H. micans* (I). Scale bars: 0.5 mm.

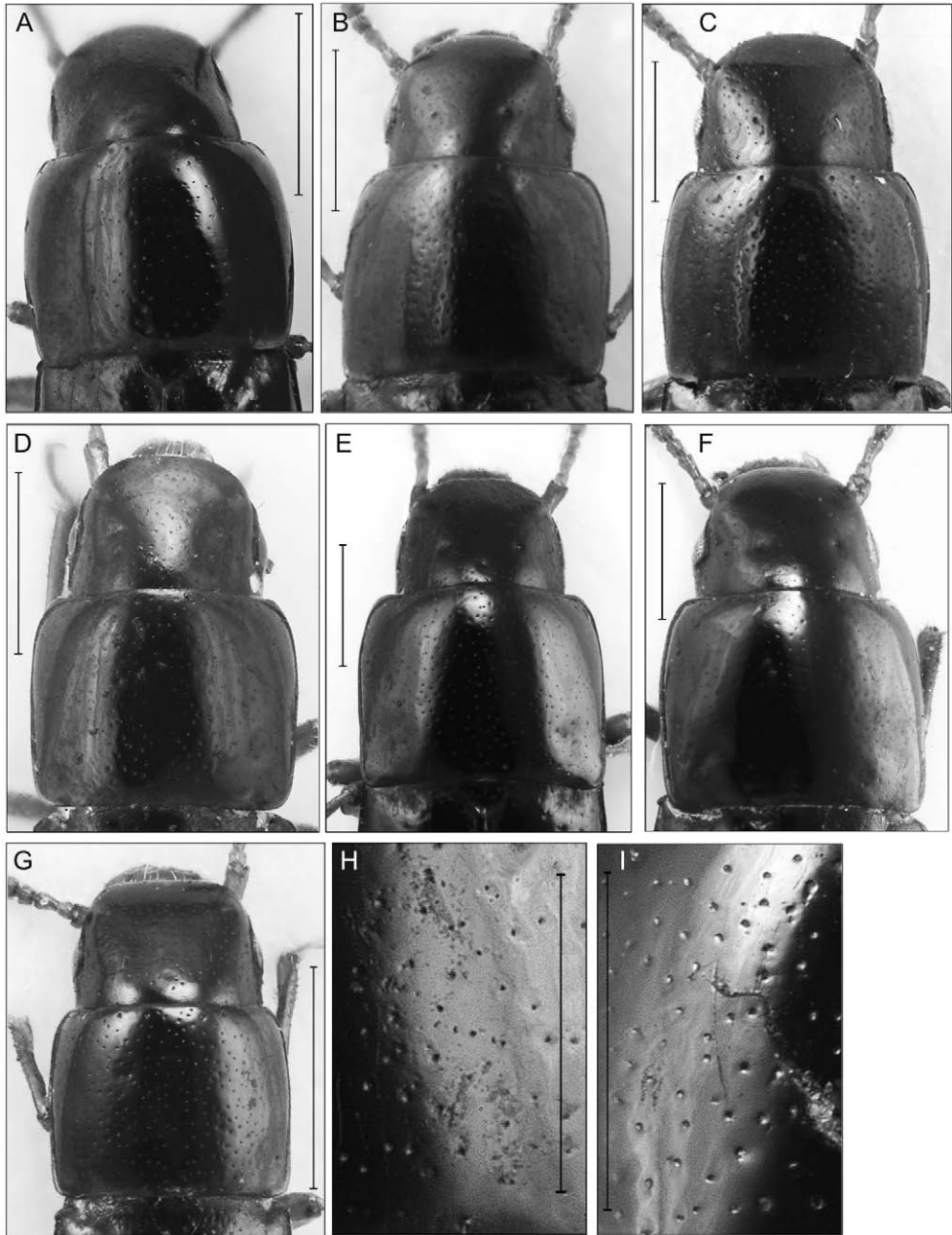


Fig. 13: Head and pronotum of *H. hanagarthi* (A), *H. newtoni* (B), *H. vianai* (C), *H. blackwelderi* (D), *H. glabrinotus* (E), *H. honduranus* (F), and *H. uncinatus* (G) and surface of pronotum of *H. puntarenae* (H), and *H. nationes* (I). Scale bars: 0.5 mm.

