

A new species of Leucothoid Amphipod, *Anamixis bananarama*, sp. n., from Shallow Coral Reefs in French Polynesia (Crustacea, Amphipoda, Leucothoidae)

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Abstract

Both leucomorph and anamorph developmental stages of *Anamixis bananarama* sp. n., are illustrated and described from shallow back reef environments of Moorea, French Polynesia. Distinguished by vestigial first gnathopods that persist in post-transformational adult males, this is the second species in the genus to exhibit this unusual character. In other features such as coxae and second gnathopods *A. bananarama* sp. n. resembles other Pacific Plate endemics of *Anamixis* known from the region. Specific host association is not documented but suspected to be small calcareous asconoid sponges associated with coral rubble.

Keywords

Amphipod, Leucothoidae, sponge, Coral reefs, French Polynesia

Introduction

Leucothoid amphipods are of interest for their unusual ecology as commensal inhabitants of sessile invertebrates such as sponges, sea squirts, and bivalves. Obligate commensal species have evolved highly characteristic and unusual morphologies and feeding strategies as

a consequence of their way of life, including eusocial structure, a condition once thought limited to insects and naked mole rats. Duffy (1996, 2003) first documented eusocial behavior in marine sponge-inhabiting snapping shrimp. Thomas (1983, 1997) documented eusociality and communal living in highly derived tropical leucothoids in the genus *Anamixis*. Thiel (1999) reported on nest guarding in *Leucothoe spinicarpa* from Florida, USA. Because of their cryptic lifestyle and need for specialized collecting methods, leucothoid diversity has been vastly underrepresented in museum collections. Specialized *in-situ* underwater collecting techniques pioneered by the first author are beginning to reveal the extent of leucothoid diversity (Thomas, 1997, Thomas and Klebba, 2006, 2007; White and Thomas, 2010). The 22 species in genus *Anamixis* Stebbing, 1897, are primarily tropical – warm temperate in distribution. Their greatest diversity is in the Pacific with 14 species, followed by the Indian Ocean with five species, and the Caribbean Sea and Western Atlantic with four species. Further specialized collecting of host and symbiont will undoubtedly significantly expand the addition of new taxa in the Leucothoidae.

Thomas and Barnard (1983) announced the transformation of males of *Leucothoides pottsi*, originally belonging to Leucothoidae Dana, 1852, into hyperadult males of *Anamixis hanseni* belonging to Anamixidae Stebbing, 1897 [now *Anamixis cavatura* (Thomas, 1997)], but avoided synonymising the two families. In 2000, Lowry and colleagues merged the Anamixidae and Leucothoidae (Lowry et al, 2000). With the addition of both anamorph and leucomorph descriptions in *A. bananarama* sp. n. this proposed familial restructuring now comprises 139 species in six genera: *Anamixis* Stebbing, 1897 (22 spp.); *Nepanamixis* Thomas, 1997 (4 spp.); *Paranamixis* Schellenberg, 1938 (13 spp.); *Leucothoe* Leach, 1814 (96 spp.); *Leucothoella* Schellenberg, 1928 (2 spp.); and *Paraleucothoe* Stebbing, 1899 (2 spp.). A full taxonomic database for the Leucothoidae with hyperlinks to illustrations is available (Thomas, 1999) at: http://www.nova.edu/ocean/jthomas/Current_Leucothoidae_7_09.pdf

In a study of leucothoids from Florida and Belize reefs, the first author and graduate students documented 43 invertebrate host species for Caribbean leucothoids (Thomas and Klebba 2006; 2007). These results combined with the recent addition of Lizard Island (Australia) species of leucothoids underscore the high level of undiscovered leucothoid diversity and illustrate how specialized field collecting can lead to new taxonomic discovery. Despite current taxonomic limitations, the Leucothoidae remain objects of intense interest due to their intriguing ecology, endocommensal lifestyle, and emerging biogeographic patterns.

Methods

Specimens were collected by snorkeling and SCUBA. Rubble and other shallow algal substrates were isolated *in-situ* and processed by elutriation. In the lab juvenile (leucomorph) and adult males (anamorphs) were separated and photographed using AutoMontage[®]. Specimens were fixed in 100% ETOH for molecular analysis and in 2% buffered formalin for dissection and illustration. Type material is deposited in the

collections of the Florida Museum of Natural History in Gainesville, Florida with the prefix “UF” for museum numbers.

Taxonomy

Anamixis bananarama sp. n.

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http://species-id.net/wiki/Anamixis_bananarama

Figures 1–3

Type material. *Holotype*, Anamorph male “A”, 2.34mm, UF 26542, *Paratype*, leucomorph female “B”, 2.10mm; UF 26543; Cook’s Bay, Moorea, French Polynesia, J.D. Thomas collector, 4 December 2009, JDT Moorea 09–4 (South 17.48220:West-149.82530). Wash of backreef rubble, 1–2m. *Additional paratypes*, female leucomorphs (7 specimens), UF 26544, Cook’s Bay, Moorea, French Polynesia, J.D. Thomas collector, 11 December 2009, JDT-Moorea 09–10 (South 17.59205:West-149.835211) coral rubble, coralgal sand, and coral heads, 2–3m.

Additional material. Hans-Georg Mueller collector; 27 February to 6 March 1988, shallow reef, Bora Bora.

Diagnosis. Terminal anamorph males: Eyes with 7 scattered ommatidia; gnathopod 1 greatly reduced, shriveled, persisting in post-transformational stages. Gnathopod 2, basis greatly elongated, narrow; carpus elongate, apically blunt, with reduced setal tufts on medial margin; propodus with sparse mediofacial setal row. Telson elongate for genus, 1.72 times longer than wide.

Description. Head margin broadly rounded, lacking any defining processes; ventral keel, anterior margin rounded, with small midapical indentation; eyes reduced, consisting of 7 scattered ommatidial facets. Antenna 1, ratio of segments 1–3, 43:33:28, peduncle segment 1 and 2 with 3 and 2 plumose setae respectively; flagellum 6-articulate, articles 3–6 with aesthetascs. Antenna 2, flagellum short, 4-articulate. Maxilliped, inner plates fused, apically produced, apical margin with small concave excavation; outer plates lacking inner lobes; palp article 4, 1.36 times length of article 3. Pereonite 1 with small lateral locking ridge.

Gnathopod 1, coxa greatly reduced, apically bifid; remainder of appendage a small bud, articles 2–5 extremely reduced and shriveled. Gnathopod 2, coxa extending deeper than coxa 3–4, distal margin evenly rounded, bearing 10 mediobasal submarginal setules; basis thin, elongate; carpus slightly curved, blunt, reaching 85 percent of propodus, with 6 medial clusters of setae: 2:(2+3):(3+3):(4+1):3:1, distal margin with 5 small submarginal setules; propodus with single row of 7 mediofacial feeding setae, extending 43 percent of propodus length, posterior margin smooth with 3 submarginal setae, anterior margin with 2 prominent apically truncate processes; dactyl straight, inner surface smooth with paired setae on small process near apex, reaching 83 percent on propodus.

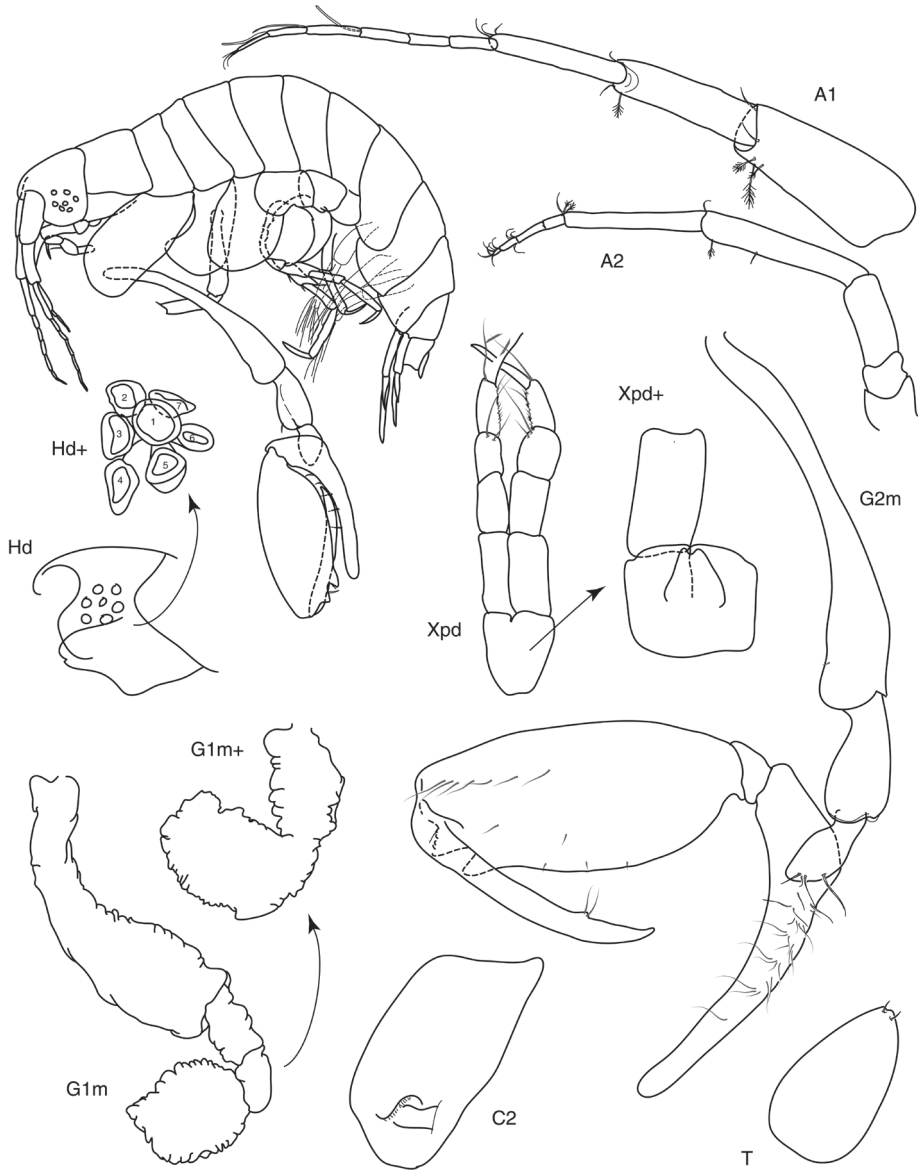


Figure 1. *A. bananarama* sp. n., holotype, anamorph male male "A", 2.34 mm.

Pereopod 3, coxa smaller than 4, rounded ventrally, anterior and posterior margins straight; remainder of pereopods unremarkable. Pereopod 4, coxa slightly larger than 3, posterior margin slightly expanded, remainder of peropod similar to pereopod 3. Pereopods 5–6, coxae bilobed; pereopod 7, coxa entire. Epimera normal for genus. Uropods 1–2, outer rami shortened, approximately 40 percent of inner ramus. Uropod

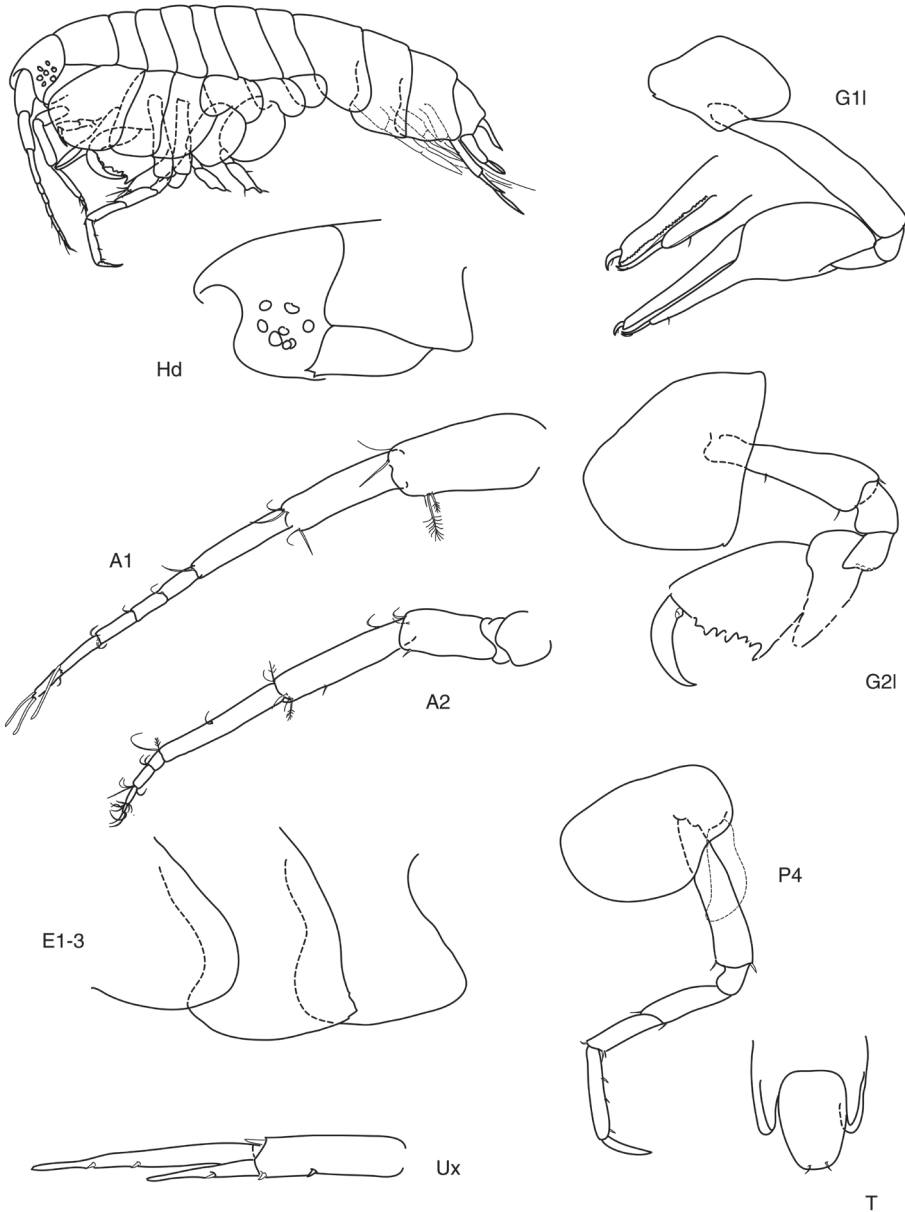


Figure 2. *A. bananarama* sp. n., paratype, leucomorph female “B”, 2.10mm.

3, outer ramus 40 percent of inner ramus, outer and inner rami with 1 and 2 marginal spines respectively. Telson 1.70 times longer than wide, with 2 apical setae.

Leucomorph. Description of female leucomorph. Head, anterior margin rounded, smooth, eyes consisting of 7 scattered ommatidial facets. Antenna 1, ratio of segments 1–3, 33:26:23; flagellum 5-articulate, articles 4 and 5 with aesthetascs. Antenna



Figure 3. AutoMontage Z-stacked photograph of *A. bananarama* sp. n., holotype, anamorph male male "A", 2.34 mm.

2, flagellum short, 5-articulate. Gnathopod 1, coxa moderately reduced, extending to ventral margin of head, apically bifid; carpus shorter than propodus, with two apical recurved spines, anterior margin bare; propodus, posterior margin finely serrate, bearing a thick recurved apical seta. Gnathopod 2, anterior margin of coxa broadly rounded, ventral margin slightly produced, posteroventral corner with small cusp, posterior margin straight; propodus, palm angle transverse, palmar margin defined by series of concavities and processes, corner of palm defined by distinct cusp; dactyl reaching to end of palm. Telson 1.72 times longer than wide, with 2 apical setae.

Etymology. This species is named for the long recurved carpal lobe on the second gnathopod that resembles the shape of a banana.

Relationships. *Anamixis bananarama* shares its closest affinity with *A. jebbi* from the Madang Lagoon, Papua New Guinea, (Thomas, 1997), with both species having 7 ommatidial facets in both leucomorph and anamorph stages, and a reduced, vestigial first gnathopod in the post transformational anamorph stage. The second gnathopod of *A. bananarama* differs from *A. jebbi* in the elongate basis, the more blunt and less

setose carpus, and reduced mediofacial setal row (7 in *A. bananarama*; 14 in *A. jebbi*). *A. bananarama* exhibits an elongated telson typical of ratios found in *Nepanamixis* (Thomas, 1997). Both *A. jebbi* and *A. bananarama* show transitional characters placing them in a clade by themselves with the elongate telson of *A. bananarama* placing it nearer to *Nepanamixis* in this regard. The telson of *A. bananarama* at 1.70 times longer than wide exceeds that of *A. jebbi* at 1.32 and approaches the telson ratios typical of the genus *Nepanamixis* at 1.8–2.0 times longer than wide.

Remarks. Color in life and in freshly collected and preserved material of both leucomorph and anamorph stages are pale translucent pink. There is faint thin reddish banding on posterior thoracic and abdominal segments. Eyes are red. Ovigerous females contain an average of 7–10 yellow eggs in the marsupium.

The vestigial first gnathopods found in *A. bananarama* and *A. jebbi* are persistent morphologies in post transformational anamorphs in both taxa. A number of specimens were examined by the first author to ensure these were not transitional transformational features as reported by Thomas (1997) in *Paranamixis clarkae* from the Seychelles Islands. In *P. clarkae*, transformational anamorphs exhibit small shrunken vestiges of gnathopod 1 which are lost in subsequent molts. Ren (2006) described *P. vestigium* from the South China Sea, illustrating similar reduced first gnathopods. In all other aspects *P. vestigium* resembles *P. misakiensis* described by Thomas (1997) from Japan and examination of a series of anamorph specimens of *P. vestigium* is needed to resolve whether these vestigial first gnathopods persist in post-transformational molts.

Habitat. Specific habitat/host undocumented but assumed to be small asconoid calcareous sponges in protected rubble habitats in backreef environments.

Distribution. Moorea and Bora Bora, French Polynesia, Pacific Ocean. 1–3m.

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Nomenclatorial changes and redescrptions of three of Navás' *Leucochrysa* (*Nodita*) species (Neuroptera, Chrysopidae)

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Abstract

Three species that Navás described – *Leucochrysa* (*Nodita*) *azevedoi* Navás, 1913, *Leucochrysa* (*Nodita*) *camposi* (Navás, 1933) and *Leucochrysa* (*Nodita*) *morenoi* (Navás, 1934) – have received recent taxonomic attention. All three have many similar external features; indeed Navás himself, as well as subsequent authors, have confused the species with each other. Here, (a) misidentifications are corrected; (b) a neotype of *L. azevedoi* is designated; (c) *L. (N.) morenoi*, previously synonymized with *L. (N.) camposi*, is recognized as a valid species [**Reinstated status**]. All three species are redescrbed and illustrated, with special emphasis on the types. *Leucochrysa* (*N.*) *azevedoi* was found to be relatively common in agricultural areas along Brazil's Atlantic coast. The two other species are known only from their type localities: *Leucochrysa* (*N.*) *camposi* – coastal Ecuador, and *Leucochrysa* (*N.*) *morenoi* – Quito, Ecuador.

Resumo

Três espécies que Navás descreveu – *Leucochrysa* (*Nodita*) *azevedoi* Navás, 1913, *Leucochrysa* (*Nodita*) *camposi* (Navás, 1933) e *Leucochrysa* (*Nodita*) *morenoi* (Navás, 1934) – receberam atenção taxonômica recentemente. Essas espécies compartilham muitas características externas; de fato, o próprio Navás e outros autores posteriormente confundiram-se na sua identificação. Aqui, (a) identificações errôneas são corrigidas; (b) um neótipo de *L. azevedoi* é designado; (c) *L. (N.) morenoi*, sinonimizada previamente com *L. (N.) camposi*, é reconhecida como espécie válida [**status reconduzido**], e (d) as três espécies são redescritas e ilustradas, com ênfase especial nos tipos. *Leucochrysa* (*N.*) *azevedoi* é relativamente comum em áreas agrícolas ao longo da costa atlântica do Brasil. As outras duas espécies são conhecidas apenas de sua localidade-tipo: *Leucochrysa* (*N.*) *camposi* – costa do Equador, e *Leucochrysa* (*N.*) *morenoi* – Quito, Equador.

Keywords

Leucochrysinini, neotropical lacewings, taxonomy

Introduction

Recent field surveys of natural enemies associated with insect pests in neotropical agroecosystems show that the chrysopid fauna is very rich and taxonomically complex (e.g., in Brazil: Freitas and Penny 2001, Multani 2008, Tauber et al. 2008). The Leucochrysinines are especially diverse and difficult to identify; as a consequence, the literature on the group is rife with synonymies, errors, and uncertainty.

To help clarify the systematics of the group, we have begun examining the leucochrysinine types and comparing them with recently collected or reared specimens. This is a slow process. Here we report the results of our studies with three *Leucochrysa* (*Nodita*) species that Navás described. All three resemble each other closely, and have been misidentified and confused with each other in both old and recent literature (Navás 1928, Freitas and Penny 2001, Legrand et al. 2008). One of these species occurs in agricultural settings throughout Brazil; thus timely clarification of its taxonomy is important.

Taxonomy

Leucochrysa (*Nodita*) *azevedoi* Navás, 1913

[http://species-id.net/wiki/Leucochrysa_\(Nodita\)_azevedoi](http://species-id.net/wiki/Leucochrysa_(Nodita)_azevedoi)

additional images: <http://morphobank.org/permalink/?P243>

Figs 1A, 2–6

Leucochrysa azevedoi Navás, 1913: 97; Type: missing; original description: “Brasil: Rio de Janeiro, Agosto de 1911. R.P. Joaquín da Silva Tavares S.J. (Col. m.)”. Navás (1912–1913: 303) [species list].

Nodita azevedoi (Navás). First combination in *Nodita* by Navás (1928: 111) [collection record: Guayaquil, Ecuador, May 1926, probably misidentified; see below]. Navás (1929: 859) [collection record: Prov. de Rio de Jan., Coll. v. Bönninghausen, 20-X-1906, M. H., specimen probably destroyed]; Penny (1977: 25) [species list].

Leucochrysa (*Nodita*) *azevedoi* Navás (Brooks and Barnard 1990: 277) [species list]; Oswald (2007) [catalog listing, nomenclature]; Legrand et al. (2008: 117) [probably *Nomen Dubium*]; Mantoanelli et al. (in press) [larval descriptions]. Here: confirmed as a valid species.

