

Description of the males of *Lincus singularis* and *Lincus incisus* (Hemiptera: Pentatomidae: Discocephalinae)

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ABSTRACT. The Neotropical *Lincus* Stål, 1867 includes 35 species, thirteen of which are known only from females. Several species are vectors of *Phytomonas staheli* McGhee & McGhee, 1979, a trypanosomatid parasitic in palm-trees in South America that causes hart-rot, sudden and slow wilt diseases. The hitherto unknown males of *L. singularis* Rolston, 1983 (“swollen head” species group found in the oil palm *Elaeis guineensis* Jacq.), and *L. incisus* Rolston, 1983 (“hatchet-lobed” species group; found in the coconut tree *Cocos nucifera* L.), are described with emphasis on the morphology of the genitalia, and taxonomic remarks are provided. Males of *L. singularis* can be distinguished from other species included in “swollen head” group by their pronotal lobes with anterior and posterior margins subparallel and projected laterally from the eye margin, while males of *L. incisus* can be distinguished from the species of the “swollen head” group by an obtuse projection with a deepest incision and several additional diagnostic characters of the genitalia.

KEY WORDS. Genitalia; morphology; Ochlerini; stink bugs; taxonomy.

Lincus Stål, 1867 is the richest genus of Ochlerini, comprising 35 species (CAMPOS & GRAZIA 2006). Even though the genus was described in the 19th century (STÅL 1867), most of its 25 species were described in the late 20th century (ROLSTON 1983, 1989, DOLLING 1984), and 13 of them are known only from one sex (ROLSTON 1983). Species of *Lincus* are found mostly in the Amazon region. There are a few exceptions to this, for instance *Lincus lobuliger* Breddin, 1908, recorded from the Brazilian Atlantic Forest and *Lincus anulatus* Rolston, 1983 and *Lincus discensus* (Distant, 1900) from Central America (ROLSTON 1983). Several species are sympatric in different countries. Geographic records of *Lincus* are particularly rich in Peru due to the extensive surveys on native palms carried out during the 1980's (COUTURIER & KAHN 1989, 1992, LLOSA et al. 1990). Sixteen species occur in that country, including *Lincus singularis* Rolston, 1983, although it has never been collected on *Elaeis guineensis* Jacq. Suriname comes next in terms of species richness in the Amazon region (ROLSTON 1983, 1989, DOLLING 1984), with six species, including *Lincus incisus* Rolston, 1983.

The association of pentatomids with the transmission of *Phytomonas staheli* McGhee & McGhee, 1979, a trypanosomatid parasitic in plants, has been known for a long time and is well documented (for a review see CAMARGO 1999 and MITCHELL 2004). Several species of *Lincus* play a major role as vectors of hart-rot, and of sudden and slow wilt (also called Marchitez sorpresiva in

Spanish-speaking countries) diseases in palm trees (Arecaceae) in South America, being of economic interest in crops of *E. guineensis* (African oil palm) and *Cocos nucifera* L. (coconut) (DESMIER DE CHENON 1984, COUTURIER & KAHN 1989, PERTHUIS et al. 1985, PANIZZI et al. 2000, DI LUCCA et al. 2013; for a review see HOWARD 2001). Although eleven species of *Lincus* have been reported on palm trees (HOWARD 2001), the genus was not listed as a possible vector of oil palm diseases until the 1980's (COUTURIER & KAHN 1992). Furthermore, transmission of *Phytomonas* trypanosomatids to palms has been documented in only six species, four of which transmit the parasite to *E. guineensis*: *Lincus lethifer* Dolling, 1984, *L. lobuliger*, *Lincus tumidifrons* Rolston, 1983, and *Lincus spurcus* Rolston, 1983 (CAMARGO 1999, DI LUCCA et al. 2013).

In 2009, the corresponding author received, for identification, specimens of *Lincus* collected from *E. guineensis* palm trees from Palmas del Espino S.A., Peru. These specimens were identified as *L. spurcus* and *L. singularis*, and included the only known males of the latter. Moreover, during the course of this study, we located males of *L. incisus* among specimens of Ochlerini received during the 1990's, two of which from *C. nucifera* crops cultivated by Sococo S.A., Moju, Pará State, Brazil. For the first time, *L. singularis* and *L. incisus* are reported from oil palm and coconut trees, respectively, and their males are described and illustrated for the first time, with emphasis on the morphology of genitalia.