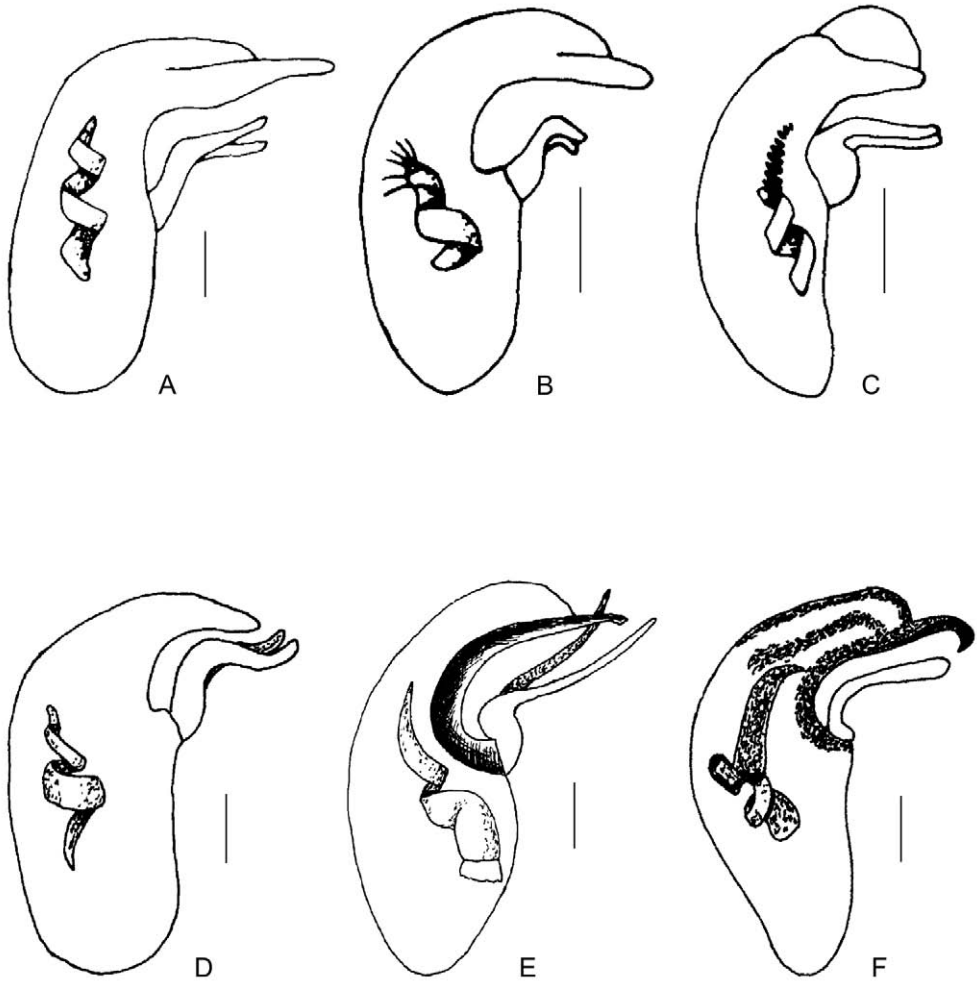


Fig. 14: Aedeagus of *Holotrochus blackwelderi* (A), *H. hanagarthi* (B), *H. vianai* (C), *H. glabrinotus* (D), *H. nationes* (E), *H. uncinatus* (F). Scale bars: 0.1 mm.