Type Material. The original type remained in Navás collection (Navás 1913: 97); however, it does not exist in the Navás collection at the Natural History Museum of Barcelona now (Montserrat 1985: 240). Also, Legrand et al. (2008: 117) were unable to find it in the Muséum national d’Histoire naturelle, Paris (MNHN). It is reason-

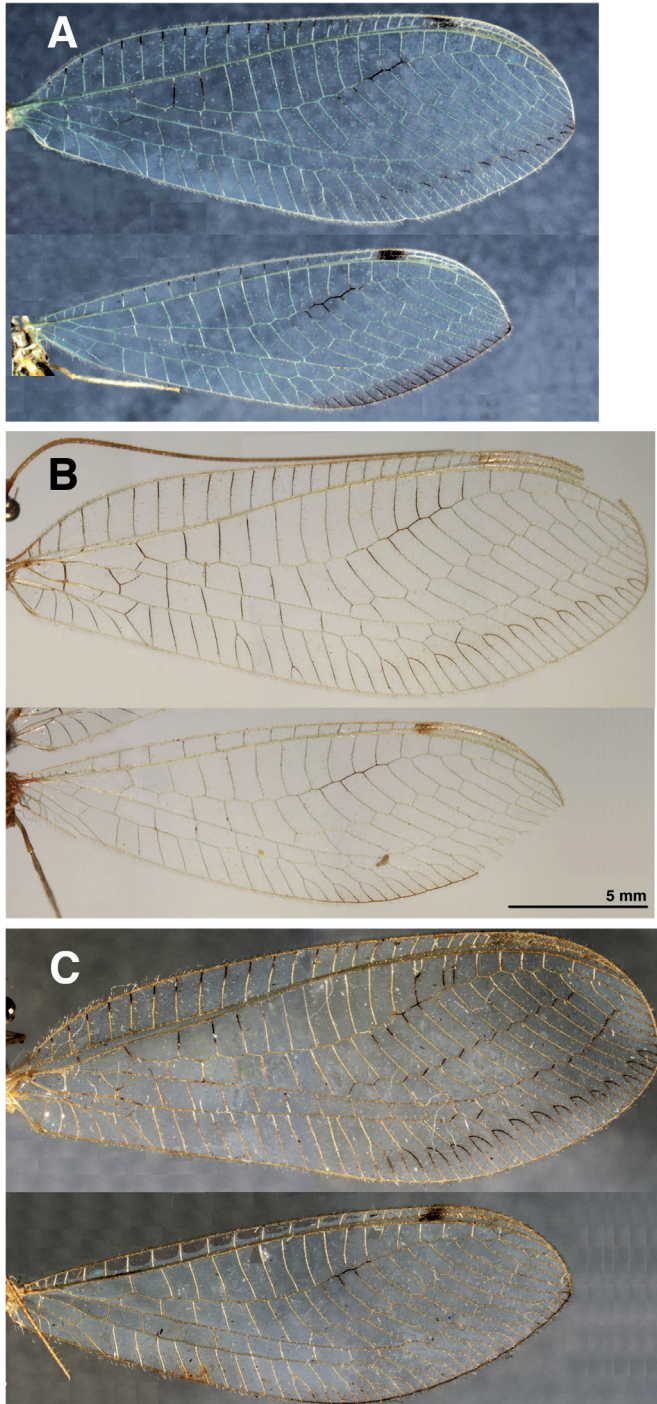


Figure 1. Wings. **A** *Leucochrysa (Nodita) azevedoi* (Male, Mato Grosso, Brazil, CAS) **B** *Leucochrysa (Nodita) camposi* (Male, Lectotype, MNHN) **C** *Leucochrysa (Nodita) morenoi* (Male, Lectotype, MNHN). Scale applies to all images.

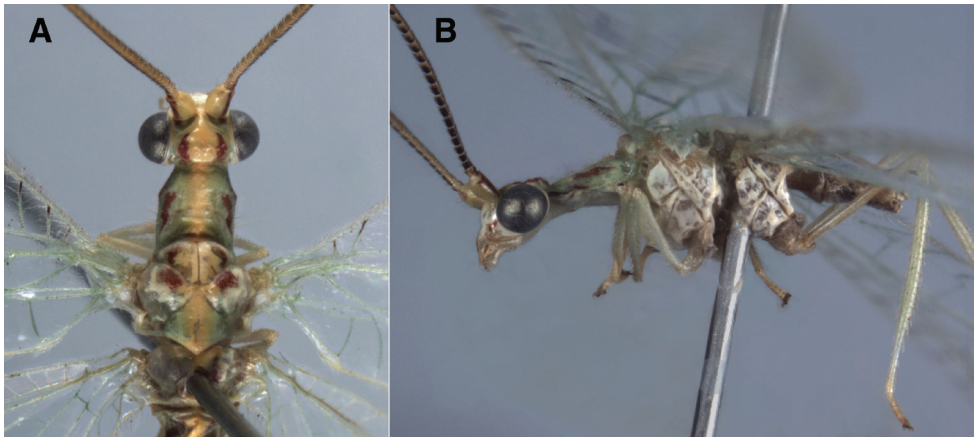


Figure 2. Habitus, *Leucochrysa (Nodita) azevedoi* (Male, Mato Grosso, Brazil, CAS). **A** Head, thorax, dorsal **B** Head, thorax, lateral.

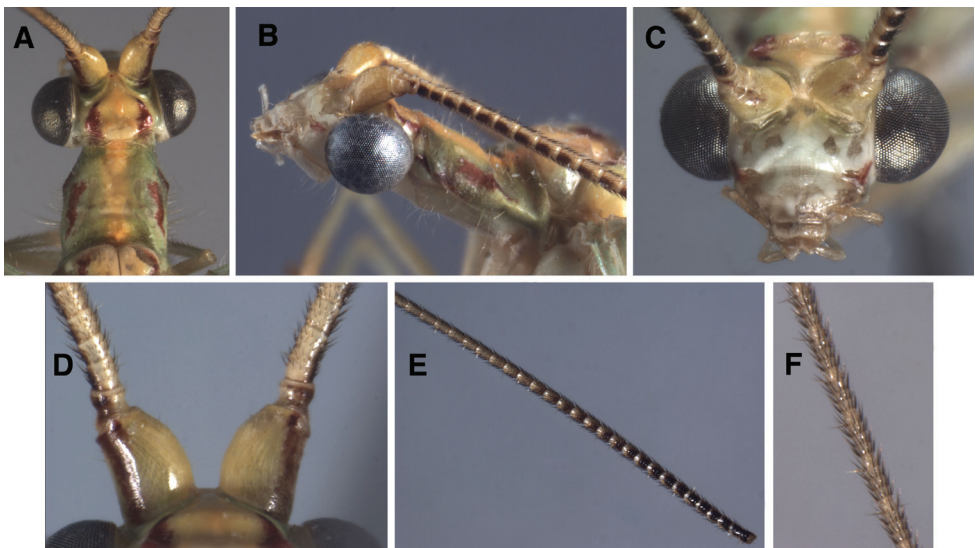


Figure 3. External features, *Leucochrysa (Nodita) azevedoi* (Male, Mato Grosso, Brazil, CAS). **A** Head, prothorax, dorsal **B** Head, prothorax, lateral **C** Head, frontal **D** Scapes, dorsal **E** Base of antenna, lateral **F** Mid-section of antenna.

able to assume that the specimen has been destroyed; therefore, Legrand et al. (2008) considered the species a Nomen Dubium.

Recently we attempted to identify a *Leucochrysa (Nodita)* species from orchards in northern Rio de Janeiro State. Using the key by Freitas and Penny (2001), we identified the specimens as *Leucochrysa (Nodita) camposi*, a species that was described from coastal Ecuador; our specimens matched the drawings and description included with the key. However, comparison of our specimens with the type of *N. camposi* showed significant differences.

Earlier, we had noted that Navás had confused *L. (N.) camposi* and *azevedoi* (see Legrand et al. 2008: 116). That is, he had labeled a specimen of *L. (N.) camposi* in the MNHN as *Nodita azevedoi*; this specimen had been collected from the *N. camposi* type locality in 1930. [Note: Navás may also have similarly misidentified another specimen collected from the same locality in 1926 (Navás 1928: 111), but we have not seen that specimen.]

Navás's errors then led us to consider whether our specimens could be *L. (N.) azevedoi*. Indeed our specimens were collected in the state of Rio de Janeiro, where *L. (N.) azevedoi* was originally collected; moreover our specimens fit Navás's original description of *L. azevedoi* well. Although Navás's type of *L. azevedoi* is missing, the similarities in external features, coupled with his confusion of the two species, give us confidence that Navás's original description applies to the specimens we have at hand from northern Rio de Janeiro State.

As a result of our studies and the correction of Navás misidentifications, we now consider that *L. (N.) azevedoi* ranges throughout coastal Brazil [and probably also into the state of Pará] and that *L. (N.) camposi* occurs on the west coast of northern South America (currently known only from Ecuador). Now, to stabilize the nomenclature of these species, we designate as the *L. azevedoi* neotype, a specimen (male) from the Brazilian state where the original type specimen was collected. Its labels read: (1) "Brazil: R[io de] J[aneiro], Campos dos Goytacazes, Est. Exp. PESAGRO (Estação Experimental da Empresa de Pesquisa Agropecuária do Estado do Rio de Janeiro) [21°44'55"S, 41°18'30"W], 06/IV/2002"; (2) "G. S. Albuquerque, Collector"; (3) "NEOTYPE *Leucochrysa azevedoi* Navás 1913, desig. C.A. Tauber, G.S. Albuquerque 2010." In the Coleção Entomológica Pe. Jesus Santiago Moure (Universidade Federal do Paraná, Curitiba, PR, Brazil).

Diagnosis. Externally, *L. (N.) azevedoi* adults closely resemble several *Leucochrysa (Nodita)* species that have a red to reddish brown dorsolateral stripe on the scape, dark brown to black ventrolateral marks on the basal flagellomeres, red to reddish brown marks on the sides of the raised portion of the vertex, a darkened section in the middle of the Radial sector (forewings and hindwings), and darkened terminal veinlets along the posteroapical margin of the hindwings (Figs 1A, 2–3). *Leucochrysa (N.) azevedoi* is slightly smaller than many of these species, including *L. (N.) camposi* and *L. (N.) morenoi* (wing length 17.7–19.5 mm versus ~21.3–21.6 for *L. (N.) camposi* and *morenoi*), but it can only be identified with accuracy by its genitalic characters (male and female) (Figs 4–6). In the male *L. (N.) azevedoi*, the gonarcular arms are broadly spread; they extend almost the full width of the segment. The gonocornua are located mesally on the gonarcular bridge, well within the span of the mediuncus, and they are directed upward from the bridge, not laterally from the bridge as are the *L. (N.) camposi* gonocornua. The mediuncus is heavy; the beak is borne on a posteriorly projecting ventral plate (arcessus) that angles back towards the gonarcular arch; the beak is broad and blunt, and the membranous arms extending laterally from below the beak are rounded and each bears a lateral patch of setae. The hypandrium internum has a broad V-shape. Females can be recognized by their tubular spermatheca, small bursa, relatively small, fluted bursal duct. The bursa has two elongate, branched, tubular glands attached to its dorsal surface, and the subgenitale is heavy-based; the terminus has a thick neck, paired short, dorsal lobes and a short protrusion.

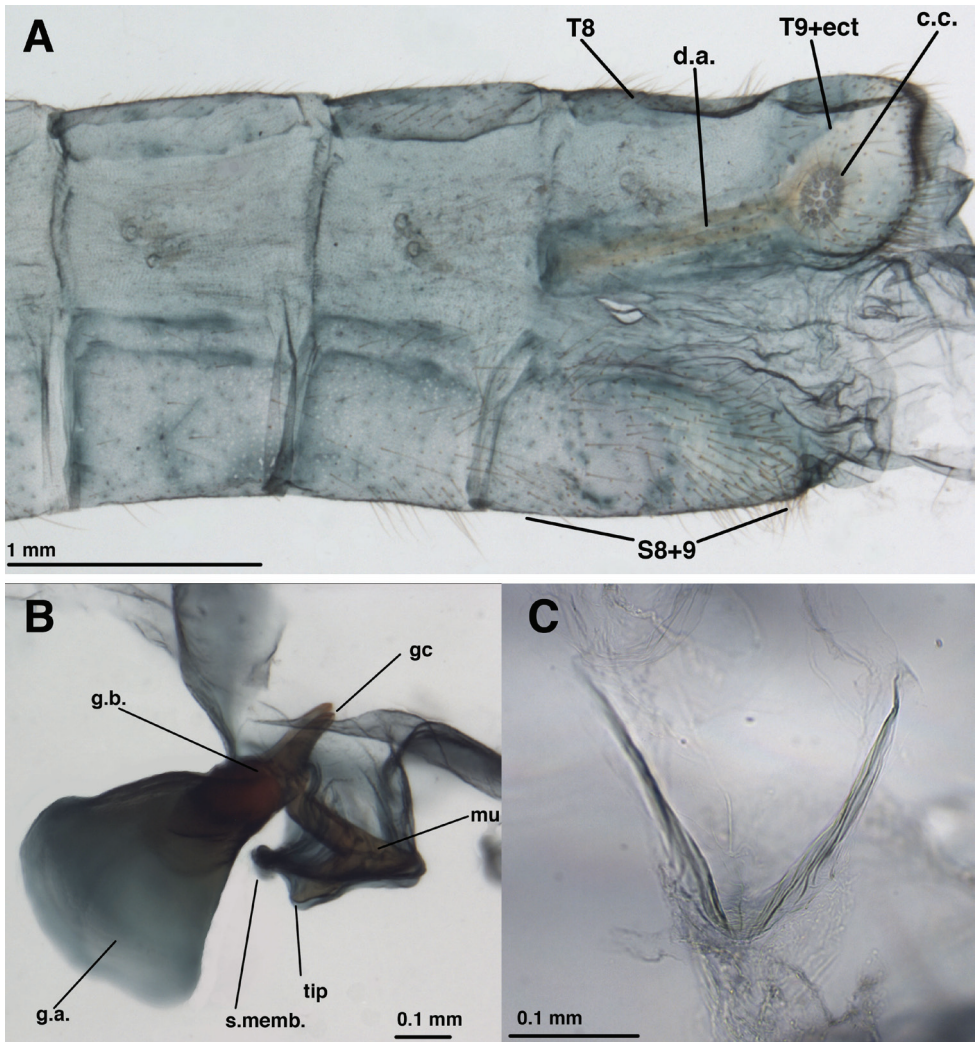


Figure 4. *Leucochrysa (Nodita) azevedoi*, Male (Rio de Janeiro, TRC). **A** Abdomen, lateral **B** Gonarcus, lateral **C** Hypandrium internum, dorsal. *Abbreviations:* c.c., callus cerci; d.a. dorsal apodeme **gc** gonocornu **g.a.** gonarcapodeme **g.b.** gonarcal bridge **mu** mediuncus **s.membr.** setose membrane lateral to mediuncus beak **tip** tip of mediuncus beak **S8+9** fused eighth and ninth sternites **T8** eighth tergite **T9+ect** fused ninth tergite and ectoproct.

Adult description. [Measurements: head, thorax, abdomen, wings (n=4), genitalia (n=2 mature males, 2 mature females)]. *Head:* 1.7–1.9 mm wide (including eyes); ratio of head width to eye width = 2.3–2.5:1. Vertex raised, with smooth surface, prominent, rounded posterior fold, without setae. Antenna 24.7 mm (~1.3 times length of forewing); scape longer than broad, (0.41–0.44 mm long, 0.32–0.34 mm wide), width = 3.2–4.4× distance between scapes, with three to four long setae distally on dorsal surface, shorter setae laterally; lateral margin fairly straight, mesal

margin straight basally, curved outward distally; pedicel ~ 0.10 mm long, ~ 0.15 mm wide (at widest point); proximal flagellomeres short (segments 1, 2, 3: length = 0.85–1.0 times width), with three to four concentric rings of setae; middle and distal segments becoming longer (segments 6–8: length = 1.7–2.1 times width; distal segments: length = 3.0–3.2 times width), with four concentric rings of setae. Distance between scapes 0.08–0.10 mm; distance between tentorial pits 0.57–0.61 mm; length of frons (midway between scapes – midway between tentorial pits) 0.44–0.55 mm. Frons relatively flat mesally, with scalloped fold below toruli; surface smooth to slightly textured, with short setae. Clypeal margins straight; surface slightly textured, not horizontally striated. Labrum with distal margin indented mesally; dorsal surface smooth, rounded, setose distally. Ratio of genal length to distance between tentorial pits = 0.26–0.33:1.

Head coloration: Antennae: scape cream to golden with light greenish tinge, broad red to reddish brown dorsolateral stripe extending full length of scape, onto anterolateral corner of dorsal torulus; pedicel cream with dark brown band distolaterally; flagellum cream with black setae, basal ~ 15 antennomeres with large dark brown to black mark ventrolaterally, fading on antennomeres ~ 16 – 20 ; marks forming prominent dark ventrolateral stripe. Vertex with central area raised, yellowish to greenish posteriorly, with prominent, triangular red to reddish brown mark laterally; area around raised area light green, unmarked. Frons, clypeus white, unmarked; labrum cream to amber; gena white, with narrow longitudinal red to reddish brown stripe immediately below tentorial pit. Torulus cream to amber. Maxilla, maxillary palpi, labium, labial palpi white to cream.

Thorax: Cervix small, largely withdrawn below prothorax, light green, with small reddish brown lateral marks. Prothorax (sclerotized region) 0.86–0.93 mm long; 1.1–1.2 mm wide; ratio of length : width = ~ 0.69 – 0.77 :1; setae thin, long, light golden; pronotum light green, with broad, golden yellow mesal stripe, with pair of lateral to sublateral elongate, red to reddish brown marks with irregular margins, sometimes with pair of small anterolateral reddish marks, pair of small, mesal reddish brown marks. Mesothorax, metathorax light green with golden yellow mesal stripe, sometimes with white; mesoprescutum with pair of crescent-shaped reddish brown marks; mesoscutum with pair of bold, submesal dark red to reddish brown marks; mesoscutellum unmarked; metascutum unmarked or with pair of small, diffuse, reddish brown spots mesally; metascutellum unmarked or with pair of small, diffuse reddish brown spots laterally. Legs unmarked, with golden setae; coxae, femora cream to white; tibiae light green, tarsi golden. Tarsal claws with deep cleft, elongate, with quadrate base.

Wings: Forewing 17.7–19.5 mm long, 6.4–6.9 mm wide (at widest point); ratio of length : maximum width = 2.7–2.9:1. Costal area moderately broad; tallest costal cell (#7–9) 1.4–1.5 mm tall, 2.0–2.2 times width, 0.23–0.24 times width of wing (midwing). First intramedian cell triangular, 0.4–0.7 width of third median cell. First radial crossvein distal to origin of radial sector (Rs); radial area (between Radius and Rs) with single row of 16–18 closed cells; tallest cell (#7–8) 2.2–2.8 times taller than wide. No crassate veins; 5–6 b cells (= cells beneath Rs, not including an inner gra-

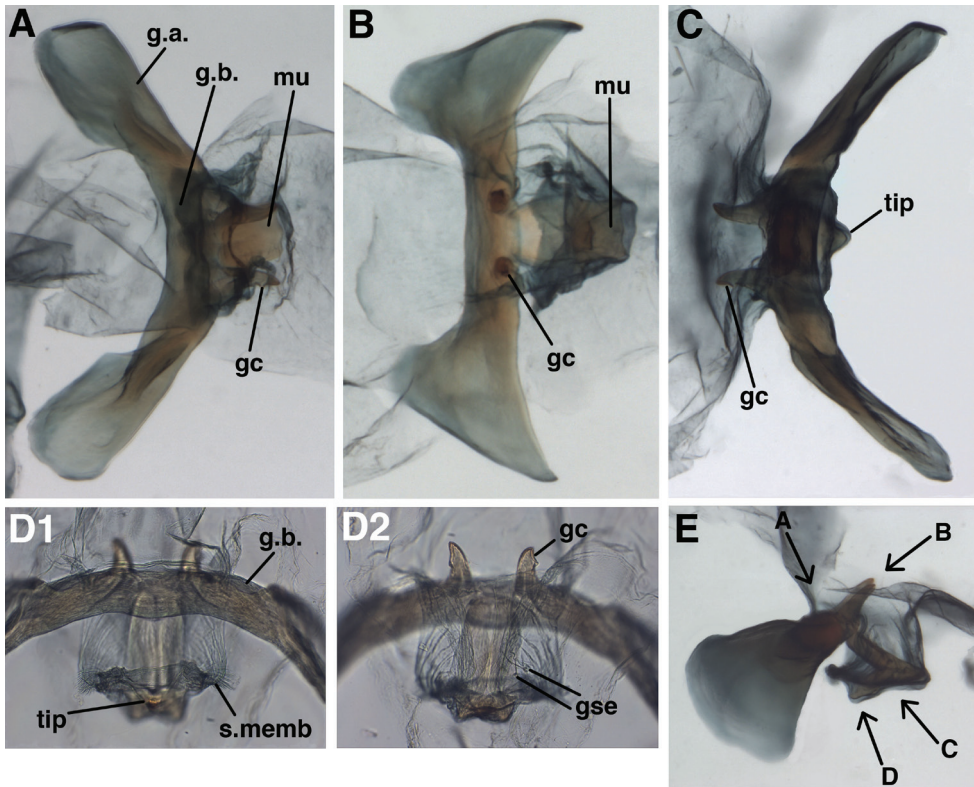


Figure 5. *Leucochrysa (Nodita) azevedoi*, Male gonarcus, series of views. The arrows on the lateral view, **E**, indicate the direction of the views in **A–D** (A–C, Rio de Janeiro, TRC; D, Mato Grosso, CAS). **A** View from above, with gonocornua projecting from the gonarcal bridge to the right, mediuncus extending downward, away from camera [Note heavy membrane above gonarcus extending over gonocornua] **B** Gonarcus with gonocornua projecting directly upward towards camera, mediuncus fully extended to right, covered with heavy membrane extending from gonarcal bridge **C** Gonarcus, view from beneath, with gonocornua extending to left **D** Mediuncus, view from below the tip of the beak: **D1** View at level of the beak; note the setose membranous areas lateral to the tip of the beak **D2** View at level above tip of beak; note membranous gonosaccus and gonosetae well above beak. **Abbreviations:** **gc** gonocornua **gse** gonoseta **g.a.** gonarcal apodeme **g.b.** gonarcal bridge **mu** mediuncus **s.membr**, setose membrane lateral to mediuncus beak **tip** tip of mediuncus beak.

date vein). Two series of gradate veins; 9 inner gradates, 8–10 outer gradates; Eight b' cells (cells beneath pseudomedia after second intramedian cell). Three intracubital cells (two closed). Membrane clear; stigma opaque, marked with brown. Veins green, with black on tips of costal veinlets, basal segment and midsection of Rs, two basal radial crossveins, distal arm of im2, bases of marginal forks.

Hindwing 15.3–16.9 mm long, 4.7–5.4 mm wide. Two series of gradate veins; 7–8 inner, 7–8 outer; 14–16 radial cells (counted from origin of Radius, not false origin). Five to six b cells (including small b1 cell); five to six b' cells beyond second intramedian cell; three intracubital cells (two closed). Membrane clear, with posteroapical

margin streaked with light brown; stigma pronounced, marked with brown basally. Veins mostly light green, but dark brown on tips of costal veinlets, midsection of Rs, tips of marginal forks, vein along distal half of posterior margin.

