



A new species of *Lygistorrhina* (*Lygistorrhina*) Skuse, 1890 (Diptera: Keroplatidae, Lygistorrhinae) with a key to the subgenus

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Abstract

A new species of *Lygistorrhina* (*Lygistorrhina*) Skuse, 1890, *Lygistorrhina woodi* sp. nov., is described. The specimen was dissected from an alcohol-preserved flower of *Ceropegia aristolochioides* ssp. *deflersiana* Bruyns (Apocynaceae, Asclepiadoideae, Ceropegieae) stored in the Kew herbarium. This is the first occurrence of the lygistorrhine gnats in a hot, semi-arid climate. A key to all known species of the subgenus *Lygistorrhina* (*Lygistorrhina*) is provided.

Key words: biodiversity, *Ceropegia*, Apocynaceae, fungus gnats, taxonomy, new taxa, Afrotropical region

Introduction

Lygistorrhinae Edwards, 1925 is a small group of fungus gnats comprising 55 species in 16 genera, of which 16 are fossil species in nine genera and 35 extant species in eight genera (Blagoderov 2022, 2023; Yang *et al.* 2023). Their biology is practically unknown, except for some field observations of nectariphagy and their role as flower nectar feeders and possible pollinators (Ollerton *et al.* 2009; Bertone, 2018). Although previously lygistorrhinids were considered as a separate family, the latest molecular phylogenetic study presented the group as a well-supported monophyletic clade within Keroplatidae Rondani, 1856 (Mantič *et al.* 2020).

The largest genus of the subfamily, *Lygistorrhina* Skuse, 1890, is subdivided into two subgenera, *L.* (*Lygistorrhina*) and *L.* (*Probolaeus*) Williston, 1896, both with 14 known species, distributed in the Old World and New World respectively (Grimaldi & Blagoderov 2001). Blagoderov & Pollet (2020) published a key to the known species of the subgenus *L.* (*Probolaeus*). In the current paper we describe a new species of *L.* (*Lygistorrhina*) and provide a key to the nominative subgenus.

Material and Methods

A specimen of *Lygistorrhina* was dissected by JO in 2006 from the flowers of a specimen of *Ceropegia aristolochioides* ssp. *deflersiana* Bruyns (Apocynaceae, Asclepiadoideae, Ceropegieae) preserved in the spirit collection of the Royal Botanic Gardens, Kew and identified to genus level by AW. Unfortunately, the specimen was somewhat deteriorated, and several structures, including tips of antennae and legs were lost. The specimen was treated with 10% KOH and mounted on a slide in Euparal. Images were obtained with Canon EOS 7D coupled with Leica M205C and Olympus BX51 microscopes. The type is deposited in the collection of the National Museums Scotland (NMS).

Climate information was obtained through the ClimateCharts database (Zepner *et al.* 2021) and FAO Climate information Tool (FAO 2021).

Taxonomy

Lygistorrhina woodi, sp. nov.

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Material. Holotype: Male. Yemen, Dhi Sufal, alt. 2000m. 20/10/1975. J.R.I.Wood leg. NMS-10018524, (dissected by J. Ollerton from a flower of *Ceropegia aristolochioides* ssp. *deflersiana*, [Kew 39277.000]; identified as *Lygistorrhina* sp. by A. Whittington).

Description

Male. Measurements (mm). Head height 0.27; palpi 0.61; hypopharynx 0.78; proboscis labellum 0.84; thorax length 0.53, thorax height 0.59; coxa 1 0.42; coxa 2 0.32; coxa 3 0.33; wing 1.6 (Sc 0.25, R1 0.73, R5 1.25, width 0.64).



FIGURE 1. *Lygistorrhina woodi*, sp. nov., holotype, habitus.

Colouration. Head, preserved part of antennae, thorax and abdomen brown; terminalia slightly darker brown; legs brown except hind femora which are darkened on apical third.

Head rounded, vertex rather flat. Head dichoptic, oval. Ommatidia round, densely set, equal in size. Interommatidial setae stiff and very short, $\sim\frac{1}{2}$ the diameter of ommatidia. Three ocelli, almost in a straight line, set each on its own mound, lateral facing to the sides, medial facing forward, slightly smaller than lateral. Antenna with pedicel spherical, basal four flagellomeres with length 1.3–1.5 \times the width, covered with setae 0.5 \times the width of

flagellomeres, with two longer apical dorsal setae. Face narrow. Clypeus pointed at apex, its length 1.8× the width. Palpi long, 0.7× the length of proboscis, tapering, with long setae along entire surface. Proboscis evenly curved caudally, its length 2× the length of fore coxa, and 3× the head height.

Thorax. Scutum evenly covered with short setae, with longer supraalar setae. Scutellum short, without long setae. Anteprenotum with three setae, proepisternum with 5 setae; suture between them indistinct. Ventral margin of preepisternum 2 widely rounded. Posterior margin of metepisternum longer than anterior, not extending to the level of laterotergite. Laterotergite with an irregular posterior row of 6–8 setae. Mediotergite very convex.