This species appears to be distributed from southern Mexico to Panama. *Holotrochus honduranus* and *H. simplex* are more geographically restricted in Central America as are the new species *H. tuxtlae* and *H. campanae*. Only *H. glabrinotus* is distributed from Central America to the northern mountains of Venezuela in South America. This low number of common species between Central and South America differs from other Osoriinae genera, e.g. *Lispinus* ERICHSON and *Tannea* BLACKWELDER. In these genera, several species are distributed from southern Central America to the northern South American regions; pan-neotropical distributions are found in several species (IRMLER 2006, 2007, 2009). This zoogeographical situation may either be referred to a less-mobile behaviour of the *Holotrochus* species in comparison to the *Lispinus* or *Tannea* species, or to a higher rarity, which would result in a less extensive collection status of *Holotrochus* species than of *Tannea* or *Lispinus* species.

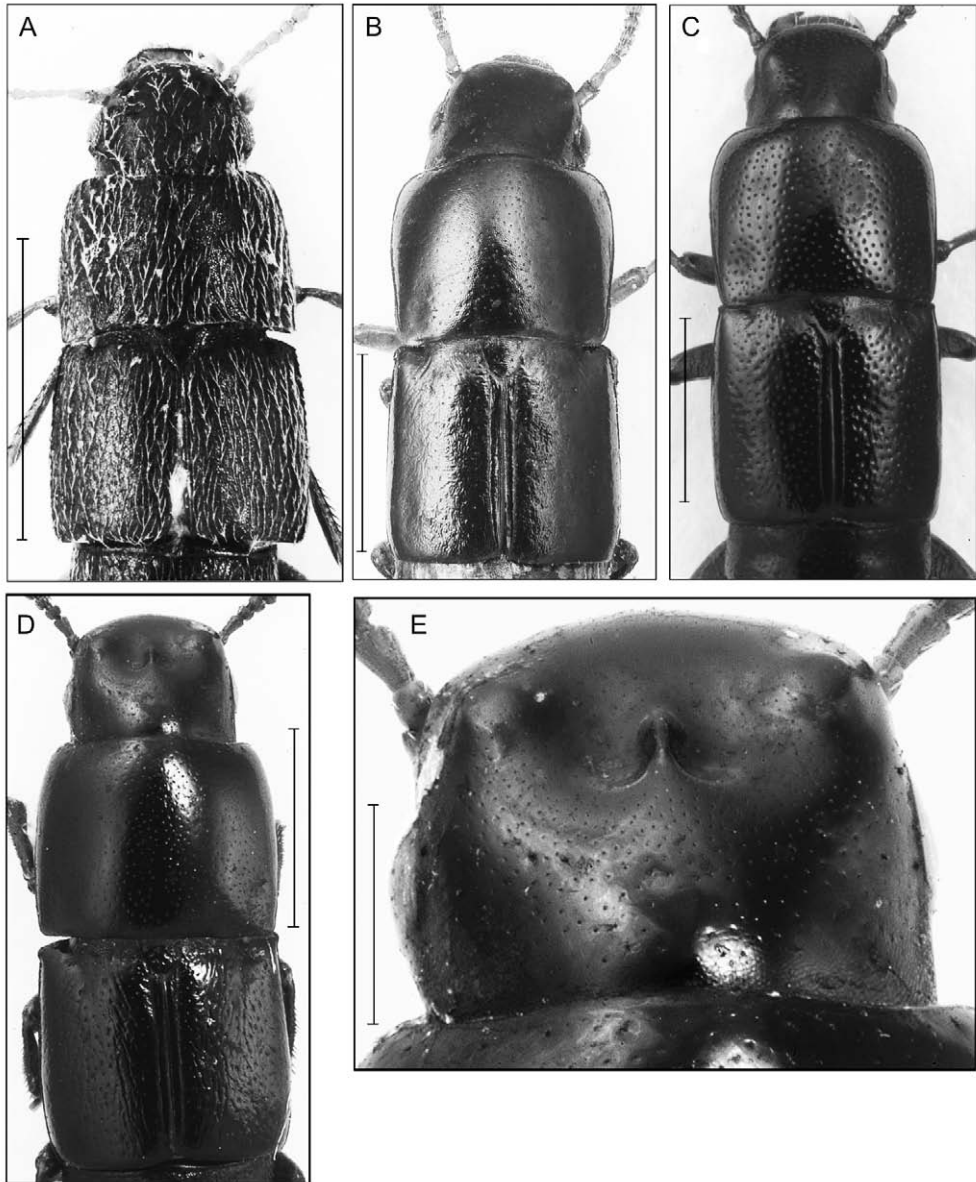