Abdomen: Distal segments (beyond A4) moderately expanded; pleural region ca. twice height of sternites. Sternites, tergites with microsetae moderately dense; pleural region with very dense microsetae. Male: S6 approx. 1.2–1.4 times longer than tall, S7 approx. 1.0–1.1 times longer than tall (lateral view); female: S6 approx 1.4–1.7 times longer than tall, S7 approx. 1.7–2.0 times longer than tall. Tergites narrow, roughly rectangular, with lighter setae and longer microsetae than on sternites. Spiracles oval externally; atria not enlarged. Coloration: Dorsum with medial yellow stripe, deep red sublateral markings; sides green with deep red marks posterodorsally; venter white; callus cerci white; trichobothria pale.

Male: Callus cerci oval to round, 0.20–0.27 mm diameter (range), with 29–37 relatively thin trichobothria of various lengths. Sternites 3–8 (not S1 or S2) with microtholi. T9+ectoproct truncate distally, fused mesally, midline without deep cleft, setae robust throughout, slightly smaller proximally than distally; ventral section of T9+ectoproct with broad, elongate proximal extension reaching full length of A8; proximal section well sclerotized, with apodeme heavy, unbranched, extending around proximal margin of callus cerci. S8+9 fused, without suture in mature specimens; S9 without microtholi; S8 much shorter, slightly taller than S9; S8+9 (lateral view) with proximal margin straight, rounded dorsally, acute ventrally; distal margin straight, with rounded apices, approximately 1/3 height of proximal margin. Setae on S9 slightly heavier than those on S5–S8; terminus of S9 without gonocristae. Subanal region membranous, with small striations around anus, no setae. Gonarc complex connected to terminus of ectoproct by long, clear, smooth membrane that attaches to gonarc bridge around base of gonocornua; gonocornua protruding through membrane; section of membrane below mediuncus extending interiorly and holding hypandrium internum. Gonarcus robust, very broadly arcuate, with lateral apodemes extending laterally almost entire width of T9+ect; gonarc apodemes robust, stiff, slightly concave dorsally, rounded distally. Gonocornua broadly attached to gonarc bridge, mesal to mediuncus, extending upward, away from mediuncus, short, stout, with inner margin curving outward, outer margin perpendicular to bridge, with lateral knob distally. Mediuncus largely membranous, dorsally with pair of longitudinal ridges, trough between, distally with pair of rounded lobes, recurved arcessus with heavy, rounded, beak-like tip; sides of mediuncus membranous, expanded, forming hollow depression; membrane inside depression bearing ~3 pairs of robust, medium-length setae on small chalazae; distal margins of mediuncal membrane with dense patches of relatively long, fine setae. Entoprocessus, tignum, gonapsis, pseudopenis, spinellae, gonocristae, gonosaccus absent. Hypandrium internum with broad V-shape, apex rounded, large, delicate, lightly sclerotized; comes elongate, thin, sometimes not visible.

Female: Callus cerci round, 0.16–0.22 mm maximum diameter, with 25–33 trichobothria of mixed length. Tergite 8 roughly quadrate (lateral view), similar in depth to T6. Tergite 9+ectoproct elongate; posterior margin: dorsal half straight,

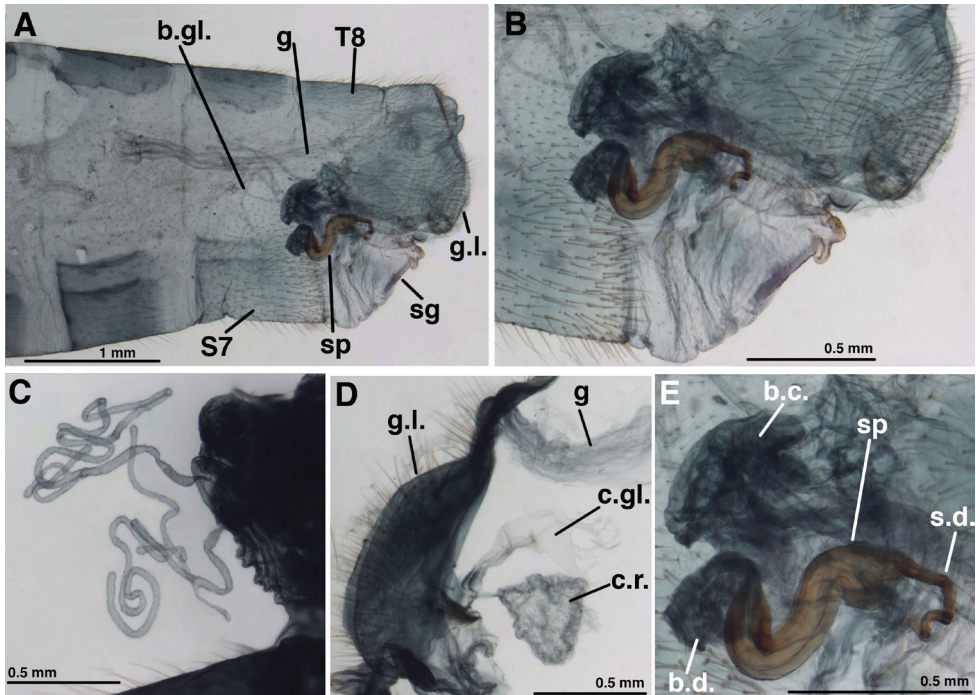


Figure 6. *Leucochrysa (Nodita) azevedoi*, Female (Rio de Janeiro, TRC). **A** Abdomen, lateral **B** Terminalia, lateral **C** Paired bursal glands [Note narrow connections to bursa copulatrix.] **D** Gonapophyses laterales and colleterial structures [Colleterial gland damaged] **E** Spermatheca and part of bursa copulatrix. *Abbreviations:* **b.c.** bursa copulatrix **b.d.** bursal duct **b.gl.** bursal gland **c.gl.** colleterial gland **c.r.** colleterial reservoir **g** gut **g.l.** gonapophysis lateralis **sg** subgenitale **sp** spermatheca **s.d.** spermathecal duct **S7** seventh sternite **T8** eighth tergite.

almost perpendicular to dorsal margin of tergite, ventral half indented, angled inward, straight; ventral margin rounded, extending slightly below gonapophyses laterales. Sternite 7 with transverse weakness midlength, dorsal margin straight, not tapering distally; terminus unmodified, with terminal (posteroventral) setae slightly more dense, robust, and longer than other setae. Gonapophysis lateralis angled dorsally, rounded distally, ventrally, $\sim 0.65\text{--}0.68$ length of T9+ectoproct; inner membranous surface not expandable, with \sim two vertical rows of short setae. Colleterial gland smooth-walled, delicate, with fluted, globate reservoir or secondary gland attached via a narrow duct immediately before transverse sclerification. Transverse sclerification robust, flat, platform-like with lateral margins upturned, with coarse longitudinal striations. Bursa copulatrix saccular, consisting of robust, densely folded membrane, extending anteriorly over spermatheca, into distal section of S7; pair of robust, branching, elongate, tubular bursal glands, connected to dorsolateral surface of bulbous end of bursa via short, very narrow duct. Spermatheca tubular, bent, thick at opening, tapering slightly (0.17–0.20 mm diameter at mouth, 0.12 mm diameter at midsection), 0.8–0.9 mm long, with broad, shallow (0.06–0.09 mm)

invagination; slit along entire side of spermatheca opening to bursa. Spermathecal duct attached to anterior margin of spermatheca; basal section thick, straight, extending directly into base of subgenitale, then gradually tapering at first U-shaped bend, recurving posteriorly with two curves; basal ~one-half to two-thirds well sclerotized; distal section clear, brushy. Subgenitale broad, rounded, with smooth, rigid surface distally, with folded, membranous surface, with terminus broad, bilobed, with shallow, flat depression between lobes (heart shaped in posterior view); small ventral fold on S7 without setae.

Larvae. Described elsewhere (Mantoanelli et al. in press).

Biology. This species has been collected in orchards in the states of Rio de Janeiro, São Paulo, Mato Grosso and Rio Grande do Sul, in some cases in relatively large numbers. Its seasonal occurrence in orchards of coastal Brazil was assessed (Multani 2008).

Distribution. Currently known only from Brazil. We have seen specimens from the States of Rio de Janeiro, Matto Grosso, and São Paulo [also see Freitas and Penny 2001, as *L. (N.) camposi*]. Probably, the species also occurs in the State of Pará. [Note: Adams (1987) considered a specimen that he studied from Pará (illustrated in Fig. 18) to be an abnormal variant of *Leucochrysa (Nodita) amazonica* (Navás). It is not clear why he did so; Navás's description of *L. (N.) amazonica* was based on a single teneral male from the lower Amazon. Our study shows that Adams' figure of the specimen from Pará is typical of *L. (N.) azevedoi*.]

Variation. See images on our project site at www.morphobank.org. In teneral males, S8 and S9 are only partially fused; the segments are fully fused, but well demarcated in mature males. When teneral, the gonarcus is thin and delicate; the gonocornua are small and closely aligned, adjacent to the mediuncus; and the setose lateral extensions below the beak of the mediuncus are not visible, but the beak is distinct.

In addition to the specimens listed below, we examined one specimen (a male) from the State of Rio Grande do Sul. This specimen's background color and markings are lighter than those of the other specimens; in addition, the beak on its mediuncus is sharp and straight, not blunt and decurved as in *L. (N.) azevedoi*. A determination of whether this specimen represents a separate species or a variant population of *L. (N.) azevedoi* awaits the availability of additional specimens.

Adult specimens examined. In addition to the neotype listed above: Brazil. Rio de Janeiro: Campos dos Goytacazes, VI/22/1999, R. R. Moraes (1♂, 1♀, Tauber Research Collection, TRC); Campos dos Goytacazes, Est. Exp. PESAGRO (Estação Experimental da Empresa de Pesquisa Agropecuária do Estado do Rio de Janeiro, 21°44'55"S, 41°18'30"W, 14m, VII-2005 – III-2007, G. S. Albuquerque, J. S. Multani, Collectors (2♂♂, 2♀♀, alcohol, UENF; 3♂♂, 3♀♀, alcohol, 1♀ pinned, TRC). São Paulo: Jaboticabal, FCAV, 10 July 1998, Freitas, S., 10 (1♂, California Academy of Sciences, CAS). Mato Grosso: Itiquira, P. E. Michelin, 18 July 1998, Freitas, S., M10 (1♂, CAS).

Etymology. Latinized proper name, genitive. Navás named the species in honor of Ignacio de Azevedo (1528–1570), a Portuguese Jesuit who labored in Brazil and was killed along with 39 Jesuit companions, while sailing near the Canary Islands on a return voyage from Rome to Brazil. They are known as the “Fourty Martyrs of Brazil”.

***Leucochrysa (Nodita) camposi* (Navás, 1933)**

[http://species-id.net/wiki/Leucochrysa_\(Nodita\)_camposi](http://species-id.net/wiki/Leucochrysa_(Nodita)_camposi)

additional images: <http://morphobank.org/permalink/?P243>

Figs 1B, 7–10

Nodita camposi Navás, 1933: 197–8, Fig. 17 (Lectotype: MNHN, male, examined; original description: “Ecuador: Guayaquil, Julio de 1932. Campos R. Leg.”). Navás (1934b: 16) [collection record: “Guayaquil (Ecuador), 1933. Campos leg.”; specimen in MNHN]; Penny (1977: 25) [species list].

Leucochrysa (Nodita) camposi (Navás). First combination in *Leucochrysa (Nodita)* apparently by Brooks and Barnard (1990: 277) [species list]. Freitas and Penny (2001: 287) [misidentified; see *L. (N.) azevedoi*, above]; Oswald (2007) [catalog listing, nomenclature]; Legrand et al. (2008: 121) [lectotype designation, information on type].

Nodita morenoi Navás 1934a: 157–158 (Lectotype: MNHN, male, examined; original description: “Équateur, Quito, R. Benoist, 1930. Mus. Paris.”). Synonymized by Legrand et al. (2008: 154). Here: **Synonymy reversed** (see below).

Type material. The *N. camposi* lectotype, a male, is badly discolored, but its wings are in good condition, its body is mature, and the genitalia are well sclerotized. A female specimen collected one year later, at the same locality as the type, is also mature.

Diagnosis. *L. (N.) camposi* can be distinguished from *L. (N.) azevedoi* by its somewhat larger size and more robust appearance (see above) and genitalic characters (male and female) (Figs 8–10). In the male *L. (N.) camposi*, the gonarcal arms are narrowly arched; the gonarcal arms extend perpendicularly from the gonarcal bridge, not laterally as in *L. (N.) azevedoi*. The gonocornua are located distally on the gonarcal bridge, well outside the span of the mediuncus, and they extend laterally away from the gonarcal bridge. Like *L. (N.) azevedoi*, the mediuncus is heavy apically and its beak is borne on a plate (arcessus) that bends back toward the gonarcal arch; however, the membrane extending from the beak does not have distinct arms or patches of setae, as are found on *L. (N.) azevedoi*. The hypandrium internum is delicate and has a very narrow U-shape. The *L. (N.) camposi* female can be recognized by its bulbous spermatheca, asymmetrical bursa that extends from its left side over the spermatheca and part of the bursal duct, and its highly coiled bursal duct that extends well into the sixth abdominal segment. The bursal glands are elongate, branching and ribbon-like.

Adult description. *Head:* 1.9 mm wide (including eyes); ratio of head width to eye width = 2.1:1. Vertex raised, with smooth surface, four prominent, circular muscle attachment scars along posterior margin, without setae. Antenna 33.3 mm (~1.5 times length of forewing); scape longer than broad, (0.47–0.50 mm long, 0.36–0.39 mm wide), width = 4.2–4.5× distance between scapes, with ~four long setae distally on dorsal surface, shorter setae laterally; lateral margin fairly straight, mesal margin straight basally, curved outward distally; pedicel ~0.17 mm long, ~0.17 mm wide (at widest point); proximal flagellomeres short (segments 1, 2, 3: length = 1.2–1.5 times width), with three concentric rings of setae; middle and distal segments becoming longer (seg-

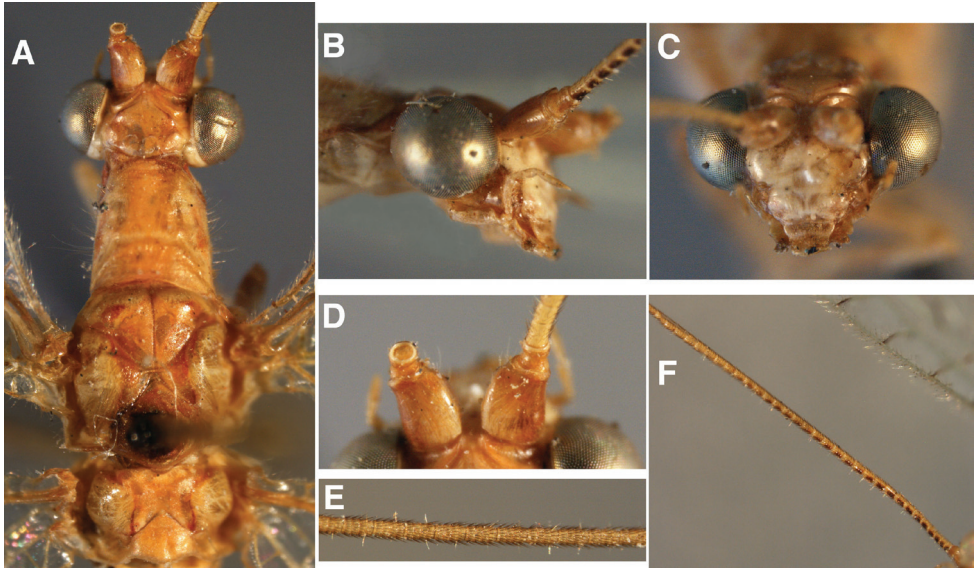


Figure 7. External features, *Leucochrysa (Nodita) camposi*, Male (Guayaquil, Ecuador, Lectotype, MNHN). **A** Head, thorax, dorsal **B** Head, lateral **C** Head, frontal **D** Scapes, dorsal **E** Mid-section of antenna **F** Base of antenna, dorsal. Note red markings on the notum of each segment.

ments 8–10: length = 1.5–1.8 times width; distal segments: length = 2.1 times width), with four concentric rings of setae. Distance between scapes 0.09 mm; distance between tentorial pits 0.65 mm; length of frons (midway between scapes – midway between tentorial pits) 0.50 mm. Frons relatively flat mesally, with scalloped fold below toruli; surface smooth. Clypeal margins straight; surface slightly textured, not horizontally striated. Labrum with distal margin slightly indented mesally; dorsal surface smooth, setose distally; sides rounded. Ratio of genal length to distance between tentorial pits = 0.31:1.

Head coloration. Specimen largely discolored with age. Antennae: scape amber colored mesally, noticeably darker laterally, probably a broad reddish brown dorsolateral stripe extending full length of scape; pedicel probably with brownish band distolaterally; flagellum cream with golden brown setae, basal ~20 antennomeres with large dark brown to black mark ventrally, fading on antennomeres ~20–28; marks forming prominent dark stripe ventrally. Vertex with raised central area discolored, with thin reddish brown streak across frontal margin, trace of large triangular red mark laterally; area between raised area and eyes maybe marked with red. Frons, clypeus white, unmarked; labrum cream to amber; gena discolored, possibly red throughout. Maxilla, maxillary palpi, labium, labial palpi white to cream.

Thorax: Cervix small, largely withdrawn below prothorax, discolored, with small reddish lateral marks. Prothorax (sclerotized region) 0.95 mm long; 1.3 mm wide; ratio of length : width = 0.74:1; prothorax (extended) 1.3 mm long; setae thin, long, golden; discolored, with pair of anterolateral spots, pair of elongate, sublateral, red marks with irregular margins. Mesothorax, metathorax discolored; mesoprescutum

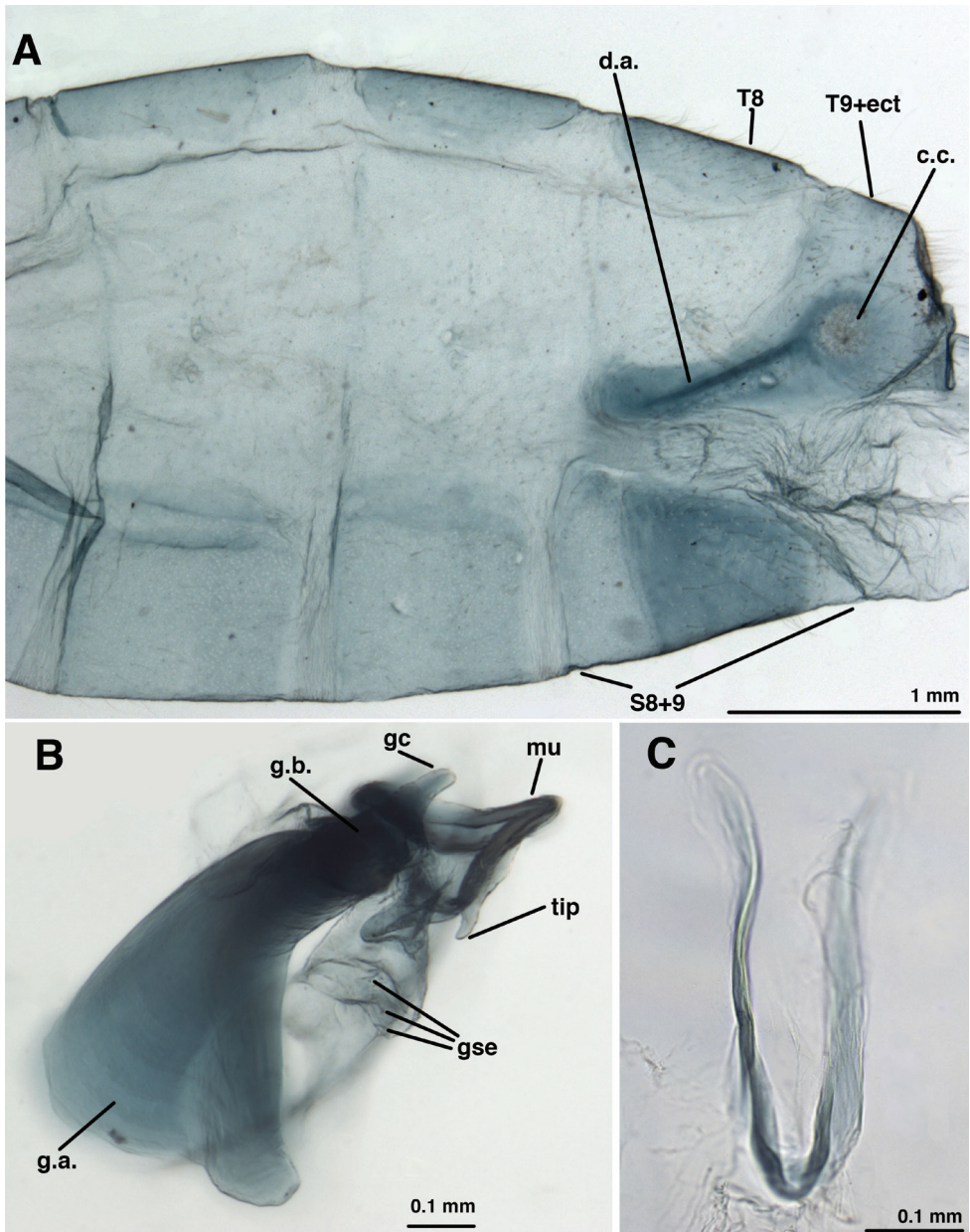


Figure 8. *Leucochrysa (Nodita) camposi*, Male (Guayaquil, Ecuador, Lectotype, MNHN). **A** Abdomen, lateral **B** Gonarcus, lateral **C** Hypandrium internum, dorsal. *Abbreviations:* **c.c.** callus cerci **d.a.** dorsal apodeme **gc** gonocornu **gse** gonoseta **g.a.** gonarcus apodeme **g.b.** gonarcus bridge **mu** mediuncus **tip** tip of mediuncus beak **S8+9** fused eighth and ninth sternites **T8** eighth tergite **T9+ect** fused ninth tergite and ectoproct.

with pair of red marks mesally; mesoscutum with pair of red marks on anteromesal flank; metascutum with pair of thin red submesal streaks from middle to posterior margin. Legs unmarked, with golden setae, described by Navás as: greenish, tarsi probably amber.