Wing hyaline, moderately wide, costal margin slightly convex. Microtrichia on membrane moderately long (0.01 mm), overlapping. Costa with long setae, ending at half distance between R_5 and M_1 . Sc short, 0.25 mm, ending at C. R_1 straight, 0.73 mm. R_5 slightly sinusoid, both R_1 and R_5 with long setae (0.04 mm) dorsally and ventrally. Crossvein *r-m* indistinct. M_1 and M_2 almost straight, the base of their fork is reduced, M_2 begins more proximally than M_1 . M_{3+4} and CuA evenly curved caudally, slightly diverging. CuA ends distad of the level of R_1 tip.



FIGURE 2. *Lygistorrhina woodi*, sp. nov., holotype, wings.

Legs. Fore coxa is the longest, mid coxa a little shorter. Tibial and tarsal setae not in rows. Fore basitarsus shorter than fore tibia. Number of tibial spurs on fore, mid and hind tibia 1:2:2, mid tibia tibial spurs ca. 1.5× the tibia diameter, hind tibial spurs 2.5× (outer) and 2× (inner) the maximum tibia diameter. Hind tibia slightly expanded apically. Mid tarsal claws straight, sharply pointed.

Abdomen unicolorous, irregularly covered in setae, sternite 1 bare. Terminalia slightly darker than abdomen. Tergite 9 roughly triangular with rounded apex and shallow sinus at the base, length 0.12 mm, width 0.09 mm, with long scattered setae and a dense patch of short spines at apex. Cerci triangular. Apodeme of tergite 9 with long, narrow stalk, and two short thin arms directed apically. Gonocoxites fused ventrally, with a deep incision, almost reaching the base of synsclerite. Synsclerite length and width 0.15 mm. Gonostyli simple, length 0.12 mm, with a strong pointed dorsoapical tooth and dense patch of ventroapical setae. Long flagellate setae on mediodorsal edge of gonostylus absent. Aedeagus with flat apex.



FIGURE 3. *Lygistorrhina woodi*, sp. nov., holotype, lateral view of thorax.

Diagnosis.

Lygistorrhina woodi sp. nov. is unique among other species of the subgenus in having compound eyes with very short interommatidial setae, proboscis relatively short; costa reaching only $\sim\frac{1}{2}$ of distance between R_5 and M_1 ; and tergite 9 of male terminalia with shallow sinus basally and very small arms of apodeme.

Etymology

The specific epithet is a patronym for John R. I. Wood, a prominent botanist, who inadvertently collected the holotype of the species.



FIGURE 4. *Lygistorrhina woodi*, sp. nov., holotype, photograph of male genitalia. a) dorsal view; b) ventral view.