Fig. 15: A–D: Fore-body of A) *Holotrochus setifera*, B) *H. canalus*, C) *H. jatunsachae*, and D) *H. trilobatus*; F: head of *H. trilobatus*. Scale bars A–D: 1 mm, E: 0.5 mm.

*Holotrochus blackwelderi*, which is found in eastern Venezuela and Trinidad, represents the most eastern distribution in northern South America. Several species are found along the Andean range from Ecuador to Bolivia; in particular, *H. hanagarthi* seems to occur in a wide geographical range. *Holotrochus vianai* bridges the Andean region with the southern Brazilian species in the mountains at the Atlantic coast. Two species have been found in this region, *H. micans* and *H. nationes*. Thus, the geographic distribution of the *H. simplex*-group in South America resembles the Circum-Amazonian distribution of several species of the genus *Lispinus* (IRMLER 2009).



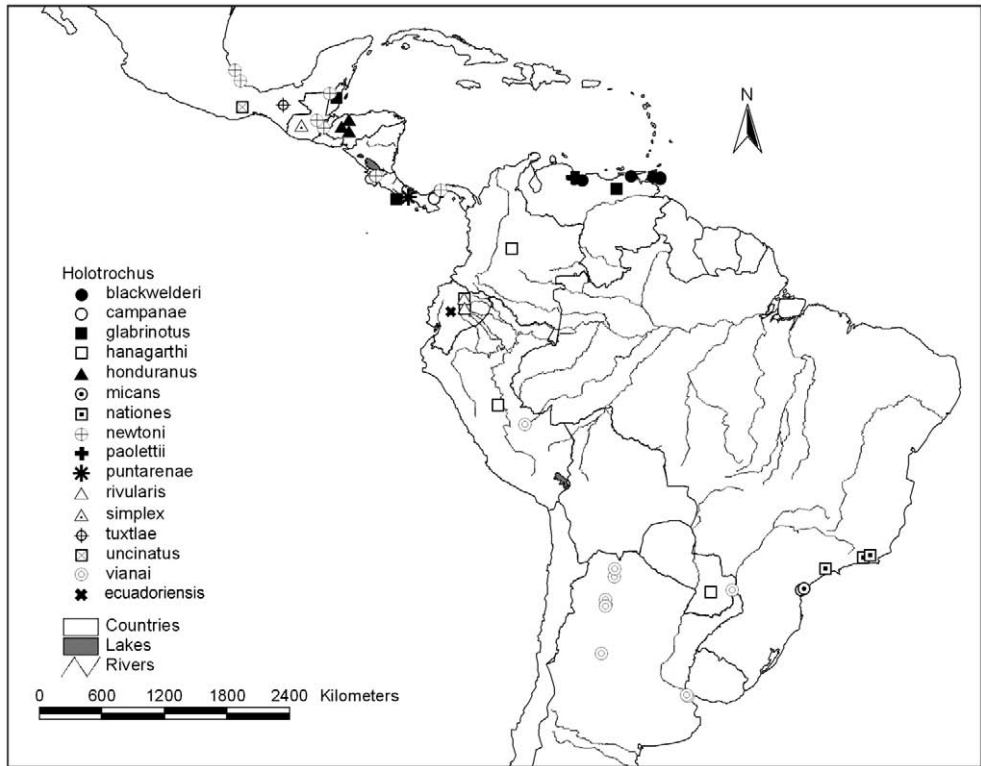


Fig. 16: Geographical distribution of the species of the *Holotrochus simplex*-group.

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