Wings: Forewing 21.3–21.6 mm long, 8.1–8.2 mm wide (at widest point); ratio of length : maximum width = 2.7:1. Costal area slightly expanded basally; tallest costal cell (#8, 9) 1.1 mm tall, 2.1 times width, 0.2 times width of wing (midwing). First intramedian cell triangular, 0.7 times width of third median cell. First radial crossvein distal to origin of radial sector (Rs); radial area (between Radius and Rs) with single row of 17 closed cells; tallest cell (#6) 3.0 times taller than wide. No crassate veins; 5 b cells. Two series of gradate veins; 10–11 inner gradates, 10–11 outer gradates; 6–8 b' cells. Three intracubital cells (two closed). Membrane clear, except posteroapical faint tinge of brown streaked across bases of forked distal veinlets; stigma golden, with small brown mark basally. Veins green, with dark brown to black on tips of costal veinlets, basal segment of Rs (to first posterior crossvein), two basal radial crossveins, midsection of Rs and radial crossveins above, bases of marginal forks.

Hindwing 18.5–18.8 mm long, 5.5–6.1 mm wide. Two series of gradate veins; 8 inner, 9 outer; 15 radial cells (counted from origin of Radius, not false origin). Four to five b cells (including small b1 cell); five b' cells beyond second intramedian cell; two intracubital cells (one closed). Stigma golden, marked with brown distally; membrane clear with posteroapical margin streaked with faintly brown tinge. Veins green, except midsection of Rs, tips of marginal forks (posteroapical margin of wing) dark brown to black.

Abdomen (male type only; female abdomen damaged): Distal segments (beyond A4) expanded; pleural region (P6) ca. 2.75 times height of sternite (S6). Setae on tergites, sternites, moderately long, slender; setae on pleura short, small; microsetae moderately dense, small throughout. S6 approx. 1.3 times longer than tall, S7 approx. 1.1 times longer than tall (lateral view). Tergites cap-like, with lighter setae and longer microsetae than on sternites. Spiracles oval externally; atria not enlarged. Coloration: specimen discolored.

Male [gonarcus complex separated from abdomen, connecting membrane remains attached to gonarcus]: Callus cerci ~round, 0.21–0.25 mm diameter (range), with 39 long, thin, trichobothria. Sternites 3–8 (not S1 or S2) with microtholi. T9+ectoproct short, truncate distally, fused mesally, midline without deep cleft, setae long, moderately slender throughout; ventral section of T9+ectoproct with elongate proximal extension reaching full length of A8; proximal section well sclerotized, with apodeme heavy, extending around proximal margin of callus cerci. S8+9 fused, without suture; S9 without microtholi; S8 much shorter, slightly taller than S9; S8+9 (lateral view) with proximal, distal margins straight, with acute ventral apices, rounded dorsal apices, slightly <1/2 height of proximal margin. Setae on S9 very slightly heavier than those on S5–S8; terminus of S9 without gonocristae. Subanal region membranous, with small striations around anus, no setae. Gonarcus complex attached to gonarcus bridge by clear, smooth membrane around base of gonocornua; gonocornua protruding through membrane; section of membrane be-

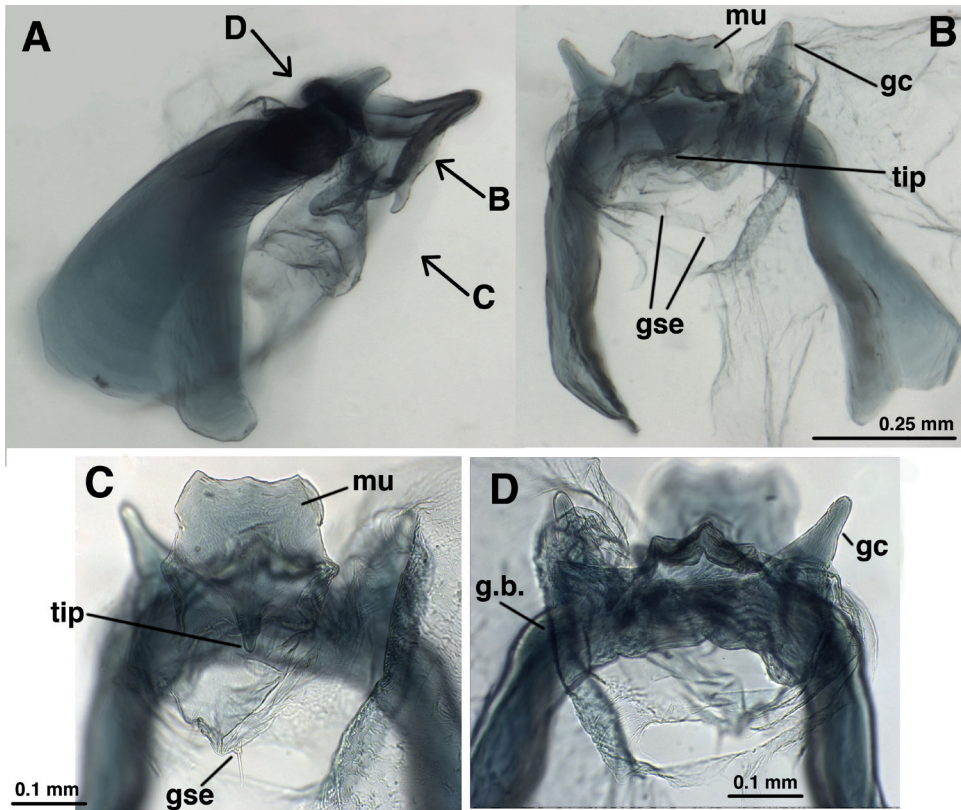


Figure 9. *Leucochrysa (Nodita) camposi*, Male gonarcus, series of views. The arrows on the lateral view, **A**, indicate the direction of the views in **B–D**. (Guayaquil, Ecuador, Lectotype, MNHN). **A** Lateral view **B** Gonarcus, view from beneath, with gonocornua extending upward above gonarcal bridge [Note heavy membrane around base of gonocornua] **C** Gonarcus, view from beneath, with gonocornua extending upward above gonarcal bridge, focus on frontal surface of mediuncus and gonoseta on membrane beneath gonarcus **D** Gonarcus, view from above, with gonocornua extending upward above gonarcal bridge, focus on junction of mediuncus with gonarcal bridge. *Abbreviations:* **gc** gonocornua **gse** gonoseta **g.b.** gonarcal bridge **mu** mediuncus **tip** tip of mediuncus beak.

low mediuncus confluent with gonosaccus below mediuncus, holding hypandrium internum distally. Gonarcus robust, narrowly arcuate, with lateral apodemes extending perpendicularly from gonarcal bridge; gonarcal apodemes robust, stiff, lateral surface slightly concave, expanded distally (lateral view). Gonocornua broadly attached to gonarcal bridge distal to mediuncus, broad basally, tapering distally, with straight margins, rounded tips. Mediuncus largely sclerotized; base with membranous attachment to dorsum of gonarcal bridge, mesal to gonocornua; basal section with pair of shallow, elongate depressions, acute ridge between, becoming flattened, expanded distally; terminus rounded laterally, scalloped frontally; ventral surface (below expanded tip of mediuncus) with elongate, recurved, mesal beak; sides of mediuncus membranous, connecting below mediuncus, forming

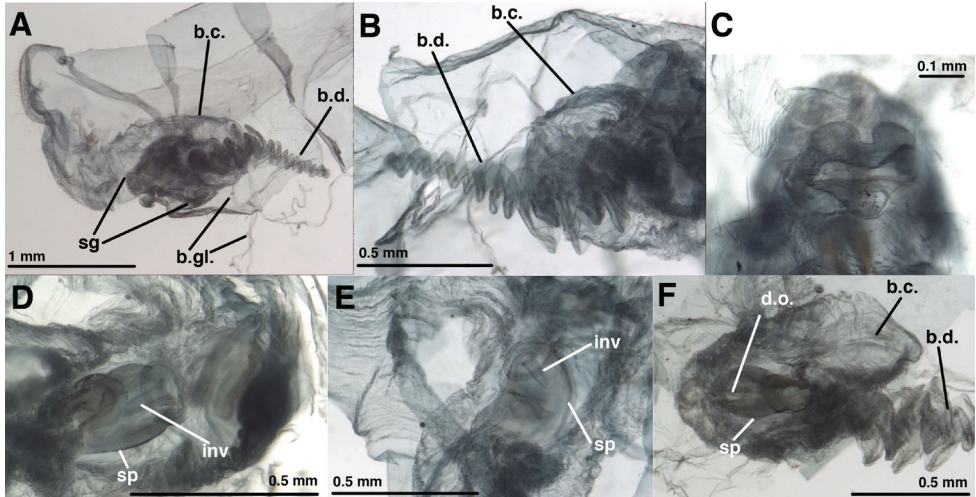


Figure 10. *Leucochrysa (Nodita) camposi*, Female [MNHN, Nontype Navás specimen]. **A** Terminalia, dissected, lateral view from right **B** Bursal duct, part of bursa copulatrix, lateral view from left **C** Subgenitale, posterior view **D** Spermatheca beneath bursa copulatrix, ventral view **E** Spermatheca beneath bursa copulatrix, ventrolateral view **F** Spermatheca, dorsal view, through bursal copulatrix [Note dorsal slit.]. *Abbreviations:* **b.c.** bursa copulatrix **b.d.** bursal duct **b.gl.** bursal gland **d.o.** dorsal slit or opening from spermatheca to bursa copulatrix **inv** spermathecal invagination **sg** subgenitale **sp** spermatheca.

internal pouch below beak, above gonosaccus. Gonosaccus clear, smooth, folded membrane, bearing ~3 pairs of robust, medium-length gonosetae on small chala-zae. Entoprocessus, tignum, gonapsis, pseudopenis, spinellae, gonocristae absent. Hypandrium internum with narrow U-shape, apex rounded, delicate, lightly sclerotized; comes very faint.

Female: Callus cerci round, 0.26 mm maximum diameter, with 39 slender trichobothria. Tergite 8 roughly quadrate (lateral view), similar in depth to T6. Tergite 9+ectoproct elongate; posterior margin: dorsal one-third straight, perpendicular to dorsal margin of tergite, then indented, angled inward, straight; ventral margin rounded, extending to depth of gonapophyses laterales. Sternite 7 largely damaged. Gonapophysis lateralis angled dorsally, rounded distally, ventrally, ~0.60 length of T9+ect; inner membranous surface not expandable, with sparse, small setae on inner surface. Colleterial gland missing but short, thick duct attached immediately before transverse sclerification. Bursa copulatrix concave, shield-like, lightly folded, thick membranous sac, extending anteriorly over spermatheca, into mid-section of S7, also extending, asymmetrically on left side of S7 above ca. basal one-half of coiled bursal duct; with pair of slender, elongate, branching, ribbon-like bursal glands, one connected on either side of bursa, near interior tip of bursa. Bursal duct flat to thickened, coiled, robust, tapering anteriorly to A6, then coiling back on itself to bursa; membranous throughout. Spermatheca broad, thick, U-shaped tube, thick walled with wide circular opening facing subgenitale, enlarged tire-shaped bulge at open end, prominent slit along entire dorsum, opening to

bursal duct (0.16 mm diameter at mouth, narrower at midsection), ~0.5 mm long, with narrow (0.04 mm), moderate length (0.12 mm) invagination. Spermathecal duct uncolored, originating on dorsal surface of spermatheca at terminus of dorsal slit, making two sharp bends, a U-shaped bend in subgenitale, then glandulose thickened portion making broad bend back toward spermatheca. Subgenitale large, rounded, with rigid, folded, heavy membranous texture, terminus broad, flat-surfaced, bilobed dorsally (heart shaped in posterior view), with large, flat transverse depression mesally below lobes, with ventrally protruding tip; small ventral fold above S7 without setae.

Larvae and biology. Unknown.

Distribution. Currently known only from Ecuador (Guayaquil, Quito).

Adult specimens examined. In addition to the type listed above, we examined two female specimens from the type locality; both are in the MNHN. One was collected in 1933 and was reported by Navás (1934b: 16). The other specimen bears a determination label reading “*Nodita Azevedoi* Nav, P. Navás S.J. det.”; it was reported by Navás (1928: 111). The descriptions above are based on the male type and the female specimen reported by Navás in 1934.

Etymology. Navás named the species in honor of its collector, D. Francisco Campos R. of Guayaquil, Ecuador. Campos provided Navás with numerous lacewing specimens from Ecuador.

***Leucochrysa (Nodita) morenoi* (Navás, 1934)**

[http://species-id.net/wiki/Leucochrysa_\(Nodita\)_morenoi](http://species-id.net/wiki/Leucochrysa_(Nodita)_morenoi)

additional images: <http://morphobank.org/permalink/?P243>

Figs 1C, 11–13

Nodita morenoi Navás, 1934a: 157–158 (Lectotype: MNHN, male, examined; original description: “Équateur, Quito, R. Benoist, 1930. Mus. París.”); Penny (1977: 26) [species list].

Leucochrysa morenoi (Navás) – listed by Oswald (2007). We could not find a supporting reference.

Leucochrysa (Nodita) morenoi (Navás). First combination in *Leucochrysa (Nodita)* apparently by Brooks and Barnard (1990: 277) [species list]. Oswald (2007) [catalog listing, nomenclature]; Legrand et al. (2008: 154) [lectotype designation, information on type, identified as subjective junior synonym of *Leucochrysa (N.) camposi* (Navás, 1933)]. Here: **Reinstated as a valid species.**

Type material. The *N. morenoi* lectotype, a male, is discolored, but otherwise in good condition; the abdomen is cleared and in a vial with glycerin. For this study, we re-examined the types of *N. morenoi* and *N. camposi* side-by-side; here, we provide images and a re-description to support our recognition of *L. (N.) moreni* as a valid species.

Diagnosis. *L. (N.) morenoi* is known only from the type specimen, which is badly discolored with age. At this time, the only reliable way to identify specimens is with

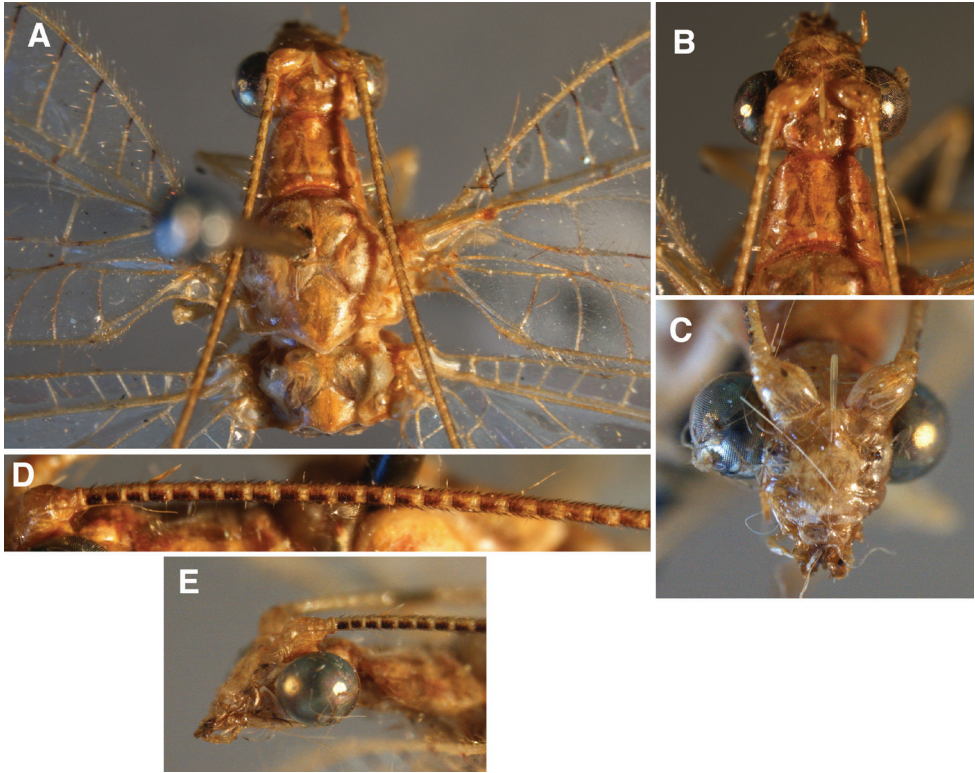


Figure 11. External features, *Leucochrysa (Nodita) morenoi*, Male (Quito, Lectotype, MNHN). A. Head, thorax, dorsal; B. Head, prothorax, dorsal; C. Head, frontal; D. Antennal base, lateral; E. Head, lateral.

the male genital characters (Figs 12 & 13). In both species the gonarc arch is U-shaped, with the gonarc apodemes approximately perpendicular to the bridge. However, unlike in *L. (N.) camposi*, the *L. (N.) morenoi* gonarcus is rounded posteriorly (c.f. Fig. 12C with Fig. 8B); the mediuncus is rounded dorsally; and the gonocornua are flattened and expanded laterally (c.f. Figs 12 and 13 with Fig. 9). Externally (Fig. 11), *L. (N.) morenoi* resembles a large number of species, including *L. (N.) azevedoi* and *L. (N.) camposi*, in the following traits: dark brown to black, lateral marks on the basal ~15 flagellomeres that give impression of a streak on the exterior edge of the antenna, a darkened section in the middle of the Radial sector (forewings and hindwings), and darkened terminal veinlets along the posteroapical margin of the hindwings. The head and thorax are too discolored to determine if there are reddish markings on the vertex, gena, scape, or prothorax as there are on many of the other species with these traits. We suspect that they are not present on this species because the only marks that Navás (1934) mentioned in the original description were an iron-grey color on the lateral margins of the pronotum (not visible on the type now) and a pair of dark brown (“fuscis”) marks on the mesoprescutum (present on the type). *L. (N.) morenoi* is large and robust in appearance, more like *L. (N.) camposi*, than *L. (N.) azevedoi* [e.g., forewing

length: 21–22 mm for *L. (N.) morenoi* and *L. (N.) camposi* versus 18–19.5 mm for *L. (N.) azevedoi*].

Adult description. *Head:* 2.12 mm wide (including eyes); ratio of head width to eye width = 1.85:1. Vertex approximately oval, raised slightly, with smooth to slightly textured surface, small posterior fold. Antenna 38 mm long (~1.8 times length of forewing); scape longer than broad, (~0.4 mm wide), width = 2× distance between scapes, with long setae distally on dorsal surface, shorter setae laterally; lateral margin fairly straight, mesal margin straight basally, curved outward distally; pedicel ~0.25 mm long, ~0.18 mm wide (at widest point); proximal flagellomeres short (segments 1, 2, 3: length = 1.2–1.5 times width), with three to four concentric rings of setae; middle and distal segments becoming longer (segments 9–11: length = 1.6–1.7 times width; distal segments: length = 2.2–2.6 times width), with four concentric rings of setae. Distance between scapes 1.04 mm; distance between tentorial pits 0.65 mm; length of frons (midway between scapes – midway between tentorial pits) 0.77 mm. Frons relatively flat, with slightly scalloped fold below toruli; surface smooth to slightly textured. Clypeus straight distally; surface slightly textured, not horizontally striated. Labrum with distal margin very slightly concave mesally; dorsal surface smooth, rounded, setose distally. Ratio of genal length to distance between tentorial pits = 0.41:1.

Head coloration: Antennae pale, probably yellow or cream, with or without lateral stripe on scape; pedicel pale, possibly with darkened ring distally; flagellum pale with dark brown to black setae; basal ~15 antennomeres with dark brown lateral marks, fading on antennomeres 16–20. Vertex and remainder of head pale, with no discernable markings. Frons, clypeus white, unmarked; gena discolored, probably without markings. Torulus cream. Maxilla, maxillary palps, labium, labial palps pale, unmarked.

Thorax: Cervix small, largely withdrawn below prothorax, discolored. Prothorax (sclerotized region) 0.83 mm long; 1.03 mm wide; ratio of length : width = 0.56:1; prothorax (extended) 1.5 mm long; setae thin, long, golden; surface discolored, scattered patches of red tinge visible, but not mentioned in original description, small grey area mentioned in original description not apparent now. Mesothorax, metathorax discolored; mesoprescutum with pair of sublateral reddish brown marks (mentioned in original description); mesoscutum with pair of brown streaks on anterior and posterior margin; mesoscutellum unmarked; metascutum with pair of brownish spots on posterior margin. Legs unmarked, with golden setae, originally described as greenish.

Wings: Forewing 21.6 mm long, 8.0 mm wide (at widest point); ratio of length : maximum width = 2.7:1. Costal area moderately broad; tallest costal cell (#10) 1.4 mm tall, 1.8 times width, 0.19 times width of wing (midwing). First intramedian cell triangular, 0.6 width of third median cell. First radial crossvein distal to origin of radial sector (Rs); radial area (between Radius and Rs) with single row of 17 closed cells; tallest cell (#5) 2.8 times taller than wide. No crassate veins; 6 b cells. Two series of gradate veins; 13 inner gradates, 11 outer gradates; nine b' cells. Three intracubital cells (two closed). Membrane clear; stigma golden, marked with brown basally. Veins mostly

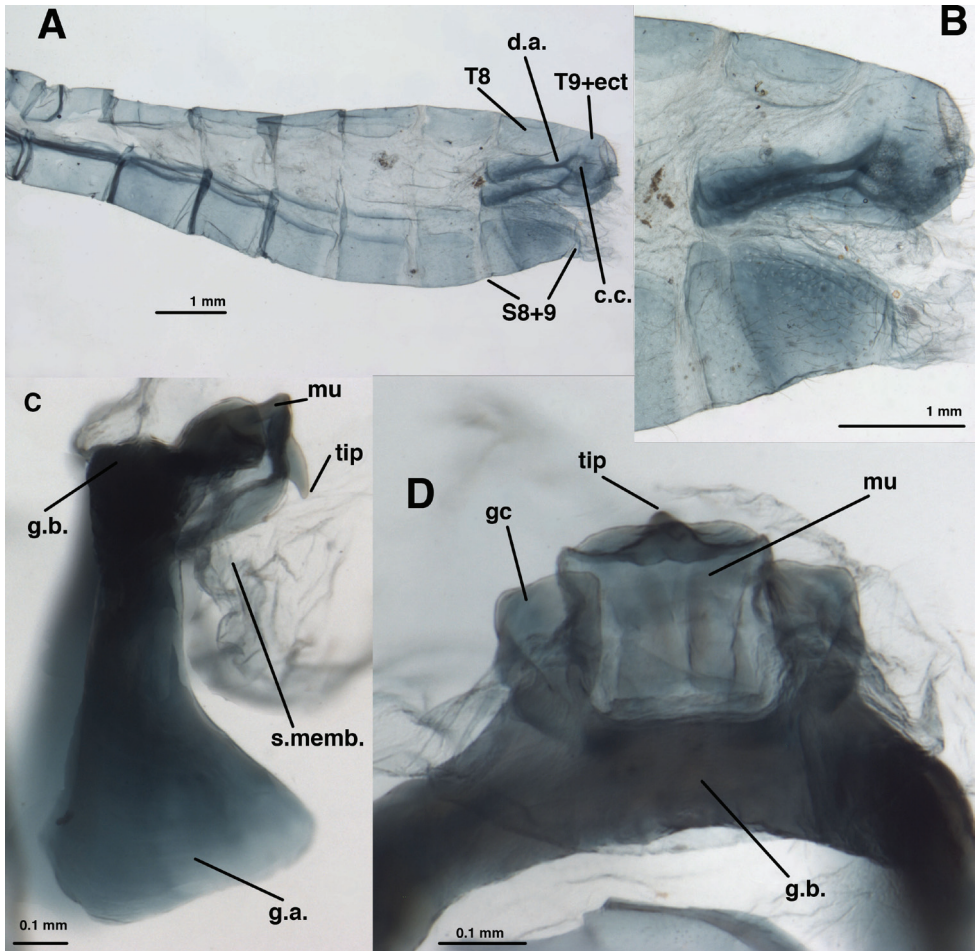


Figure 12. *Leucochrysa (Nodita) morenoi*, Male (Quito, Lectotype, MNHN). **A** Abdomen, lateral **B** Terminalia, lateral **C** Gonarcus, lateral **D** Gonarcus, dorsal view. *Abbreviations:* **c.c.** callus cerci **d.a.** dorsal apodeme **gc** gonocornu **g.a.** gonarcual apodeme **g.b.** gonarcual bridge **mu** mediuncus **s.memb** setose membrane lateral to mediuncus beak **tip** tip of mediuncus beak **S8+9** fused eighth and ninth sternites **T8** eighth tergite **T9+ect** fused ninth tergite and ectoproct.

green (probably), with dark brown on tips of most costal veinlets, basal segment, three basal radial crossveins, small midsection of Rs, crossveins stemming from darkened midsection, inner gradates, outer gradates, bases of marginal forks.