MATERIAL AND METHODS

Five males and one female of *L. singularis* and three males and three females of *L. incisus* were examined in this study. The species were identified based in a revision by ROLSTON (1983). Observation of specimens, dissection and preservation followed GARBELOTTO et al. (2013). Measurements are in millimeters (mm) and follow mainly GARBELOTTO et al. (2013) and ROLSTON (1983) for: length and width of eye and pronotal lobe, and interocellar distance. The terminology of BAKER (1931), DUPUIS (1970), CAMPOS & GRAZIA (2006) and GARBELOTTO et al. (2013) were adopted for genitalic structures. Photographs were taken using a Nikon AZ100M stereomicroscope and NIS-Elements Advanced Research software. Drawings were made under a stereomicroscope Leica MZ12 coupled with camera lucida and were vectored using Adobe Illustrator. Whenever possible, collection data were georeferenced following GARBELOTTO et al. (2013); coordinates are in decimal degrees.

Collections' acronyms follow EVENHUIS (2014). Voucher specimens are deposited in the entomological collection of the Departamento de Zoologia at Universidade Federal do Rio Grande do Sul (UFRG), Porto Alegre, RS, Brazil.

TAXONOMY

Lincus singularis Rolston, 1983

Figs. 1-9

Lincus singularis Rolston, 1983: 1, 4, 5, 18-20, Figs. 34-35 (female holotype from Chauchamayo, Peru, deposited in USNM 76690, not examined, no paratypes); Couturier & Khan, 1992: 719 (map); Campos & Grazia, 2006: 153 (list).

Description of the male. The color of males is dark brown to fuscous and the general morphology is similar to that described for females by ROLSTON (1983) (Fig. 1). Genitalia. Pygophore oval, opening of genital cup narrow. Dorsal rim uniformly concave (Fig. 2, dr), bearing 1+1 tufts of setae lateral to segment X. Posterolateral angles rounded, projected distinctly beyond the ventral rim, depressed dorsally (Fig. 2, pa). Basal 1/3 of segment X membranous, lateral margins sinuous tapering to apex (Fig. 2, X). Ventral rim V-shaped, with setae along margin (Fig. 3, vr). Ventral surface tumescent on disc, with 1+1 lateral sulci following ventral rim (Fig. 3, t); ventral surface of posterolateral angles tumescent (Fig. 3). Parameres inconspicuous and covered by segment X, attached to the articulatory apparatus of phallus, subtriangular in lateral view, bearing a dorsal dense tuft of setae on apex (Figs. 4-6). Phallus. Phallosome globose (Figs. 7-9, ph), strongly sclerotized. Vesica longer than the combined lengths of phallosome and ductus seminis distalis (Figs. 7-9, v, ds), bearing an dorsal subtriangular process posteriorly directed (Figs. 7-9, dp), and 1+1 lateral processes short and truncate (Figs. 7-9, lp). Free portion of ductus seminis distalis very short, about