Hindwing 18.7 mm long, 6.2 mm wide. Two series of gradate veins; 9 inner, 9 outer; 17 radial cells (counted from origin of Radius, not false origin). Six b cells (including small b1 cell); seven b' cells beyond second intramedian cell; two intracubital cells (two closed). Membrane clear, probably streaked with light brown tinge along posterodistal margin; stigma pronounced, marked with brown. Veins mostly green (probably), but dark brown on midsection of Rs, tips of crossveins extending from darkened midsection, and posteroapical margin of wing.

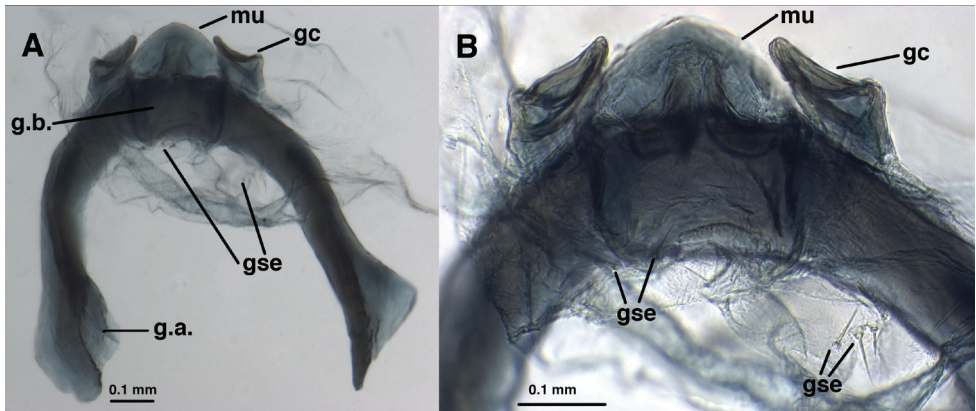


Figure 13. *Leucochrysa (Nodita) morenoi*, Male (Quito, Lectotype, MNHN). **A, B** Gonarcus, ventral view. Abbreviations: **gc** gonocornu **gse** gonoseta **g.a.** gonarcus apodeme **g.b.** gonarcus bridge **mu** mediuncus.

Abdomen: Distal segments (beyond A4) expanded; pleural region ca. two times height of sternites. Sternites, tergites with microsetae relatively sparse; male: S6 ca. same height as length, S7 approx. 1.1 times taller than long (lateral view). Tergites roughly rectangular, with rounded posterior and lateral margins, shorter setae than on sternites. Spiracles oval externally; atria not enlarged. Coloration: information not available.

Male: Callus cerci ca. round, 0.25–0.27 mm diameter (range), with 35, 36 relatively long, thin trichobothria. Sternites 5–8 with microtholi; S1–4 without. Dorsum of T9+ectoproct truncate distally, fused mesally, midline without deep cleft, setae short, delicate throughout; ventral section of T9+ectoproct with elongate proximal extension reaching full length of A8; proximal section broad, well sclerotized, with apodeme slender, slightly bent in center, extending around posterior margin of callus cerci; dorsal arm of apodeme extending above callus cerci, with acute tip; ventral arm of apodeme extending around callus cerci becoming diffuse posteriorly. S8+9 fused, with distinct demarcation, without suture; S9 without microtholi; S8 shorter than S9, ca. same height as base of S9; S8+9 (lateral view) with proximal margin straight, rounded dorsally, acute ventrally; distal margin straight, with rounded apices, approximately 0.7 times height of proximal margin. Setae on S9 mostly broken, probably slightly heavier than those on S5–S8; terminus of S9 without gonocristae. Subanal region membranous, with flat membrane below anus, no setae. Gonarcus complex removed from abdomen, membranes not intact; gonarcus membrane extending from top of gonarcus, converging with gonosaccus membrane. Gonarcus, from dorsal, ventral views: U-shaped, robust, with apodemes extending perpendicularly, smoothly, from ends of rounded gonarcus bridge; gonarcus bridge, in lateral view: broad, with straight, parallel margins, distal one-half expanding into apodemes that extend below mediuncus. Gonocornu short, flat in lateral view, broad, squareish in posterior view, extending from top of gonarcus bridge, scalloped around mediuncus. Mediuncus with dome-like base, extending forward from below and mesal to gonocornua; terminus truncate, with large, beak-like

tip between pair of rounded distal lobes; top of mediuncus with two broad, scalloped, rod-like sclerotized depressions extending entire length from base at gonarcial bridge to base of beak; ventral surface rugose, hollow, covered by thin, tight membrane that merges with gonosaccus. Gonosaccus extending from below gonarcial bridge, with three pairs of lateral gonosetae. Area below gonarcial complex, hypandrium internum missing. Entoprocessus, tignum, gonopsis, pseudopenis, spinellae and gonocristae absent.

Female: Unknown.

Larvae and biology. Unknown.

Distribution. Currently known only from Quito, Ecuador.

Adult specimens examined. Known only from the type.

Etymology. Navás named this species in honor of President Gabriel García Moreno of Ecuador (1821–1875). Moreno was a noted statesman, who strongly supported education, science, and the Roman Catholic Church.

Keys to species

The latest key to South American *Leucochrysa* species relies on external features of adults to identify species that occur in Brazilian agroecosystems (Freitas and Penny 2001: 285). As explained above, this key identifies specimens of *L. (N.) azevedoi* as *L. (N.) camposi*. Thus, the name *L. (N.) azevedoi* should replace *L. (N.) camposi* in cuplet 9 of the key. *L. (N.) camposi* is not known from Brazil and therefore should not be included in Freitas and Penny's treatment.

Unfortunately, each of the other two species — *L. (N.) camposi* and *L. (N.) morenoi* — are known from only a single specimen each (the types), and these specimens are too badly discolored to be useful in incorporating the species into a key using external characters. Reliable identifications require dissection of male and/or female genitalia, and at this time the genitalia of too few species have been studied to develop a useful key.

All three species treated here appear to be related to *L. (N.) amazonica* and its relatives (see Adams 1987, Freitas and Penny 2001); they are large bodied, apparently have similar body markings, and share a truncated plate at the tip of the mediuncus (arcessus of Freitas and Penny 2001) and elongate, coiled bursal ducts. Future studies should include comparisons among the species that share these traits.

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our study of *Leucochrysa* types and specimens. The “Lacewing Digital Library” website (<http://lacewing.tamu.edu/>), maintained by J. D. Oswald, Texas A & M University, was helpful during our study. CAT and MJT thank L. E. Ehler, L. Kimsey, M. Parella, and the Department of Entomology, University of California, Davis for their cooperation in a variety of ways.

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Definition and Revision of the *Orthrius*-group of genera (Coleoptera, Cleridae, Clerinae)

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Abstract

An “*Orthrius*-group” of genera is proposed, and defined to include *Aphelochroa* Quedenfeldt, 1885; *Cari-dopus* Schenkling, 1908; *Dozocolletus* Chevrolat, 1842; *Gyponyx* Gorham, 1883; *Languropilus* Pic, 1940; *Orthrius* Gorham, 1876; *Pieleus* Pic, 1940; *Xenorthrius* Gorham, 1892; plus three new genera *Neorthrius* **gen. n.**, *Nonalatus* **gen. n.** and *Pseudoastigmus* **gen. n.** A phylogeny of the 11 constituent *Orthrius*-group genera (analysis of 22 morphological characters using *Clerus* Geoffroy as the out-group taxon was performed with TNT v1.1) is proposed. Four genera are synonymised: *Burgeonus* Pic, 1950, **syn. n.** (with *Aphelochroa* Quedenfeldt, 1885); *Brinckodes* Winkler, 1960, **syn. n.** and *Quasibrinckodes* Winkler, 1960, **syn. n.** (both with *Dozocolletus* Chevrolat, 1842); and *Dedana* Fairmaire, 1888, **syn. n.** (with *Orthrius* Gorham, 1876). The genera *Falsoorthrius* Pic, 1940 and *Mimorthrius* Pic, 1940 are transferred from Clerinae to the subfamily Tillinae.

Keywords

Cleridae, genus-group, synonymy, phylogeny

Introduction

The checkered beetles (Cleridae and Thanerocleridae) contain approximately 3600 described species, which are classified into seven subfamilies (Lawrence and Newton Jr. 1995) and involve 303 genera. By far, the Clerinae is the most specious subfamily with

approximately 45% of the species of the family. Checkered beetles are largely tropical insects with an approximate faunal distribution as follows: 1030 species in the Afrotropics, 840 in the Neotropics, 690 in the Orientalis, 510 in the Australis and 490 in the Palaearctis (Gerstmeier 2000).

The higher classification of the Cleridae has undergone considerable categorical oscillations (Opitz 2002, 2010). Several landmark publications of Crowson (1955, 1964, 1966, 1970) form the basis for a modern classification of Cleroidea, while some nomenclatural amendments were made by Lawrence and Newton Jr. (1995). More recently, significant contributions dealing with suprageneric taxa include the elevation of Thaneroclerinae (Kolibáč 1992, 2004) and *Metaxina* Broun, to family rank (Kolibáč 1992, 2004), the proposition of two subfamily classifications (Kolibáč 1997, Opitz 2010) plus revisions of the genera and species of Epiphloeinae (Opitz 1997, 2004, 2005, 2006, 2007, 2008a, 2008b, 2008c), the genera of Hydnocerinae (which included a tribal classification for that subfamily) (Kolibáč 1998) and the Australian Korynetinae (Kolibáč 2003). Nevertheless, some discontinuities are obvious and not all changes made at the subfamily-level are universally accepted among cleridologists. From a world viewpoint, much remains to be done with clarification of generic concepts and zoogeographic relationships at supraspecific levels (Opitz 2002). In our opinion, Opitz's (2010) concept of 12 subfamilies seems to result in the best system.

The Clerinae is the largest of all subfamilies of the Cleridae and the most difficult in which to define generic limits (Chapin 1924). Furthermore, the paucity of clearly defined morphological gaps among these genera renders their generic delimitation very difficult. A paper dealing with genera related to *Clerus* Geoffroy (Gerstmeier 2002) represents an initial step in clarifying generic limits within Clerinae. After an extensive review of Indo-Australian clerid material, a generic concept of clerine genera such as *Clerus* Geoffroy, 1762, *Omadius* Laporte, 1836, and *Stigmatium* Gray, 1832 became apparent and resulted in a preliminary concept of “*Clerus*-series” (Gerstmeier 2002).

A recent revision of the genus *Xenorthrius* Gorham (Gerstmeier and Eberle 2010) represents besides Mawdsley's (1994) revision of the genus *Aphelochroa* the second in a series of papers dealing with the genera of a so-called “*Orthrius*-group”. In the *Xenorthrius* revision 11 species were transferred from *Orthrius* to *Xenorthrius*, and 22 new species were described, so that the genus *Xenorthrius* now includes 50 species (from 20 species formerly listed in Corporaal 1950). The aim of the present paper is to define the characters for a generic group, to determine those genera constituting the *Orthrius* group and examine the relationships among those genera. The following genera have been taken into consideration: *Aphelochroa* Quedenfeldt, 1885, *Caridopus* Schenkling, 1908, *Dozocolletus* Chevrolat, 1842, *Gyponyx* Gorham, 1883, *Languropilus* Pic, 1940, *Neorthrius* gen. n., *Orthrius* Gorham, 1876, *Pieleus* Pic, 1940, *Nonalatus* gen. n., *Pseudoastignus* gen. n., *Xenorthrius* Gorham, 1892, *Falsoorthrius* Pic, 1940 and *Mimorthrius* Pic, 1940 (during this study, the latter two genera were discovered to belong to the subfamily Tillinae).

Historic overview

Gorham (1876) described the genus *Orthrius* for *Orthrius cylindricus* and noticed the relationship to *Thanasimus*, and, on the basis of the tarsal structure, to *Clerus*. Seven years later, the same author (Gorham 1883) established the genus *Gyponyx* and mentioned its relationship to *Thanasimus* and *Axina*. Chevrolat (1842) described the species “*oblongus*”, drawing attention to its flightlessness and established the genus *Dozocolletus*, without a generic diagnosis; a diagnosis was given later by Lacordaire (1857). Quedenfeldt (1885) described the genus *Aphelochroa* (with *A. carneipennis* as type species) comparing it with *Opilo* and *Natalis*. Later, Gorham (1892) established the new genus *Xenorthrius* for three new species (*X. balteatus*, *X. mouhoti* and *X. subfasciatus*). For another two wingless species Schenckling (1908) erected the genus *Caridopus* and in the same publication, described the species *Apteroclerus brevis* from the Kilimanjaro, though with reservations about its generic placement. In two different publications Pic (1940a, 1940b) respectively described the genera *Languropilus* and *Pieleus*, while in an earlier paper (Pic 1933), he had expressed his view that the flightless *Astigmus pygidialis* differs greatly from all other *Astigmus* species.

Material and methods

Abbreviations

A	Antennomere
CuA2	Cubitus anterior 2
MNHN	Museum National d’Histoire Naturelle, Paris, France
MRAC	Musée Royal de l’Afrique Central, Tervuren, Belgium
MSNG	Museo Civico di Storia Naturale “Giacomo Doria”, Genova
MZLU	Museum of Zoology, Lund University, Sweden
RGCM	Roland Gerstmeier Collection, Munich (deposited in the collection of the Technical University Munich, Animal Ecology), Germany
r3, r4	Radial cross vein 3 and 4
RP2	Radius posterior 2
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
T	Tarsomere

Cladistic analysis

23 characters with their respective states (Tab. 1) were analysed. Character polarity was determined by the outgroup method (Nixon and Carpenter 1993); no ancestral states were forced. The genus *Clerus* Geoffroy, 1762, was considered the outgroup taxon. The data matrix (Tab. 2) was analysed with the Willi Hennig Society edition of TNT 1.1

from September 2009 (Goloboff et al. 2003, 2008). To receive an exact solution, every possible tree was computed by using the “implicit enumeration” routine.

For characters with more than one state per genus, multiple character states were used; they appear enclosed by square brackets in the matrix. Characters that were ambiguous, or missing in the available specimen, appear as a question mark. All characters were chosen to be nonadditive and none were weighted. Implied weighting was also turned off. The species were sorted alphabetically within the input file.

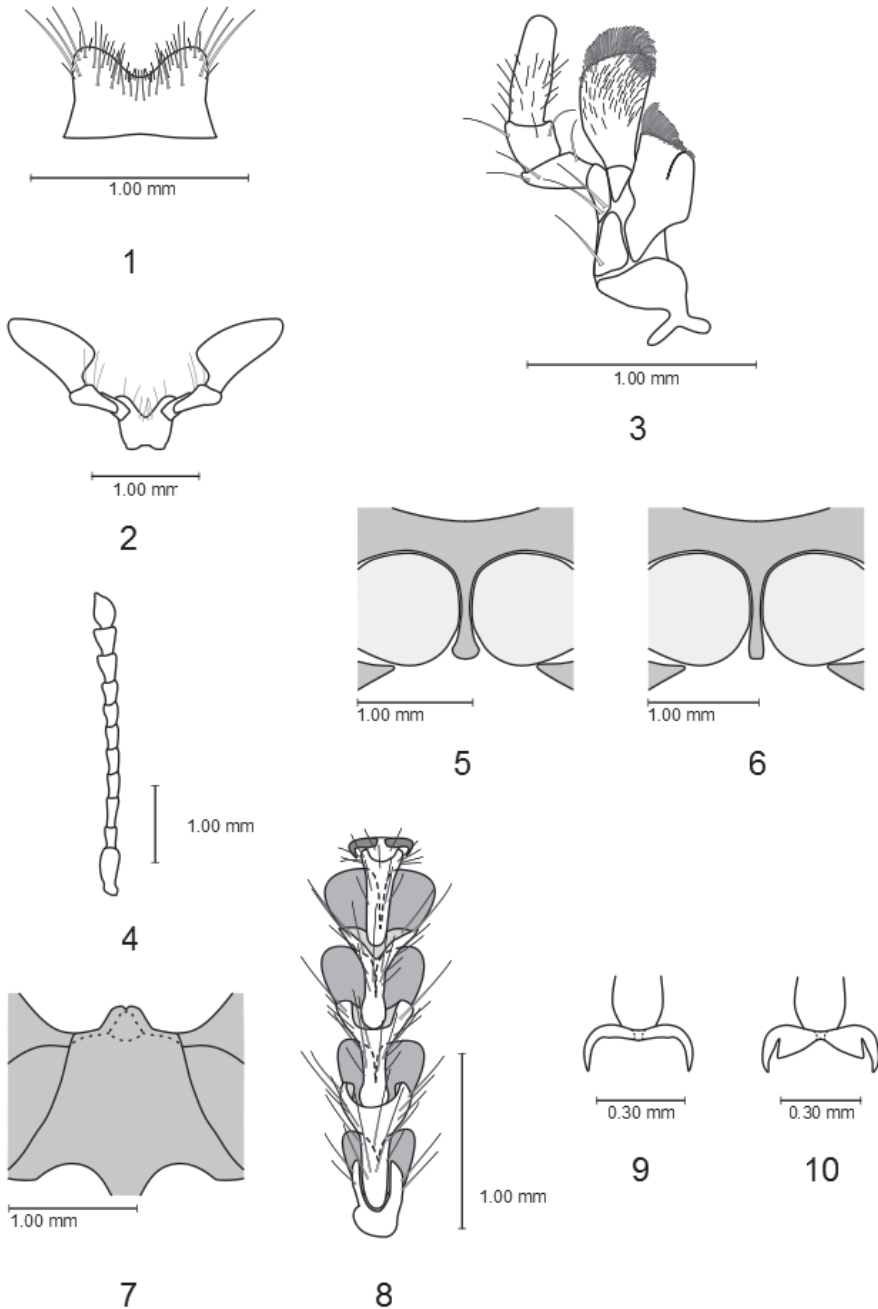
Diagnosis

Species of the *Orthrius*-group are readily distinguished from other Clerinae by the presence of the following characters (in combination):

- Eyes distinct, more or less protruding laterally, coarsely faceted
- Eyes separated by more than one eye width
- Labrum bilobed to broadly V-shaped (Fig. 1)
- Terminal segment of labial palpi securiform (Fig. 2)
- Terminal segment of maxillary palpi cylindrical (to digitiform) (Fig. 3)
- Antennal flagellum more or less filiform (Fig. 4)
- Antennomere 2 shorter than antennomere 3 (except *Languropilus*)
- Procoxal cavities broadly open posteriorly (Figs 5, 6)
- Pro-intercoxal process not (or only slightly) dilated distally (Figs 5, 6)
- Metendosternites without anterior tendons, furcal arms distinct, furcal laminae mostly distinct, furcal stalks mostly of normal length or very short in wingless genera (Figs 11–20)
- Elytra without sharply-defined basal margin
- Typical wing venation (if winged), with open wedge cell, r3, r4 and CuA2 (except *Pieleus*) present, RP2 absent (Figs 21–28)
- Pro- and meso-tarsi each with four pulvilli (number of metatarsal pulvilli variable) (Fig. 8)
- Hind tarsi: T2 < T3 + T4 (Tarsomere 2 smaller than tarsomeres 3 and 4 together)
- Spiculae of spicular fork more or less dilated (Figs 29–37)

Key to genera

- | | | |
|---|--|--------------------------|
| 1 | Pronotum with six gibbosities on disc..... | <i>Caridopus</i> |
| – | Pronotum without six gibbosities on disc..... | 2 |
| 2 | Wingless species..... | 3 |
| – | Species with wings..... | 5 |
| 3 | Antennomeres of flagellum from A4 dilated, antennal club absent..... | 4 |
| – | Flagellum filiform, antennal club with 3 antennomeres..... | <i>Dozocolletus</i> |
| 4 | Tarsal pulvillar formula 4-4-2..... | <i>Nonalatus</i> gen. n. |



Figures 1–10. 1–4 Labrum, labium, maxille and antenna of *Orthrius sepulcralis* 5 Pro-intercoxal process of *Xenorthrius robustus* 6 Pro-intercoxal process of *Orthrius sepulcralis* 7 Anterior mesosternal process of *Xenorthrius robustus* 8–9 Tarsus and claws of *Orthrius sepulcralis* 10 Claws of *Xenorthrius robustus*.

–	Tarsal pulvillar formula 4-4-3	<i>Pseudoastigmus</i> gen. n.
5	Claws dentate (Fig. 10)	6
–	Claws simple (Fig. 9)	7
6	Tibial spur formula 1-1-2, elytral punctation not arranged into 10 striae... <i>Pieleus</i>	
–	Tibial spur formula 1-2-2, elytral punctation arranged into 10 striae	<i>Xenorthrius</i>
7	Anterior mesosternal process present (Fig. 7), tarsal pulvillar formula 4-4-4..	<i>Gyponyx</i>
–	Anterior mesosternal process absent, tarsal pulvillar formula 4-4-3	8
8	Tibial carinae absent	<i>Languropilus</i>
–	Tibial carinae present	9
9	Eyes weakly emarginate.....	10
–	Eyes conspicuously emarginate.....	<i>Neorthrius</i> gen. n.
10	Tibial spur formula 1-2-2	<i>Aphelochroa</i>
–	Tibial spur formula 0-1-1	<i>Orthrius</i>

Description of genera

Aphelochroa Quedenfeldt, 1885

<http://species-id.net/wiki/Aphelochroa>

Figs 11, 21, 29, 38, 47, 58

Burgeois Pic, 1950 syn. n.; Pic 1950: 158.

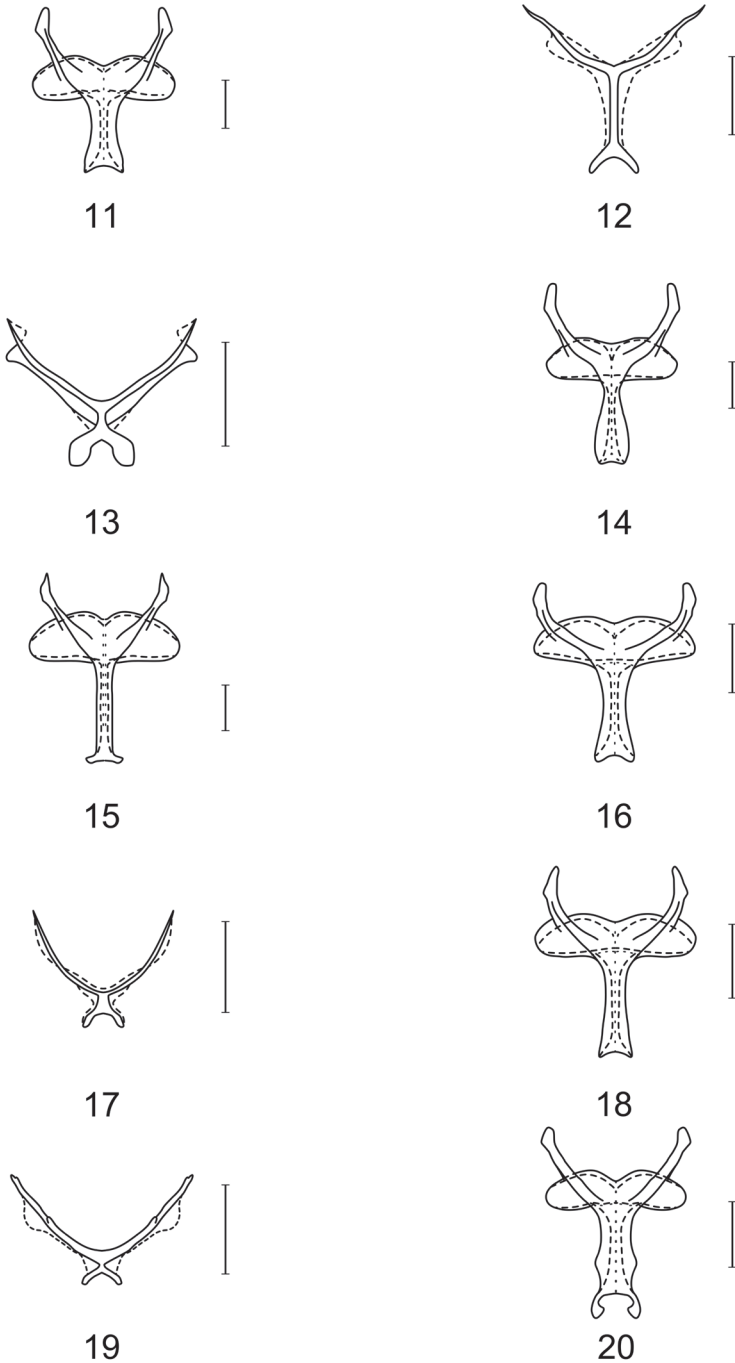
Type species: *Aphelochroa carneipennis* Quedenfeldt, 1885. Quedenfeldt 1885: 267; Kraatz 1899: 86; Schenkling 1902: 326; Schenkling 1903: 29, 57; Mawdsley 1994: 128; Mawdsley and Sithole 2010: 1.

Distribution: Aethiopian region.

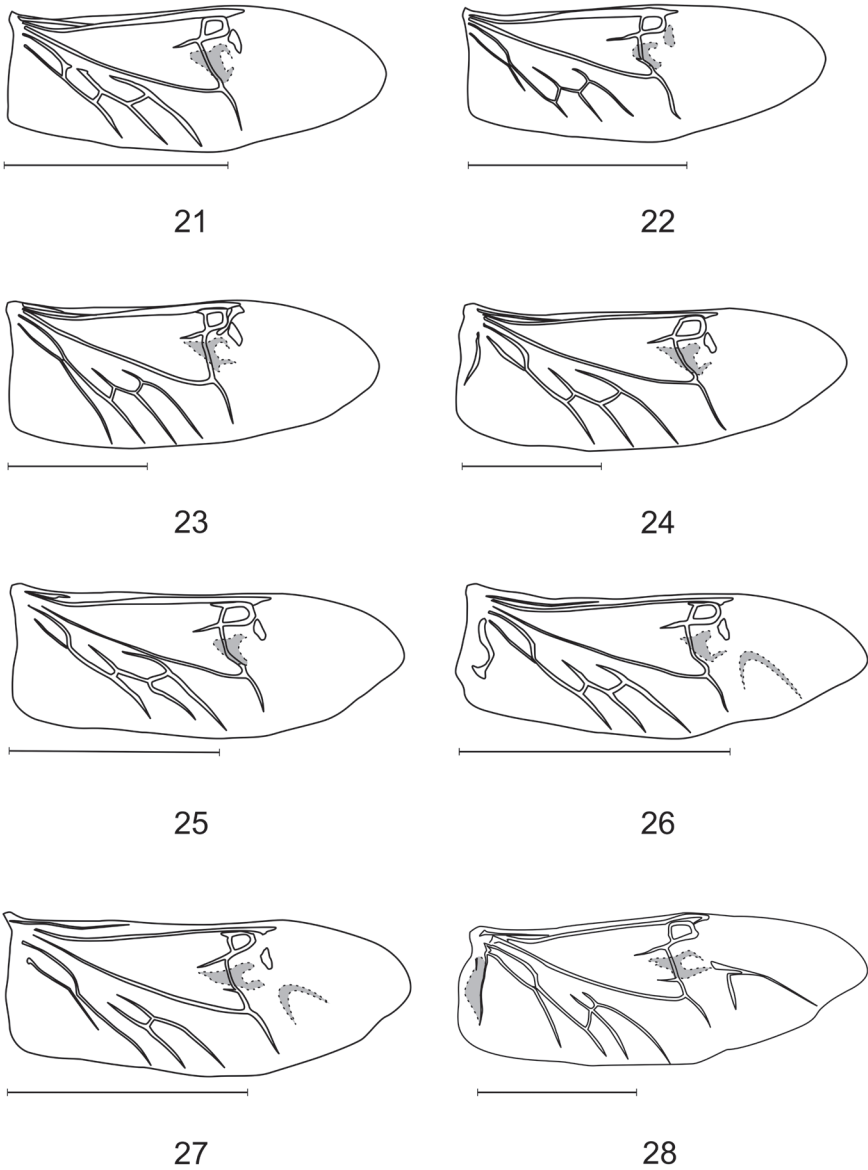
Material examined: *Aphelochroa sanguinea* (Thomson, 1857), Kenya, Voi, Sagala Region, 12.1991, leg. K. Werner. *Aphelochroa sanguinalis* (Westwood, 1852), Congo, VIII.1959, Albertville. *Aphelochroa fulva* Kraatz, 1899, Kenya, Meru Distr., Materi (Mitunguu), mt. 800, R. Mourglia legit; and several other specimens of this genus (all RGCM). *Burgeois freynei* Pic, 1950 (Holotype), Coll. Mus. Congo, Lulua: Luashi, XI-1938, F. Freyne; R. DET., X., 5621; désiré; *Burgeois freynei* n sp [handwritten by Pic](MRAC).

Head: Eyes strongly protruding, only slightly emarginate at antennal insertion; interocular space more than one eye width; gular sutures converging, gular process broad; A1 large, stout, almost twice as long as A2, A2 shorter than A3, A3-A8 filiform, antennomeres becoming shorter, A9 dilated distally, A10 broader than long, A11 sub-ovate, apical third pinched, terminal three antennomeres forming a loose club.

Thorax: Proepimeron short, not acute; anterior mesosternal process absent; proepimeron short; metendosternite with normal furcal stalk, short, normal furcal



Figures 11–20. Metendosternites of **11** *Aphelochroa* sp. **12** *Caridopus* sp. **13** *Dozocolletus discophorus* **14** *Gyponyx* sp. **15** *Languopilus fortipes* **16** *Neorthrius* sp. **17** *Nonalatus brevis* **18** *Orthrius sepulcralis* **19** *Pseudoastigmus pygidialis* **20** *Xenorthrius loricus*. Scale bars 0.5mm.



Figures 21–28. Wings of **21** *Aphelochroa* sp. **22** *Caridopus* sp. **23** *Gyponyx* sp. **24** *Languopilus* sp. **25** *Neorthrius* sp. **26** *Orthrius* sp. **27** *Pieleus* sp. **28** *Xenorthrius* sp. Scale bars 5mm.

arms and very slightly emarginate stalk base (Fig. 11). Elytra long, subparallel, broadest behind middle, apices broadly rounded, elytral punctation not arranged into striae.

Legs: Of normal size, stout; tarsal pulvillar formula 4-4-3, tibial spur formula 1-2-2; tibiae with longitudinal carinae; claws simple.

Abdomen: Apical margin of male ventrite 6 distinctly emarginate (Fig. 47); tegmen slender, tapering to a curved acumination distally, phallic struts acuminate, not fused, phallobasic apodeme slightly dilated distally (Fig. 38).

***Caridopus* Schenkling, 1908**

<http://species-id.net/wiki/Caridopus>

Figs 12, 22, 30, 39, 48, 59

Type species: *Caridopus monstruosus* Schenkling, 1908. Schenkling 1908: 71.

Distribution: Aethiopian region.

Material examined: *Caridopus monstruosus* (Type), Kilimandj., Sjöstedt; Kibonoto, kulturz.; 30. April; *Caridopus monstruosus*, Typus! (NRM). *Caridopus affinis* Schenkling, 1908 (Type), Meru, Regenwald; Meru, Sjöstedt; *Caridopus affinis* Schklg., Typus! (NRM).

Head: Eyes strongly protruding, only slightly emarginate at antennal insertion; interocular space more than 1.5 eye widths; gular sutures converging, gular process broad; antennae long, A2 shorter than A3, A3-A8 filiform, antennomeres becoming shorter, A9 and especially A10 dilated distally, A10 shorter than A9, A11 sub-ovate, apical third pinched, without club.

Thorax: Conspicuously longer than broad, with six gibbosities on disc; pro-intercoxal process narrow, linear; proepimeron short, acute to slightly rounded; anterior mesosternal process present; metendosternite with normal furcal stalk length, furcal arms acute distally, stalk base conspicuously emarginate (Fig. 12). Elytra compact (broadest behind middle), conspicuously constricted at base and strongly dilated apically in wingless species, apices broadly rounded, elytral punctation arranged into ten more or less regular striae; wingless or with hindwings.

Legs: Long, very stout, femora conspicuously thickened; tarsal pulvillar formula 4-4-4, tibial spur formula 1-2-2; tibiae without longitudinal carinae; claws simple.

Abdomen: Apical margin of male ventrite 6 deeply emarginate (Fig. 48); phallobasic struts fused, phallic struts very broad, phallobasic apodeme strongly dilated distally (Fig. 39).

***Dozocolletus* Chevrolat, 1842**

<http://species-id.net/wiki/Dozocolletus>

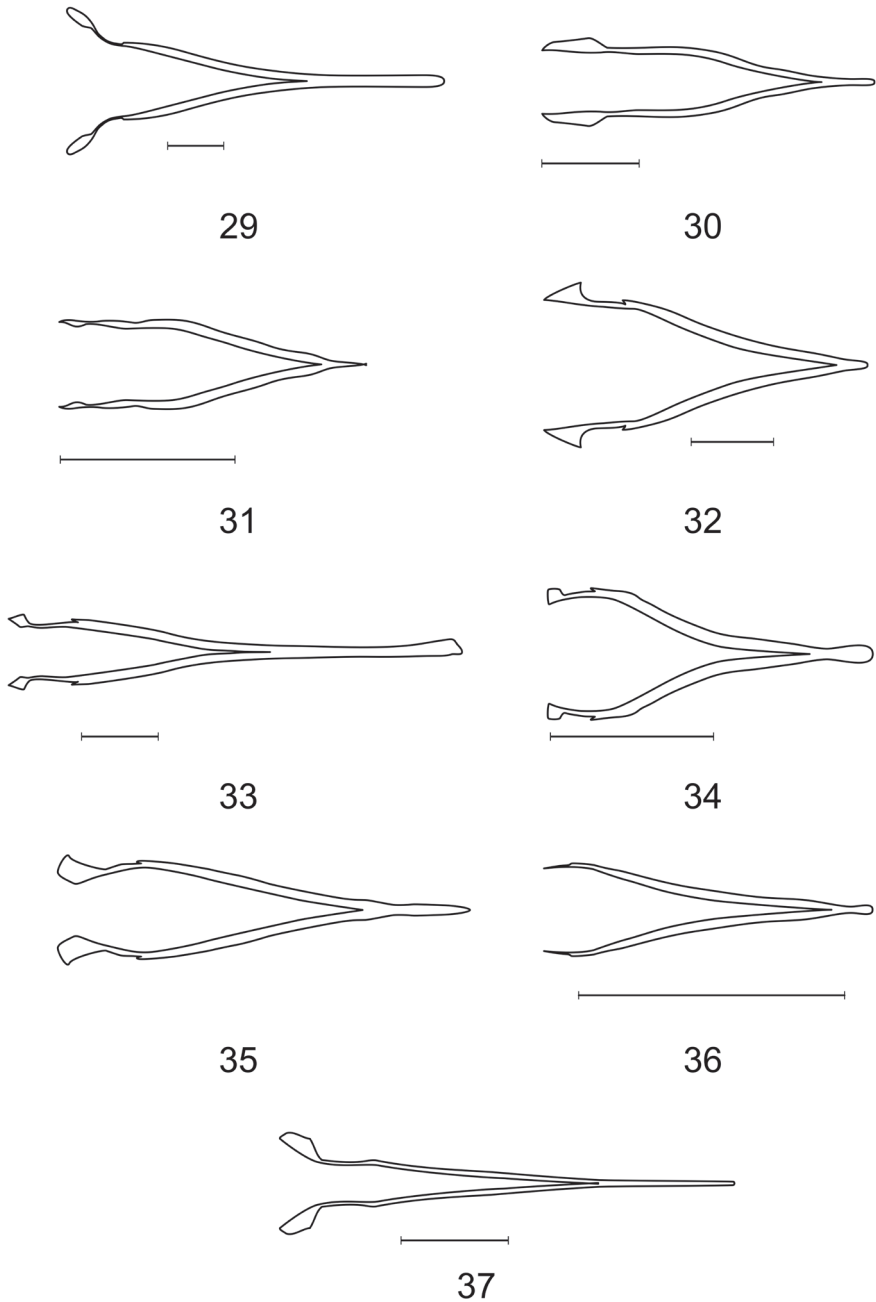
Figs 13, 31, 40, 49, 60

Brinckodes Winkler, 1960 syn. n.; Winkler 1960: 130.

Quasibrinckodes Winkler, 1960 syn. n.; Winkler 1960: 134.

Type species: *Dozocolletus oblongus* Chevrolat, 1842. Chevrolat 1842: 278; Lacordaire 1857: 442; Schenkling 1903: 28, 38.

Distribution: Aethiopian region (southern Africa).



Figures 29–37. Spicular forks of **29** *Aphelochroa* sp. **30** *Caridopus monstruosus* **31** *Dozocolletus discophorus* **32** *Gyponyx* sp. **33** *Neorthrius* sp. **34** *Nonalatus brevis* **35** *Orthrius sepulcralis* **36** *Pseudoastigmus pygidialis* **37** *Xenorthrius simplex*. Scale bars 0.5mm.

Material examined: *Dozocolletus discophorus* (Boheman, 1851)(Type), Caffraria, J. Wahlb, Type. *Dozocolletus puberulus* (Boheman, 1851)(Type), Caffraria, J. Wahlb, Type. *Dozocolletus oblongus* Chevrolat, 1842, Pretoria, 2.XII.1963, leg. A.L. Capener (all NRM). *Brinckodes apterus* Winkler, 1960 (Holotype and two Paratypes), S. Afr. Transvaal, 16 miles NE of Pretoria, Oct.-Nov. 1954, G. Rudebeck; *Brinckodes apterus* n.g., n.sp., Det. J.R. Winkler 1959. *Brinckodes apterus* ab. *ater* Winkler, 1960 (Holotype), S. Afr. Transvaal, 16 miles NE of Pretoria, Oct.-Nov. 1954, G. Rudebeck; *Brinckodes apterus* n.g., n.sp., n.ab., Det. J.R. Winkler 1959. *Quasibrinckodes pictus* Winkler, 1960 (Holotype), 8200 ft.; S. Afr. Cape Prov., Drakensbergen, 8 miles ENE Rhodes, 10.III.51, No 223; Swedish South Africa Expedition, 1950–1951, Brinck - Rudebeck; *Quasibrinckodes pictus* n.g., n.sp., Det. J.R. Winkler 1959, Holotypus (all MZLU).

Head: Eyes protruding, very slightly emarginate at antennal insertion; interocular space two to three eye widths; gular sutures converging, gular process broad; antennae long, A1 large, stout, almost twice as long as A2, A2 shorter than A3, A3-A8 filiform, antennomeres becoming shorter, A9 short, transverse, A10 larger than A9, transverse, A11 approximately equal in length to A9+A10, sub-ovate, apical half pinched, terminal three antennomeres forming a distinct club.

Thorax: Pronotum conspicuously constricted towards base, without transverse impression, proepimeron short to medium-sized, not acute; anterior mesosternal process present, broadly bent, proepimeron broad, short; metendosternite with very short furcal stalk, stalk base broad, with a deep emargination, furcal arms long, acute distally (Fig. 13). Elytra short, elytral base strongly constricted, broadest behind middle, apices rounded, elytral punctation arranged into ten striae; wingless.

Legs: Relatively short, stout; femora conspicuously thickened (especially profemora); tarsal pulvillar formula 4-4-4, tibial spur formula 2-2-2; tibiae with longitudinal carinae; claws simple, stout.

Abdomen: Apical margin of male ventrite 6 not emarginate (Fig. 49); tegmen relatively broad, phallobasic struts fused, phallic struts broad, dilated distally, phallobasic apodeme not dilated distally (Fig. 40).

***Gyponyx* Gorham, 1883**

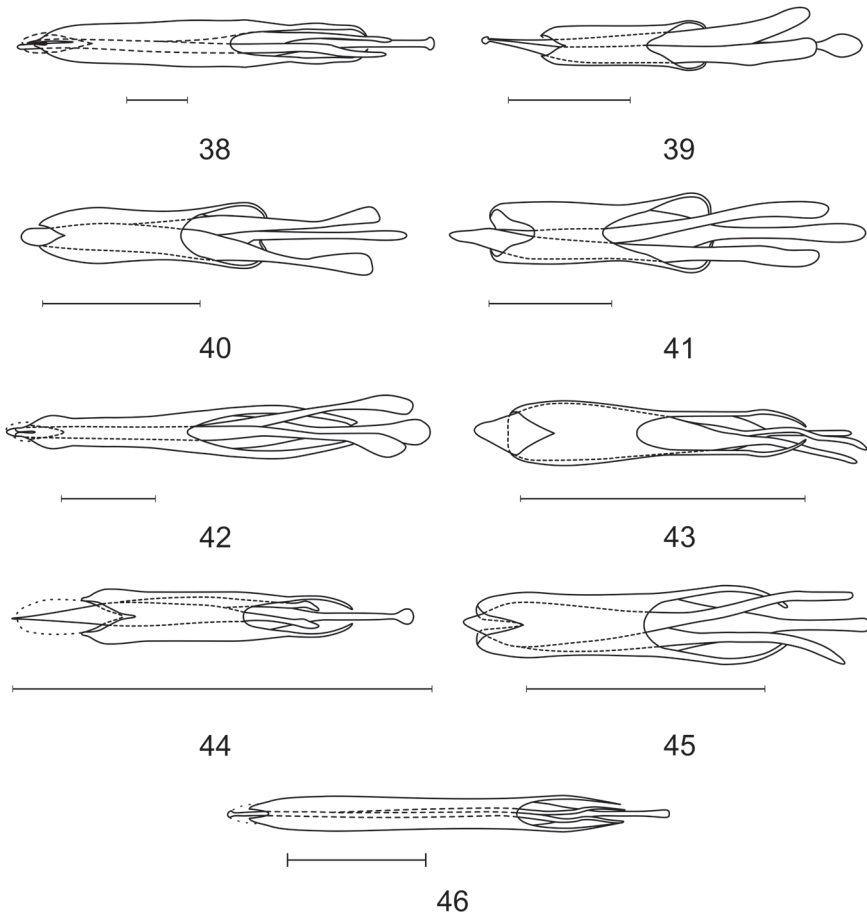
<http://species-id.net/wiki/Gyponyx>

Figs 14, 23, 32, 41, 50, 61

Type species: *Notoxus chinensis* Fabricius, 1794. Gorham 1883: 604; Schenkling 1900: 14; Schenkling 1903: 29, 45; Schenkling 1907: 199.

Distribution: Aethiopian region.