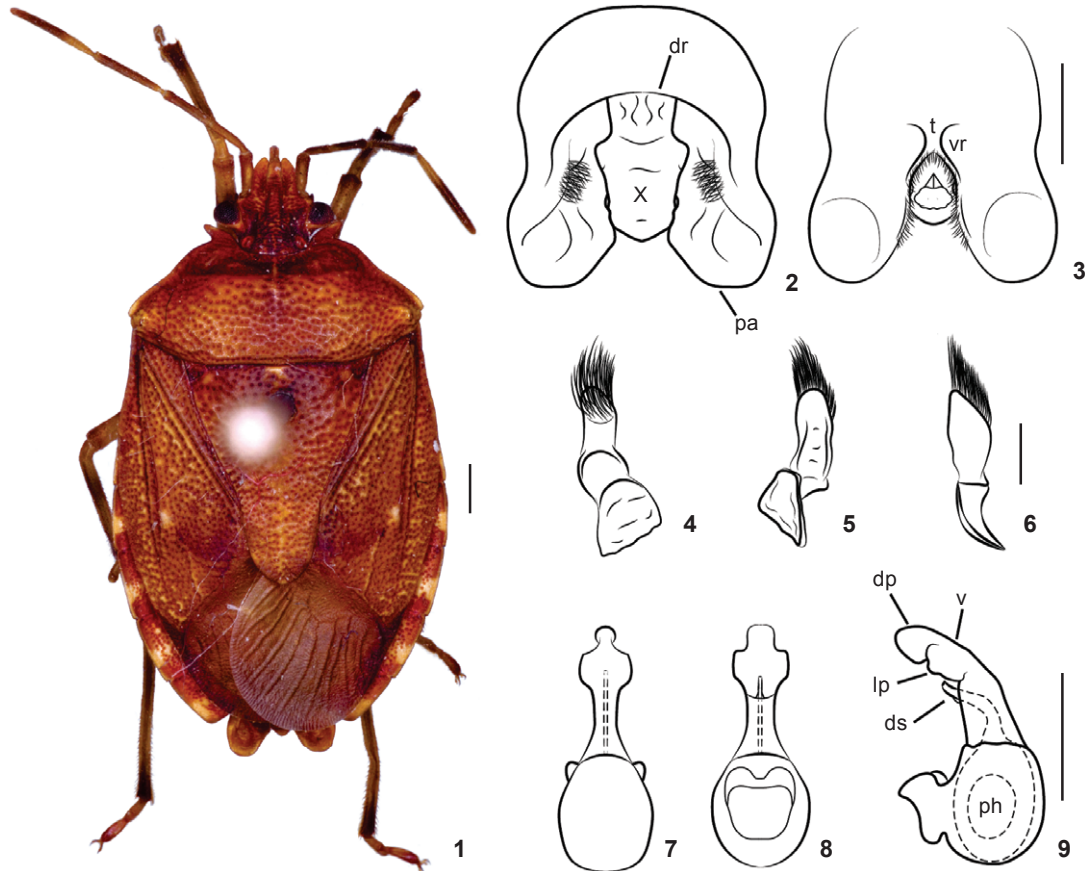
half the length of the inner portion, projecting ventrad of vesica before the lateral processes (Figs. 7-9, ds).

Male. Measurements (n = 5). Total length 10.75 ± 0.29 (10.37-11.00); width of abdomen 6.62 ± 0.36 (6.12-7.00); head length 1.67 ± 0.08 (1.57-1.76); head width 2.24 ± 0.10 (2.14-2.39); eye length 0.50 ± 0.03 (0.47-0.55); eye width 0.55 ± 0.02 (0.52-0.57); interocellar distance 1.20 ± 0.03 (1.17-1.2); interocular distance 1.21 ± 0.06 (1.13-1.26); pronotum length 2.17 ± 0.14 (1.95-2.27); pronotum width 5.66 ± 0.19 (5.42-5.90); length of pronotal lobe 0.23 ± 0.03 (0.20-0.27); pronotal lobe width 0.17 ± 0.02 (0.15-0.20); scutellum length 4.27 ± 0.25 (3.91-4.60); scutellum width 3.55 ± 0.13 (3.39-3.72); length of antennomeres: I 0.77 ± 0.03 (0.75-0.80); II 0.82 ± 0.03 (0.77-0.85); III 1.01 ± 0.04 (0.97-1.07); IV 1.42 ± 0.04 (1.37-1.45); V 1.81 ± 0.11 (1.62-1.92); length of labial segments: I 1.28 ± 0.11 (1.12-1.37); II 2.36 ± 0.09 (2.25-2.37); III 1.87 ± 0.03 (1.82-1.9); IV 1.79 ± 0.06 (1.75-1.90).

Material examined. PERU, *Tocache*: 5 males and 1 female, San Martín (Palmas del Espino S.A., Cultivo Palma Aceitera, parcela A11a [-8.41; -76.41] 500 m a.s.l.), 2009, E. Trinidad leg.

Distribution. Peru, Cusco and San Martín regions.