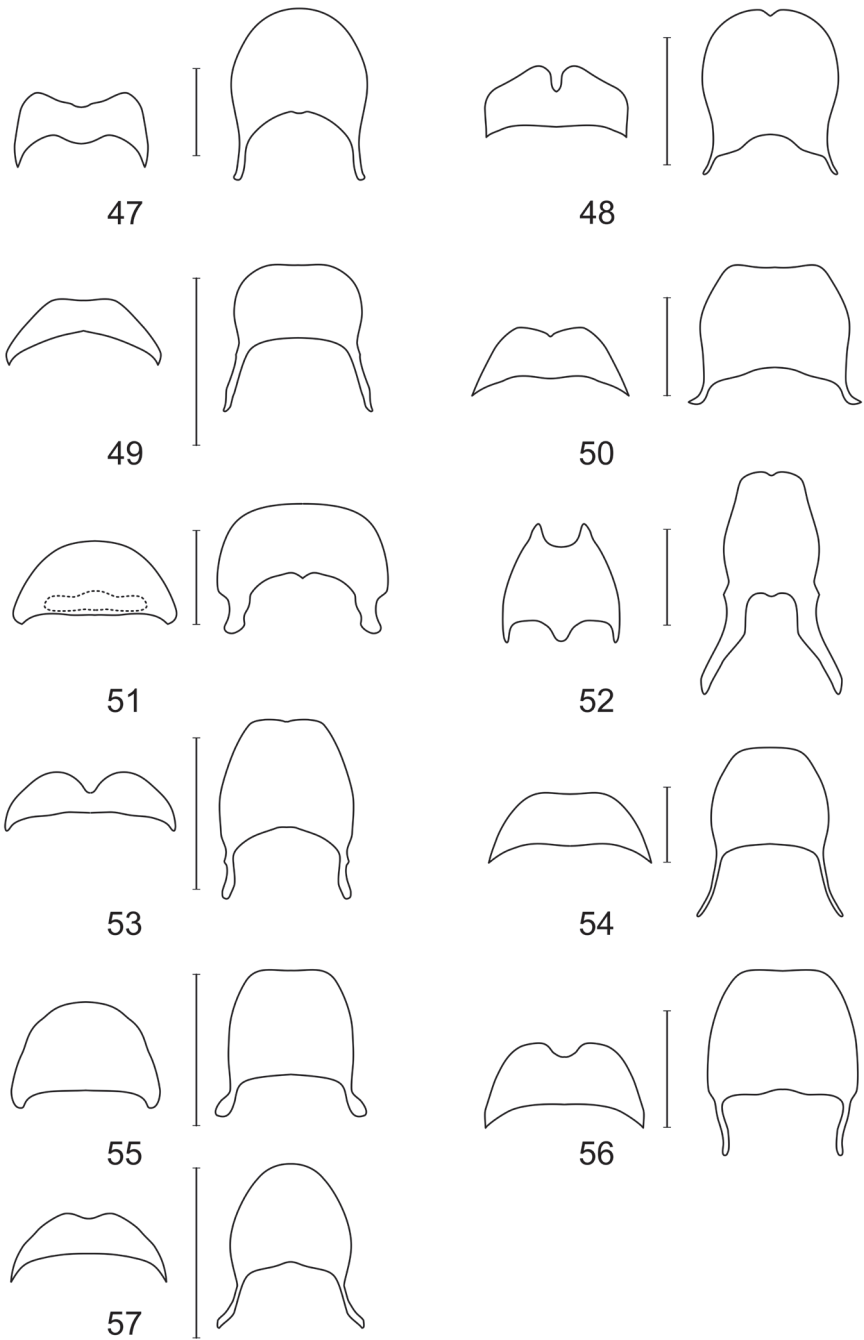
Material examined: *Gyponyx apicalis* (Chevrolat, 1842), Südafrika, SE 3130AA, Umtanvuma 3.1.1989, leg. T. Beyers; *Gyponyx signifer* (Boheman, 1851), Tanzania, Nufindi Dist., Nafinga 1000m, 21.11.-4.12.1989, leg. R. Mourglia; and several further specimens of this genus (all RGCM).



Figures 38–46. Aedeagi of **38** *Aphelochroa* sp. **39** *Caridopus* sp. **40** *Dozocolletus discophorus* **41** *Gyponyx* sp. **42** *Neorthrius* sp. **43** *Nonalatus brevis* **44** *Orthrius sepulcralis* **45** *Pseudoastigmus pygidialis* **46** *Xenorthrius simplex*. Scale bars 1mm.

Head: Eyes strongly protruding, broadly but not deeply emarginate at antennal insertion; interocular space more than 1.5 eye widths; gular sutures converging, gular process broad; A1 large, stout, almost two times longer than A2, A2 shorter than A3, A3–A6 filiform, A7–A10 slightly dilated distally, antennomeres becoming shorter, A11 sub-ovate, apical third pinched, without club.

Thorax: Proepimeron medium-sized, more rounded than acute; anterior mesosternal process present; metendosternite with normal furcal stalk, short, normal furcal arms and very slightly emarginate stalk base (Fig. 14). Elytra long, subparallel, strongly dilated apically (broadest behind middle), apices broadly rounded, elytral punctation arranged into ten more or less regular striae.



Figures 47–57. Terminal abdominal segments of **47** *Aphelochroa* sp. **48** *Caridopus* sp. **49** *Dozocolletus discophorus* **50** *Gyponyx* sp. **51** *Languropilus fortipes* **52** *Neorthrius* sp. **53** *Nonalatus brevis* **54** *Orthrius sepulcralis* **55** *Pieleus irregularis* **56** *Pseudoastigmus pygidialis* **57** *Xenorthrius simplex*. Scale bars 1mm.

Legs: Of normal size; tarsal pulvillar formula 4-4-4, tibial spur formula 2-2-2; tibiae with longitudinal carinae; claws simple.

Abdomen: Apical margin of male ventrite 6 very slightly emarginate (Fig. 50); tegmen broad, phallobasic struts fused, phallic struts and phallobasic apodeme broad, but not conspicuously dilated distally (Fig. 41).

***Languropilus* Pic, 1940**

<http://species-id.net/wiki/Languropilus>

Figs 15, 24, 51, 62

Type species: *Languropilus fortipes* Pic, 1940. Pic 1940a: 3.

Distribution: Aethiopian region (East Africa).

Material examined: *Languropilus fortipes* (females), Tanzania, Shinyanga Prov., Serengeti Sopa L., 19.XI.93, LF., Heiss (RGCM).

Head: With weakly protruding eyes, only very slightly emarginate at antennal insertion; interocular space about two times one eye width; gular sutures long, converging, gular process broad; antennae short, A1 large, stout, almost two times longer than A2, A2=A3 or A2>A3, A3-A8 filiform, antennomeres becoming shorter, A8 almost spherical, A9 and A10 transverse, A11 ovate, terminal three antennomeres forming a distinct club.

Thorax: Proepimeron medium-sized, more rounded than acute; anterior mesosternal process absent; metendosternite with normal furcal stalk length, stalk slender, base almost straight, furcal arms of more or less normal length, acute distally (Fig. 15). Elytra long, broadest behind middle, apices broadly rounded, elytral punctuation arranged into ten striae.

Legs: Of normal size, stout; tarsal pulvillar formula 4-4-3, tibial spur formula 1-2-2; tibiae without longitudinal carinae; claws simple.

***Neorthrius* Gerstmeier & Eberle, gen. n.**

urn:lsid:zoobank.org:act:37980052-1760-48A2-8AA8-F677612AA8AE

<http://species-id.net/wiki/Neorthrius>

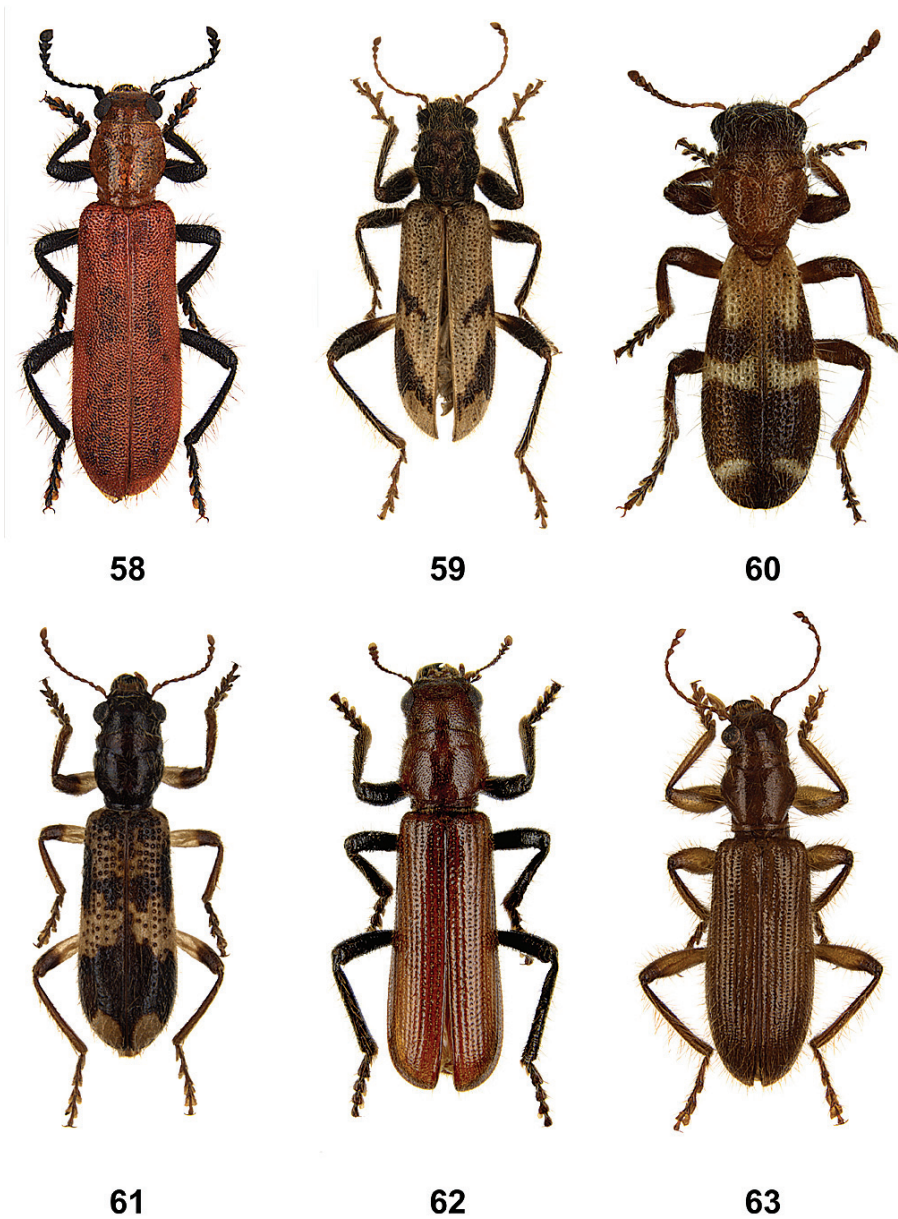
Figs 16, 25, 33, 42, 52, 63

Type species: *Neorthrius monticola* Schenkling, 1906 Schenkling 1906: 267.

Distribution: Indo-Australian region.

Material examined: *Neorthrius monticola* (Holotype), Kina-Balu-Geb., 1500m, Coll. Waterstrad; Schenkling det (SDEI); and several unidentified specimens of this genus.

Head: Eyes strongly protruding, conspicuously emarginate at antennal insertion; interocular space at least more than one eye width; gular sutures converging, gular process broad, compact, only slightly emarginate at middle; antennae long, A1 about two times longer than A2, A2 shorter than A3, A3-A8 filiform, A9 and A10 slightly dilated distally, A3-A5 more or less equal in length, A6-A8 becoming shorter, A11 sub-ovate,



Figures 58–63. Habitus of **58** *Aphelochroa* sp. **59** *Caridopus* sp. **60** *Dozocolletus discophorus* **61** *Gyponyx* sp. **62** *Languropilus fortipes* **63** *Neorthrius* sp.

apical half pinched, sometimes without club, sometimes terminal three antennomeres forming a loose club.

Thorax: Proepimeron short to medium-sized, more rounded than acute; anterior mesosternal process absent; metendosternite with normal furcal stalk length, furcal arms

normal, stalk base slightly emarginate (Fig. 16). Elytra long, subparallel, sometimes constricted apically, apices rounded separately, elytral punctuation arranged into ten striae.

Legs: Of normal size, sometimes with thickened femora; tarsal pulvillar formula 4-4-3, tibial spur formula 1-2-2; tibiae with longitudinal carinae; claws simple.

Abdomen: Apical margin of male ventrite 6 sometimes deeply emarginate (Fig. 52); phallobasic struts not fused, phallic struts and phallobasic apodeme dilated distally (Fig. 42).

***Nonalatus* Gerstmeier, gen. n.**

urn:lsid:zoobank.org:act:4331C030-7A93-4F7D-A6F1-D896965CF99D

<http://species-id.net/wiki/Neorthrius>

Figs 17, 34, 43, 53, 64

Type species: *Apteroclerus brevis* Schenkling, 1908, comb. n. Schenkling 1908: 71.

Distribution: Aethiopian region (Kilimanjaro).

Material examined: *Apteroclerus brevis* (Type), Kilimandj., Sjöstedt; Kiboscho, 3'-4000m; 15. febr.; Bärge-ängarne; Typus; Bergwiesen, Ericinella-Region, In den trockenen Blumenständen von *Lobelia deekeni* (NRM).

Head: Eyes protruding, emarginate at antennal insertion; interocular space two to three eye widths; gular sutures strongly diverging, gular process broad; antennae long, A2 shorter than A3, from A4 slightly dilated apically, A3-A7 becoming shorter, A9 and A10 more or less equal in length, A11 longer than A10, A11 sub-ovate, apical third pinched, without club.

Thorax: Proepimeron short, not acute; anterior mesosternal process present, broadly bent; metendosternite with very short furcal stalk, stalk base deeply emarginate, furcal arms acute distally (Fig. 17). Elytra ovate, short, compact, strongly constricted at base and towards apex, broadest behind middle, apices broadly rounded, elytral punctuation arranged into ten irregular striae; wingless.

Legs: Relatively long, stout; tarsal pulvillar formula 4-4-2, tibial spur formula 1-2-2; tibiae without longitudinal carinae; claws simple, with a very small, acute basal denticle.

Abdomen: Apical margin of male ventrite 6 distinctly emarginate (Fig. 53); tegmen very broad, parameres expanded laterally, tapering to an acumination distally, phallobasic struts not fused, phallic struts and phallobasic apodeme not dilated distally (Fig. 43).

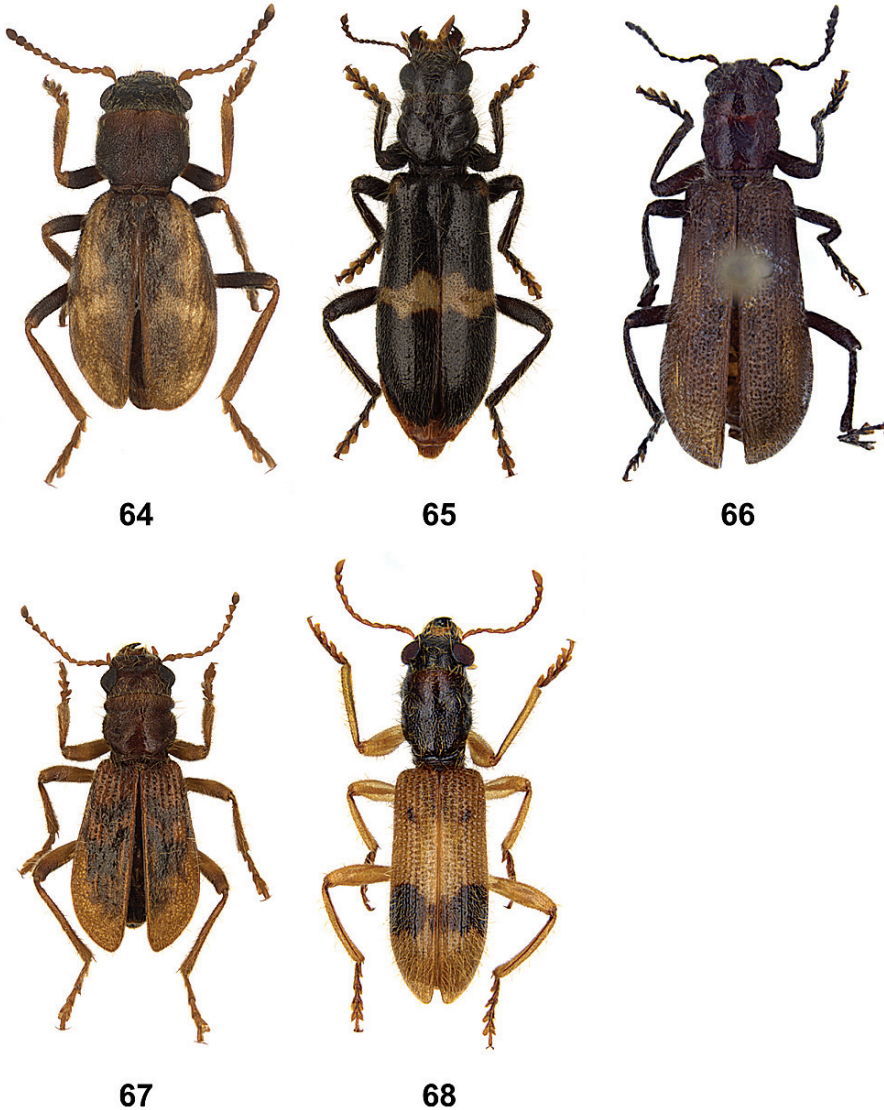
***Orthrius* Gorham, 1876**

<http://species-id.net/wiki/Orthrius>

Figs 1–4, 6, 8–9, 18, 26, 35, 44, 54, 65

Dedana Fairmaire, 1888, syn. n.; Fairmaire 1888: 26; Schenkling 1903: 4, 23.

Type species: *Orthrius cylindricus* Gorham, 1876. Gorham 1876: 74.



Figures 64–68. Habitus of **64** *Nonalatus brevis* **65** *Orthrius sepulcralis* **66** *Pieleus irregularis* **67** *Pseudoastigmus pygidialis* **68** *Xenorthrius mouhoti*.

Distribution: Indo-Australian region.

Material examined: *Orthrius cylindricus* (Type), NSW; *Orthrius* Gorh., *cylindricus* G., Type; Museum Paris, Coll. Gorham, 1914 (MNHN); and several other specimens of this genus. *Dedana rufodorsata* Fairmaire, 1888 (Type), Fokien; *Dedana rufodorsata* Fairm.; ExMusaeo Arm. David, 1900 (MNHN).

Head: Eyes strongly protruding, only slightly emarginate at antennal insertion; interocular space more than one eye width; gular sutures converging, gular process broad;

antennae long, A2 shorter than A3, A2-A8 filiform, A10 broadest, A11 sub-ovate, apical half pinched, terminal three antennomeres forming a more or less conspicuous club.

Thorax: Proepimeron short to medium-sized, not acute; anterior mesosternal process absent; metendosternite with normal furcal stalk length, furcal arms normal, stalk base very slightly emarginate (Fig. 18). Elytra long, subparallel, sometimes dilated apically (broadest behind middle), apices rounded, elytral punctation not arranged into striae.

Legs: Long, especially profemora intermediately to strongly thickened; tarsal pulvillar formula 4-4-3, tibial spur formula 0-1-1; tibiae with longitudinal carinae; claws simple.

Abdomen: Apical margin of male ventrite 6 straight or slightly emarginate (Fig. 54); tegmen relatively broad, parameres expanded laterally, tapering to a curved acumination distally, phallobasic struts not fused, phallobasic apodeme dilated distally (Fig. 44).

Pieleus Pic, 1940

<http://species-id.net/wiki/Pieleus>

Figs 27, 55, 66

Type species: *Pieleus irregularis* Pic, 1940. Pic 1940b: 4.

Distribution: China.

Material examined: *Pieleus irregularis* (Type female), T'ienmu Shan, Musée Heude; 20.VII.36, O. Piel, coll.; *Orthrius irregularis mihi* [handwritten by Pic](MNHN).

Head: Eyes strongly protruding, conspicuously emarginate at antennal insertion; interocular space about 1.5 eye widths; gular sutures diverging, gular process broad; antennae short, A1 more than two times longer than A2, A2 shorter than A3, A2-A6 filiform, antennomeres becoming shorter, A7 shorter than A6, slightly dilated distally, A11 sub-ovate, apical third pinched, terminal three antennomeres forming a loose club.

Thorax: Proepimeron medium-sized, slightly rounded; anterior mesosternal process present; metendosternite missing. Elytra compact, strongly dilated apically (broadest behind middle), apices broadly rounded, elytral punctation not arranged into striae; without CuA2 in hindwings (Fig. 27).

Legs: Of normal size; tarsal pulvillar formula 4-4-4, tibial spur formula 1-1-2; tibiae without longitudinal carinae; claws with basal denticle.

Pseudoastigmus Eberle, gen. n.

urn:lsid:zoobank.org:act:56520F10-5440-4188-ACCE-CBA847869133

<http://species-id.net/wiki/Pseudoastigmus>

Figs 19, 36, 45, 56, 67

Type species: *Astigmus pygidialis* Pic, 1933, comb. n. Pic 1933: 257.

Distribution: Aethiopian region (Ruwenzori).

Material examined: *Astigmus pygidialis* (Syntype), Musée du Congo, Ruwenzori (4200m), VII-1932, L. Burgeon; type; Stigmatium (*Astigmus*) *pygidiale* n sp [handwritten by Pic], and four additional syntypes (MRAC).

Head: Eyes strongly protruding, conspicuously emarginate at antennal insertion; interocular space about two eye widths; gular sutures subparallel to slightly diverging, gular process of medium width; antennae long, A2 shorter than A3, from A4 onwards slightly dilated distally, A11 sub-ovate, apical half pinched, without club.

Thorax: Proepimeron very short, not acute; anterior mesosternal process present; metendosternite with very short furcal stalk length, furcal arms acute distally, stalk base conspicuously emarginate (Fig. 19). Elytra short, compact, dilated apically (broadest behind middle), apices broadly rounded, elytral punctuation arranged into more or less regular ten striae; wingless.

Legs: Long, stout; tarsal pulvillar formula 4-4-3, tibial spur formula 1-2-2; tibiae without longitudinal carinae; claws with basal denticle.

Abdomen: Apical margin of male ventrite 6 deeply emarginate (Fig. 56); tegmen relatively broad, tapering to a curved acumination distally, phallobasic struts not fused, phallic struts and phallobasic apodeme not dilated distally (Fig. 45).

Xenorthrius Gorham, 1892

<http://species-id.net/wiki/Xenorthrius>

Figs 5, 7, 10, 20, 28, 37, 46, 57, 68

Type species: *Xenorthrius mouhoti* Gorham, 1892. Gorham 1892: 733, 1893: 575; Schenckling 1903: 46–47.

Distribution: Indo-Australian and Palearctic region.

Material examined: *X. mouhoti*, Lectotype (MSNG), Paralectotypes, and additional species (see Gerstmeier and Eberle 2010).

Head: Eyes strongly protruding, conspicuously emarginate at antennal insertion; interocular space larger than one eye width; gular sutures subparallel to divergent, gular process varying in width, from narrow to broad; antennal length interspecifically variable and sometimes sexually dimorphic (longer in males), A2 shorter than A3, A3-A8 more or less filiform, A10 broader than long, A11 sub-ovate, apical half pinched, mostly without club, sometimes terminal three antennomeres forming a loose club.

Thorax: Proepimeron medium-sized, more or less acute; anterior mesosternal process present, with a subtriangular sulcus in the middle (Fig. 7); metendosternite with normal furcal stalk length, furcal arms broad, apically dilated, stalk base very slightly to deeply emarginate (Fig. 20). Elytra subparallel, sometimes broadest behind middle, apices rounded (most species), strongly dehiscent (*X. prolongatus* and *X. furcalis*), or dentate (*X. truncatus* and *X. scordalus*); elytral punctuation arranged into ten striae.

Legs: Mostly relatively short; tarsal pulvillar formula 4-4-4, tibial spur formula 1-2-2; tibiae with or without longitudinal carinae; claws with pronounced basal denticle (Fig. 10).

Table 1. Characters and character states used in the cladistic analysis of the genera.