Remarks. Although no phylogenetic hypothesis has been advanced for species of *Lincus*, the genus was recovered in the *Herrichella* Distant, 1911 clade in a cladistic analysis of the Ochlerini (CAMPOS & GRAZIA 2006). The relationship between *Lincus* and the other members of the clade, however, remained unresolved. More recently, the genus (represented by *L. lobuliger*) was recovered as the sister group of the remaining taxa of the *Herrichella* clade in the phylogenetic analysis of GARBELOTTO et al. (2013). The monophyly of the genus, however, remains to be tested. Several species of *Lincus* are recognizable by their well-developed pronotal lobes, and all known males have tubular proctiger and reduced parameres (ROLSTON 1983, 1992). These characters were not used in the phylogenetic studies mentioned above. Regarding the phylogenetic relationships among the species of *Lincus*, ROLSTON (1983) placed *L. singularis* along with *Lincus parvulus* (Ruckes, 1958) and *L. tumidifrons* in the "swollen head" informal group of species ("species group of convenience" sensu ROLSTON 1983). This group was characterized by having a tumid vertex. Some features of the pygophore of *L. singularis* are consistent with Rolston's proposal to place the species in it, e.g. the 'V' shape of the ventral rim of the pygophore; subrectangular proctiger with acute apex; and globose phallosome, the latter also observed in *L. tumidifrons*. *Lincus singularis* can be differentiated from the other species in the "swollen head" group by having the anterior and posterior margins of the pronotal lobes subparallel and each lobe projected laterad of its corresponding eye; the vertex of head not as tumid as in *L. parvulus* and *L. tumidifrons* (Fig. 1; for *L. parvulus* and *L. tumidifrons* see ROLSTON 1983, Figs. 30 and 36); and the ventral opening of the pygophore is narrower than in those species (Fig. 3, vr; for *L. parvulus* and *L. tumidifrons* see ROLSTON 1983, Figs. 32 and 41).



Figures 1-9. Male of *Lincus singularis*: (1) habitus in dorsal view; (2-3) pygophore: (2) dorsal view; (3) ventral view; (4-6) left paramere: (4) dorsal view; (5) ventral view; (6) lateral view; (7-9) phallus: (7) anterior view; (8) posterior view; (9) lateral view. (dp) Dorsal projections, (dr) dorsal rim, (ds) ductus seminis distalis, (lp) lateral projection, (pa) posterolateral angles, (ph) phallosome, (t) tumescens area, (v) vesica, (vr) ventral rim, (X) segment X. Scale bars: 1-3 = 1 mm, 4-9 = 0.5 mm.

Lincus incisus Rolston, 1983

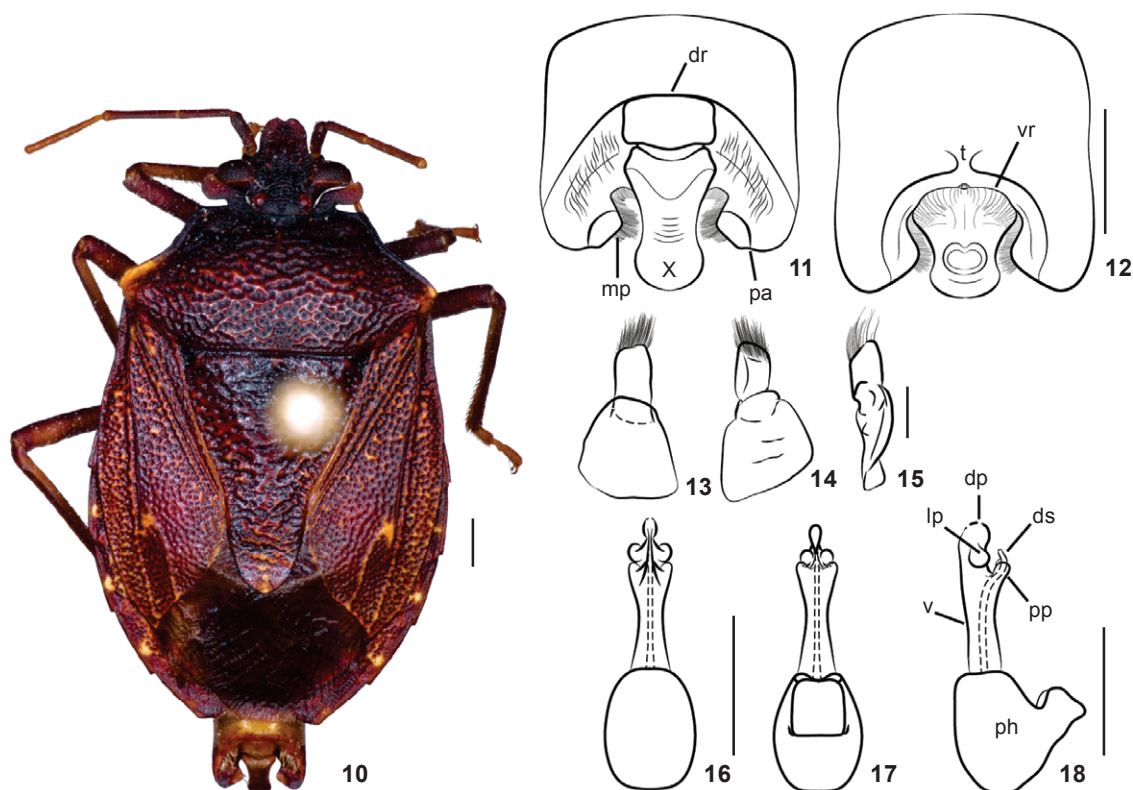
Figs. 10-18

Lincus incisus Rolston, 1983: 1, 3, 4, 9-10, Figs. 8-9 (female holotype from De Mapane, Suriname; deposited in RMNH, not examined, no paratypes); Campos & Grazia, 2006: 153 (list).

Description of the male. The fuscous general color of male and its general morphology, including the anterolateral margins of pronotum expanded in obtuse angle, posterior to pronotal lobes, are as described for females by ROLSTON (1983) (Fig. 10). Genitalia. Pygophore subrectangular. Surface with short setae. Dorsal rim concave, bearing setae lateral to segment X (Fig. 11, dr). Posterolateral angles obtuse (Fig. 11, pa), depressed, with 1+1 median projections (Fig. 11, mp). Segment X sclerotized, ventrally directed; apex expanded and flattened (Fig. 11, X); anal opening circular, and genital opening in longitudinal slit, both at ventral surface (Fig. 12). Ventral rim concave, with setae along the margin, medially carinated (Fig. 12, vr). Ventral

surface tumescent on disc, with 1+1 lateral sulci following ventral rim (Fig. 12, t). Parameres inconspicuous, attached to the articulatory apparatus of phallus, subrectangular and with an apical tuft of setae (Figs. 13-15). Phallus. Phallosome strongly sclerotized (Figs. 16-18, ph). Vesica elongated, medially narrowed, longer than the combined lengths of phallosome and ductus seminis distalis (Figs. 16-18, v); with one globose dorsal projection posteriorly directed (Figs. 16-18, dp); 1+1 lateral globose projections, posteriorly directed (Figs. 16-18, lp); posterior projection truncated, bearing ductus seminis distalis (Figs. 16-18, pp). Ductus seminis distalis antero-dorsally arched toward the projections of vesica (Fig. 18, ds).

Measurements (n = 3). Total length 12.55 ± 0.79 (11.86-13.42); width of abdomen 6.77 ± 0.32 (6.46-7.10); head length 2.18 ± 0.11 (2.06-2.28); head width 2.63 ± 0.06 (2.56-2.68); eye length 0.60 ± 0.03 (0.57-0.63); eye width 0.78 ± 0.03 (0.75-0.82); interocular distance 0.70 ± 0.01 (0.69-0.71); interocular distance 1.12 ± 0.05 (1.07-1.15); pronotum length 3.47 ± 0.18



Figures 10-18. Male of *Lincus incisus*: (10) habitus in dorsal view; (11-12) pygophore: (11) dorsal view; (12) ventral view; (13-15) right paramere: (13) dorsal view; (14) ventral view; (15) lateral view; (16-18) phallus: (16) anterior view; (17) posterior view; (18) lateral view. (dp) Dorsal projections, (dr) dorsal rim, (ds) ductus seminis distalis, (lp) lateral projection, (mp) median projection, (pa) posterolateral angles, (ph) phallosome, (t) tumescens area, (v) vesica, (pp) posterior projection, (vr) ventral rim, (X) segment X. Scale bars: 10-12 = 1 mm, 13-18 = 0.5 mm.