Character 0	Mesotarsal pulvilli: (0) 4; (1) 3
Character 1	Metatarsal pulvilli: (0) 4; (1) 3; (2) 2
Character 2	Protibial spurs: (0) 2; (1) 1; (2) 0
Character 3	Mesotibial spurs: (0) 2; (1) 1
Character 4	Metatibial spurs: (0) 2; (1) 1
Character 5	Ommatidial facets: (0) coarse; (1) fine
Character 6	Flagellomeres: (0) filiform; (1) dilated
Character 7	Eye's emargination: (0) absent or weak; (1) conspicuous
Character 8	Eye's separation: (0) more than two eyes width; (1) between one and two eyes width
Character 9	Gular sutures: (0) convergent to subparallel; (1) subparallel to divergent
Character 10	Gular process: (0) broad; (1) narrow
Character 11	Relation between A2 and A3: (0) A2 < A3; (1) A2 = A3 or A2 > A3
Character 12	Anterior mesosternal process: (0) present; (1) absent
Character 13	Metendosternite, furcal stalk length: (0) normal; (1) very short
Character 14	Metendosternite, furcal arms: (0) normal; (1) acute
Character 15	Metendosternite, furcal stalk base: (0) normal; (1) deeply emarginate
Character 16	Wings: (0) present; (1) absent
Character 17	CuA2: (0) present; (1) absent
Character 18	RP2: (0) present; (1) absent
Character 19	Elytral punctuation: (0) with 10 regular striae; (1) with 10 irregular striae; (2) with more than 10 irregular striae
Character 20	Tibial carinae: (0) present; (1) absent
Character 21	Claws: (0) simple; (1) with basal denticle
Character 22	Phallobasic struts: (0) not fused; (1) fused

Abdomen: Apical margin of male ventrite 6 more or less distinctly emarginate (Fig. 57); tegmen mostly elongate, cross-section subrectangular; phallobasic struts not fused, phallic struts acute, phallobasic apodeme not dilated distally (Fig. 46).

Discussion of cladistic results

The cladistic analysis resulted in a single most parsimonious tree with a length of 37 steps (Fig. 69). Common to all taxa of the *Orthrius*-group are four mesotarsal pulvilli (char. 0-0) and coarse ommatidial facets (char. 5-0) which distinguishes them from the *Clerus*-series.

Pseudoastigmus gen. n. and *Nonalatus* gen. n. appear together at the base of the tree. This pair is supported by the acute form of the furcal arms of the metendosternite (char. 14-1) as well as the complete reduction of the hind wings (char. 16-1).

The remaining taxa share the filiform flagellum (char. 6-0). The development of four pulvilli at the metatarsus (char. 1-0) is also synapomorphic at this point, but is

Table 2. Character matrix of 23 adult morphological characters of *Clerus* (outgroup) and genera of the *Orthrius* group.

Taxa	Characters																									
	0	1	2	3	4	5	6	7	8	9	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
<i>Clerus</i>	1	2	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0
<i>Abbelochroa</i>	0	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	0
<i>Cariidopus</i>	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	[01]	?	?	?	?	0	0	1	0	1	0
<i>Dozocolletus</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	?	?	?	0	0	0	0	1	0
<i>Gyponyx</i>	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
<i>Languropilus</i>	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	?	0
<i>Neorthrius</i>	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
<i>Nonalatus</i>	0	2	1	0	0	1	1	0	1	0	0	1	0	0	1	1	1	?	?	1	0	1	1	1	1	0
<i>Orthrius</i>	0	1	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0
<i>Piteleus</i>	0	0	1	1	0	0	1	1	1	1	0	0	?	?	?	?	?	?	?	1	2	1	1	1	?	?
<i>Pseudostigmus</i>	0	1	1	0	0	1	1	1	1	1	0	0	?	?	?	?	?	?	?	?	0	1	1	1	1	0
<i>Xenorthrius</i>	0	0	1	0	0	0	1	1	1	1	[01]	0	0	0	0	[01]	0	0	0	0	0	0	[01]	1	1	0

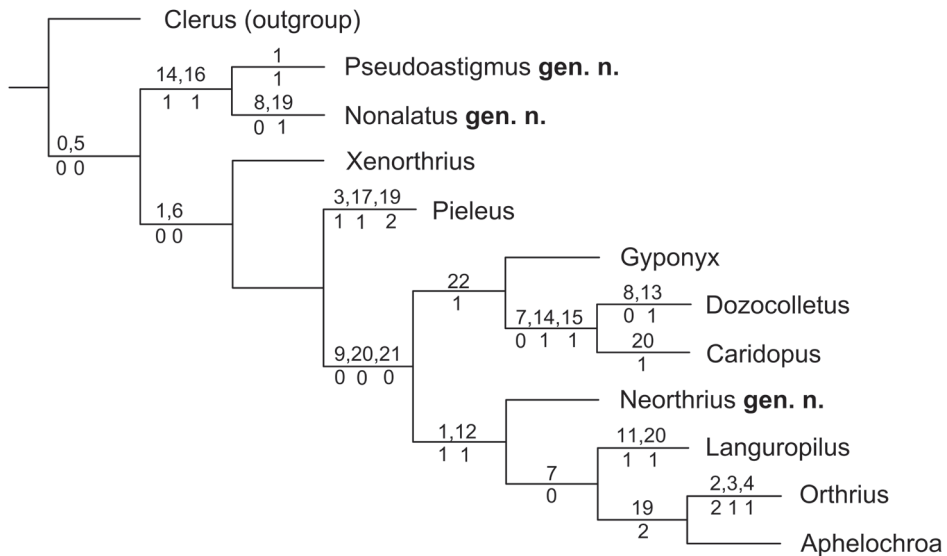


Figure 69. Cladistic tree of the genera of the *Orthrius*-group.

reduced to three pulvilli for the cluster of *Neorthrius* gen. n., *Languropilus*, *Orthrius* and *Aphelochroa* (char. 1-1).

These four genera also share the loss of the anterior mesosternal process (char. 12-1). Like in *Dozocolletus* and *Caridopus* the emargination of the eyes is weak or absent (char. 7-0) in *Languropilus*, *Orthrius* and *Aphelochroa*. For this reason, *Neorthrius* adopts a basal position in this group. The monophyly of *Orthrius* and *Aphelochroa* is supported by their elytral punctation (char. 19-2). *Orthrius* differs from all other taxa in this revision in its tibial spur formula which is 0-1-1 (chars. 2-2, 3-1 and 4-1).

The aethiopian genera *Gyponyx*, *Dozocolletus* and *Caridopus* have in common, that the phallobasic struts are fused with the phallobasic apodeme (char. 22-1). The monophyly of *Dozocolletus* and *Caridopus* is well supported by the weak or absent emargination of the eyes (char. 7-0) and similarities of their metendosternites: the furcal arms are acute (char. 14-1) and the furcal stalk base (char. 15-1) is deeply emarginate.

A common ancestor can be assumed for the latter two clusters of genera. This is supported by two synapomorphies: the gular sutures are convergent to parallel (char. 9-0) and the claws are simple (char. 21-0). The presence of the tibial carinae (char. 20-0) also is apomorphic at this node but reduced in *Caridopus* and *Languropilus*. As Solervicens (2007) mentioned, it also may be considered a symplesiomorphy, because it is a common character of the Clerinae.

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First record of the myrmicine ant genus *Carebara* Westwood, 1840 (Hymenoptera, Formicidae) from Saudi Arabia with description of a new species, *C. abuhurayri* sp. n.

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Abstract

The myrmicine ant genus *Carebara* is recorded for the first time in Saudi Arabia from the Arabian Peninsula as a whole. A new species *Carebara abuhurayri* sp. n. is described based on workers collected from Al Bahah region. One of the smallest ant species known to occur in Arabia, *C. abuhurayri* is found in an area inhabited by many ant species including *Tetramorium sericeiventre* Emery, 1877, *Pheidole minuscula* Bernard, 1952, *Pheidole* sp., *Monomorium destructor* (Jerdon, 1851), *Monomorium exiguum* (Forel, 1894) and *Monomorium* sp. and *Crematogaster* sp.

Keywords

Ant fauna, Palaearctic, Asir province, Al Bahah, Arabia, new species, Myrmicinae, taxonomy

Introduction

The ant genus *Carebara* Westwood, 1840, *sensu* Fernández (2004), is one of the largest ant genera of subfamily Myrmicinae with more than 180 species (Bolton et al. 2006) distributed worldwide in the tropics (Brown 2000) and the Afrotropical region (Weber 1950). Many of them are very tiny cryptic soil and leaf litter inhabitants (Longino 2004). They nest in rotten wood to which the bark is still adherent in the Afrotropical region (Bolton 1973), or may be lestopibiotic (Longino 2004) nesting near other ant species. Little is known about the biology of the species.

The taxonomic knowledge also is limited. Fernández (2004) is the most comprehensive study but that dealt primarily with American species. He proposed a significant change to the systematics, however, in arguing for the combination of several genera under the single genus *Carebara*. Thus: *Carebara* Westwood, 1840; = *Oligomyrmex* Mayr, 1867 = *Aeromyrma* Forel, 1891; = *Aneleus* Emery, 1900; = *Erebomyrma* Wheeler, 1903; = *Paedalgus* Forel, 1911; = *Lecanomyrma* Forel, 1913; = *Spelaeomyrmex* Wheeler, 1922; = *Hendecatella* Wheeler, 1927; = *Solenops* Karawajew, 1930; = *Sporocleptes* Arnold, 1948; = *Crateropsis* Patrizi, 1948; = *Nimbamyрма* Bernard, 1953; = *Afroxyidris* Belshaw & Bolton, 1994 (provisional); = *Neoblepharidatta* Sheela & Narendran, 1997. Fernández (2010) has added *Parvimyrma* Eguchi & Bui, 2007 to the synonymy.

There are anomalies, however, in the Fernández proposal which was based primarily on the American fauna. In particular, it does not gel with the contrasting dimorphism of the *Oligomyrmex* workers, with minors, ca. 1.0 mm in total length (TL), and majors, TL ca. 2.0–2.5 mm, coupled, where known, with queens of a similar general morphology to the major workers and no more than twice as long, TL ca. 5–6 mm or less and the *Carebara s.s.* which have monomorphic workers with TL ca. 2.0 mm and grossly enlarged queens, most with TL 15 mm plus. The *Carebara s.s.* queens also are morphologically greatly dissimilar to any *Oligomyrmex* queens.

The genus *Carebara sensu* Fernández (2004) was unknown from Arabia prior to the description of *C. arabica* (= *Oligomyrmex arabicus*) from Yemen by Collingwood and Van Harten 2001). Although the description of *C. arabica* might have been more explicit, it was based on major and minor workers, with drawings of both. Here, we give the first record of a *Carebara* species from Saudi Arabia based on the new species, *C. abuhurayri*.

Measurements and indices

Measurements in mm and indices are as follows (Bolton 1987):

- | | |
|-----------|--|
| TL | Total Length; the outstretched length of the ant from the mandibular apex to the gastral apex. |
| HW | Head Width; the maximum width of the head behind eyes in full face view. |
| HL | Head Length; the maximum length of the head, excluding the mandibles. |
| CI | Cephalic Index (HW x 100/HL). |
| SL | Scape Length, excluding basal neck. |

SI	Scape Index (SL x 100/HW).
EL	Eye Length; the maximum diameter of the eye.
ML	Mesosoma Length; the length of the mesosoma (or alitrunk) in lateral view, from the point at which the pronotum meets the cervical shield to the posterior base of the propodeal lobes or teeth.
PRW	Pronotal width in dorsal view.
PL	Petiole Length; the maximum length measured in dorsal view, from the anterior margin to the posterior margin.
PW	Petiole Width; maximum width measured in dorsal view.
PPL	Postpetiole Length; maximum length measured in dorsal view.
PPW	Postpetiole Width; maximum width measured in dorsal view.

Taxonomy

Carebara abuhurayri Sharaf & Aldawood, sp. n.

urn:lsid:zoobank.org:act:CCB8586A-7665-49D1-8CD7-62EE4F77FC7B

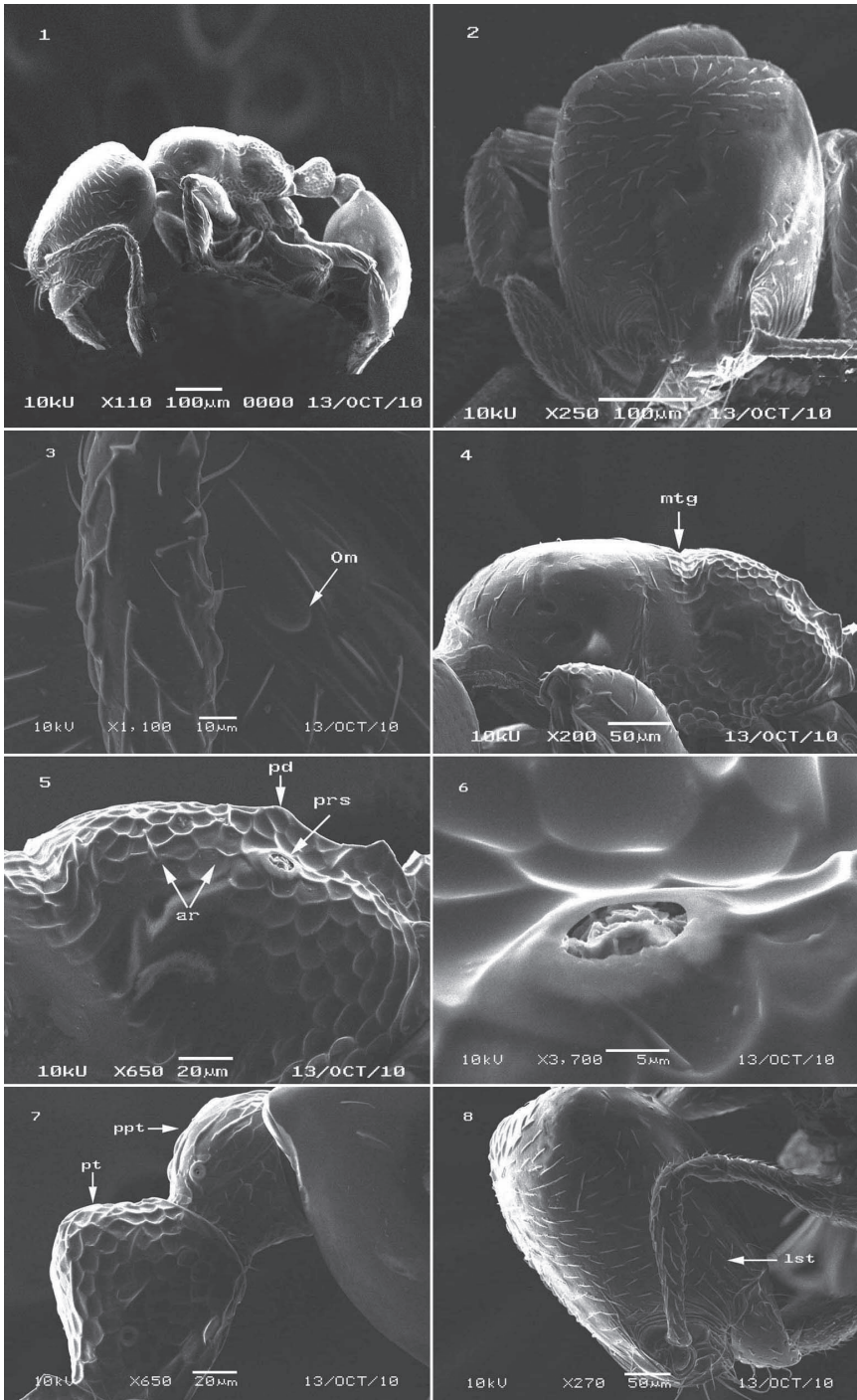
http://species-id.net/wiki/Carebara_abuhurayri

Figs 1–12

Holotype worker. TL 0.99, HL 0.39, HW 0.31, SL 0.24, ML 0.31, PRW 0.19, PL 0.11, PW 0.08, PPL 0.05, PPW 0.09, SI 77, CI 79.

Overall unicolorous yellow, smooth and shining (Fig.1). Head (Fig.2) distinctly longer than broad, with clearly convex sides and a straight posterior margin. Mandibles smooth and shining with relatively long yellow hairs and armed with four teeth. Median portion of clypeus flat. In anterolateral view, clypeal lateral carinae strongly narrowed posteriorly between frontal lobes, then continued as a frontal triangle. Eyes minute and with a single ommatidium (Fig.3). Scapes fail to reach head posterior margin by about one-third the head length. The scapes broaden evenly from about mid-length. Mesosoma in profile slightly convex. Metanotal groove shallow but distinct, dorsally and laterally (Fig.4). Propodeum obliquely angled (Fig.5). Propodeal spiracle (Fig.5, 6) relatively large, circular, high and close to propodeal declivity. Metapleural gland orifice prominent. Petiole longer than broad in dorsal view with short peduncle. Postpetiole node lower than petiole and dorsally distinctly convex, nearly as long as broad in dorsal view (Fig.7). Pilosity appressed, few and short on mesosoma, petiole, postpetiole, and rare on first gastral tergite, underside of head with a few short straight hairs. The clypeus has two pairs of standing hairs, the central pair long, and the lateral pair shorter. Anterior sides of head very finely longitudinally striated (Fig.8). Dorsum of head with abundant scattered hair pits. Lower half of mesopleura, metapleura, and petiole and postpetiole with areolate-rugose sculpture (Fig.5).

Paratypes. TL 0.99–1.13, HL 0.35–0.41, HW 0.29–0.32, SL 0.21–0.28, ML 0.31–0.34, PRW 0.17–0.19, PL 0.08–0.12, PW 0.07–0.08, PPL 0.05–0.07, PPW 0.08–0.09, SI 69–88, CI 74–89. (7 measured).



Figures 1–8. *Carebara abuhurayri* sp. n.; ar: areolate-rugose; lst: longitudinal striations; mtg: metanotal groove; om: ommatidium; pd: propodeum; prs: propodeal spiracle; ppt: postpetiole; pt: petiole.

Holotype worker. Saudi Arabia, Al Bahah, Al Mukhwah, Zei Ein Archaeological Village, 19° 55' N; 41° 26' E, 741 m. a.s.l. 18.v.2010 (*M. R. Sharaf Leg.*); deposited in the King Saud Museum of Arthropods, College of Food and Agriculture Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia.

Paratypes. 7 workers, same locality as holotype; 1 deposited in the Muséum d'Histoire Naturelle, Geneva, Switzerland (Dr Bernhard Merz); 1 deposited in Naturhistorisches Museum, Basel, Switzerland (Mrs. Isabelle Zürcher-Pfander); 1 deposited in California Academy of Science (Dr Brian Fisher); 2 deposited in World Museum Liverpool, Liverpool, U.K (Dr Guy Knight), the remaining specimens in the King Saud Museum of Arthropods, King Saud University, Riyadh, Saudi Arabia.

Given the anomalies of the Fernández (2004) schema and with only minute monomorphic workers, we are unable to place this new species within his species-complexes (denominated as species-groups in Fernández 2010). In the old schema, workers with 10-segmented antennae would fall in the Genus *Oligomyrmex* Mayr subgenus *Aeromyrma* Forel. Those, however, like all the *Oligomyrmex*, have dimorphic workers but, from the present collection, *C. abuhurayri* has only a small worker morph. *Carebara arabica* has major and minor workers, both appearing to have 11-segmented antennae. The minor is larger, TL 1.3 mm, than *C. abuhurayri*, TL max 1.13 mm, and the propodeum profile of the minor has a sharp angular transition from the dorsum to the declivity.

Etymology. This new species is named after Abuhurayra, the companion of the Prophet, Mohammed, may peace and blessing be upon him, and whose tribe inhabited Al Bahah region.

Biology. The specimens of *C. abuhurayri* were found foraging on the ground and coexisting with the ant species *Tetramorium sericeiventre* Emery, 1877, *Pheidole minuscula* Bernard, 1851, *Pheidole* sp., *Monomorium destructor* (Jerdon, 1851), *Monomorium exiguum* (Forel, 1894), *Monomorium* sp. and *Crematogaster* sp. This association with the above taxa may indicate a "lestopibiotic" relationship (Longino, 2004) but at present, it is not known with which of these above species *C. abuhurayri* is nesting. It is worth mentioning that *C. abuhurayri* is one of the smallest ant species known to occur in Arabia.

The type locality is a mountainous area which is considered as a part of upper Tihama territory which belongs to Al Bahah region (Fig. 13). The locality has a great diversity of wild plants and many cultivated fruits, especially banana, date palm, and *Ficus* trees, also alfalfa, and some lemon trees are cultivated. Many water streams are present in the area, therefore, the soil has a considerable degree of humidity all year round. Such habitats are found elsewhere in Arabia and so this or related species can be expected in most Arabian countries. For Saudi Arabia, we are expecting to record them in the Asir mountain chain, especially in the lower elevation areas which are called Tihama. We hope future collecting will allow clarification as to whether *C. abuhurayri* has monomorphic or dimorphic workers and the nature of the queen.



Figures 9–12. *Carebara abuhurayri* sp. n. paratype worker **9–12**, **9** body in profile **10** body in dorsal view **11** head in full-face view **12** type locality label (CASC)

Discussion

Additional Arabian species

Carebara arabica (Collingwood & van Harten, 2001) which was described as *Oligomyrmex arabicus* from Yemen based on major and minor workers, and is known only from a single collection, is an example of a long-headed species with 11-segmented antennae (in the original description, the SL for major is given wrongly as 0.63, from the illustration it would be ca 0.16). The small worker of the new species *C. abuhurayri* appears not too dissimilar to the minor worker of *C. arabica* but it is consistently smaller in size (TL 0.99–1.13 mm versus TL 1.30); has a higher cephalic index (CI 74–89 versus CI 71), and a relatively lower head length (HL 0.35–0.41 versus HL 0.42). In addition, *C. abuhurayri* has a distinct but shallow metanotal groove compared with the deep groove in *C. arabica*. It does not resemble *Carebara afghanus* Pisarski, 1990, which has 9-segmented antennae but has a low, elongated and flat alitrunk profile without propodeal spines. The presence of single facet eyes, however, is the main characteristic, that sets *C. abuhurayri* apart from some of the African *Carebara*.

In pre-Fernández taxonomy *C. abuhurayri* might fall in the *Oligomyrmex* subgenus *Aeromyrma*, i.e. those with 10-segmented antennae. The only sub-Saharan species



Figure 13. Type locality, Al Mukhwah, Zei Ein Archaeological village.

with 4-toothed mandibles is *O. jeanneli* Santschi, 1913. This has minor, TL 0.9 mm; metanotal groove shallow, dorsum of propodeum short; petiole noticeably narrower than postpetiole, postpetiole wider than long; head smooth, feebly punctuate, shiny; eyes atrophied set at anterior third of side; scape reaches posterior third of the head; petiole wider than high; postpetiole transverse, twice as wide as long; promesonotum wider than long; dorsum of propodeum wider than long unarmed; yellow, smooth and shiny.

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