(3.27-3.59); pronotum width 6.01 ± 0.18 (5.82-6.17); length of pronotal lobe 0.41 ± 0.02 (0.40-0.44); pronotal lobe width 0.85 ± 0.02 (0.80-0.84); scutellum length 4.45 ± 0.30 (4.12-4.70); scutellum width 3.65 ± 0.08 (3.55-3.70); length of antennomers: I 0.97 ± 0.04 (0.92-1.00); II 1.12 ± 0.08 (1.07-1.21); III 1.42 ± 0.07 (1.35-1.50); IV 1.38 ± 0.20 (1.2-1.56); V 1.78 ± 0.00 (1.78-1.78); length of labial segments: I 1.35 ± 0.70 (1.28-1.42); II 2.43 ± 0.14 (2.34-2.60); III 1.97 ± 0.14 (1.85-2.13); IV 1.66 ± 0.05 (1.63-1.72).

Material examined. BRAZIL, Amazonas: 3 females, São Miguel da Cachoeira (Cachoeira do Tucano – Pico da Neblina), X.2007, Nogueira & Candiani leg.; Pará: 2 males, Moju (Fazenda Sococo) [-2.11; -48.00], 01.XII.1995, P. Lins leg.; 1 male, Tucuruí (Rio Tocantins) [-3.7; -49.7], 20.VII.1984, W. França leg.

Distribution: Suriname, Brazil (Amazonas and Pará States).

Remarks. *Lincus incisus* was placed, along with eight other species (*Lincus convexus* Rolston, 1983, *Lincus croupius* Rolston, 1983, *Lincus fatigus* Rolston, 1983, *Lincus operosus* Rolston, 1983, *Lincus securiger* Breddin, 1904, *Lincus sinuosus* Rolston, 1983, *Lincus spathuliger* Breddin 1908 and *Lincus vandoesburgi* Rolston,

1983), in the “hatchet-lobed” informal group of species (ROLSTON 1983). This placement was justified in view of the anterior pronotal angles resembling a hatchet blade in *Lincus incisus*. Males of *L. incisus* share some genitalic characters with males of *L. convexus*, *L. securiger*, *L. sinuosus* and *L. vandoesburgi*, such as the presence of 1+1 median projections at posterolateral angles, ventrally directed; and an elongated phallus bearing apical projections. The ductus seminis distalis bent toward the projections of the vesica is also observed in *L. vandoesburgi*. Within the hatchet-lobed group, *L. incisus* and *L. vandoesburgi* share the pronotal margin posterior to the lobes expanded on each side into an obtuse projection. The incision between each lobe and the anterolateral margin of the pronotum is deepest in *L. incisus*, reaching half the width of an eye (Fig. 10; ROLSTON 1983, Figs. 1, 8). *Lincus incisus* can also be distinguished from *L. vandoesburgi* by the more convex apical margin of the posterolateral angles of the pygophore, and by a more developed median projection (Figs. 11-12, mp; for *L. vandoesburgi* see ROLSTON 1983, Fig. 2). Among the other species in the hatchet-lobed group with known males, *L. incisus* differs from *L. sinuosus* by the median projec-

tion below the apical margin of the posterolateral angles of the pygophore (Figs. 11-12, mp; for *L. sinuosus* see ROLSTON 1983, Fig. 17); from *L. convexus* and *L. securiger* by the more developed median projection and the ventral opening of the pygophore broader and shallower (Figs. 11-12, mp, vr; for *L. convexus* and *L. securiger* see ROLSTON 1983, Figs. 23 and 26). Notwithstanding the placement of *L. incisus* within the "hatchet-lobed" group, it is noticeable that the shape of segment X, with an expanded and flattened apex, is also a feature of some species of the "big-eyed" group (ROLSTON 1983), such as *Lincus lethifer* Dolling, 1984, *Lincus substylicher* Rolston, 1983 and *Lincus subuliger* Breddin, 1908. *Lincus incisus* is recorded for the first time in Brazil.

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