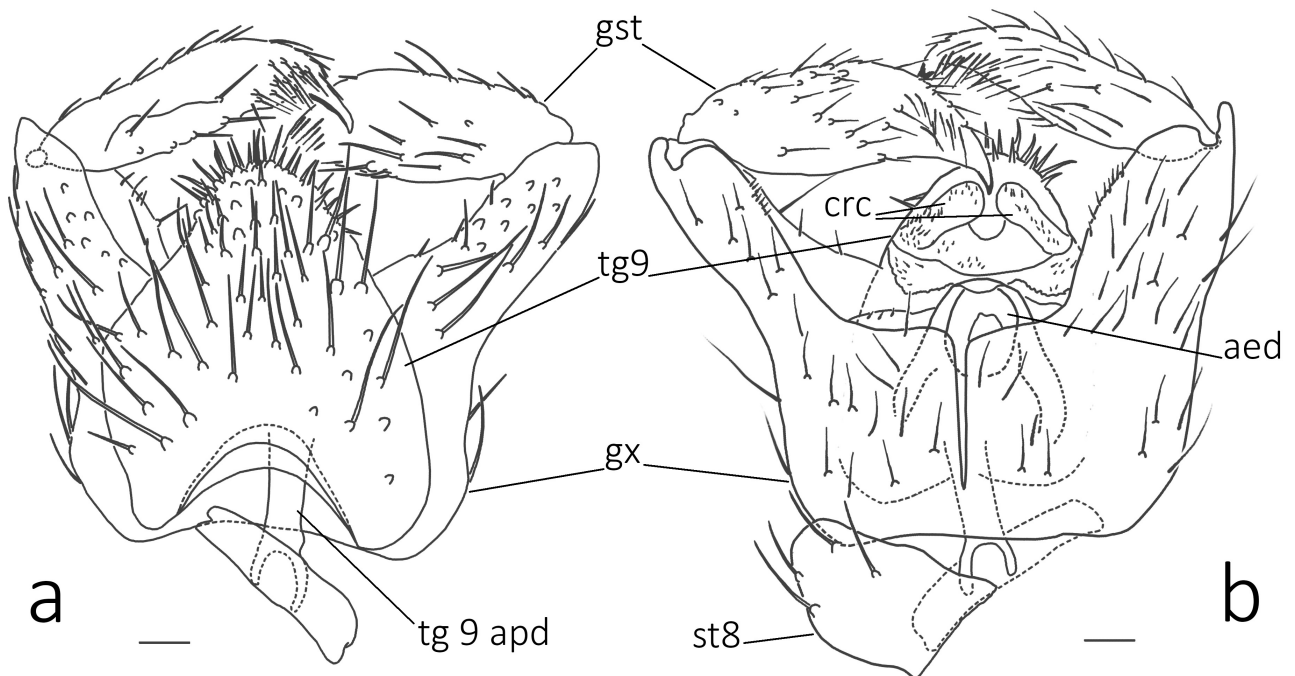


FIGURE 5. *Lygistorrhina woodi*, sp. nov., drawings of male genitalia. a) dorsal view; b) ventral view. Abbreviations: *aed*, aedeagus; *crc*, cerci; *gst*, gonostyli; *gx*, gonocoxites; *tg9*, tergite 9; *tg9 apd*, apodeme of tergite 9. Scale: 20 μ m.

Key to the species of subgenus *Lygistorrhina* (*Lygistorrhina*) Skuse, 1890

1. Wing membrane hyaline. 2
- Wing membrane with spots or conspicuously darkened 7
2. Base of CuA (position) conspicuously proximad of R₁ tip level 3
- Base of CuA (position) at the R₁ tip level or distad of it 5
3. R₅ bare *Lygistorrhina indica* Stebner & Grimaldi in Stebner *et al.*, 2017 [India, Eocene]
- R₅ setose 4
4. Median ocellus smaller than lateral; antenna pale; basal flagellomeres as long as wide, hind femur and tibia darkened on apical third. *Lygistorrhina edwardsina* Grimaldi & Blagoderov, 2001 [Uganda, Kenya, Tanzania, Zaire]
- Median ocellus equal to lateral; antenna dark; basal flagellomeres 2× as long as wide, hind femur and tibia entirely dark brown *Lygistorrhina magna* Matile, 1990 [Zaire]
5. Sc free; R₅ bare; abdomen with pale basal spots or bands on segments 2–6
- *Lygistorrhina nassreddinei* Matile, 1979 [Grande Comore]
- Sc ends on Costa; R₅ setose; abdomen unicolorous 6
6. Median ocellus equal to lateral; Costa extends to 2/3 the distance between R₅ and M₁; hind femur entirely dark
- *Lygistorrhina austroafricana* Blagoderov, Papp & Hippa, 2013 [South Africa]
- Median ocellus smaller than lateral; Costa extends to half the distance between R₅ and M₁; hind femur darkened on apical third. *Lygistorrhina woodi*, sp. nov. [Yemen]
7. Pigmented spot in cubital cell absent 8
- Pigmented spot in cubital cell present 11
8. Flagellum unicolorous 9
- Flagellum with pale and dark bands 10
9. Cell r1 and apical 2/5 of the wing evenly infusate; Sc ends on Costa; abdomen unicolorous
- *Lygistorrhina carayoni* Matile, 1986 [New Caledonia]
- Wing membrane with two greyish spots in the middle and at the tip of the wing; Sc ends free; abdomen with pale basal bands on segments 3–6 *Lygistorrhina insignis* Skuse, 1890 [Australia: New South Wales]
10. Flagellum with flagellomeres 5–6 and 12 yellow (flagellomere 13 brown); abdomen with pale basal bands on segments 2–4; M₁ and M₃₊₄ curved back *Lygistorrhina hamoni* Matile, 1996 [Côte d'Ivoire]
- Flagellum with flagellomeres 5–6 and 12–13 yellow; abdomen with pale basal bands on segments 2–6; M₁ and M₃₊₄ conspicuously sinusoid. *Lygistorrhina legrandi* Matile, 1990 [Gabon, Central African Republic]
11. Tip of the wing solidly infusate; abdomen unicolorous *Lygistorrhina fijiensis* Evenhuis, 2008 [Fiji]
- Infusate tip of the wing with hyaline spots; abdomen with pale bands or spots 12
12. Fore coxa yellow; M₁ evenly curved back; abdomen with pale basal bands on segments 2–5
- *Lygistorrhina pictipennis* Okada, 1937 [Japan: Honshu]
- Fore coxa at least partly brown; M₁ and sometimes M₃₊₄ sinusoid; abdomen with pale basal band on segment 6 13
13. Abdomen with pale basal band on segments 4–6, flagellomeres with two or more prominent dorsal setae
- *Lygistorrhina pentafida* Papp, 2005 [Thailand]
- Abdomen with pale basal band on segments 2–6; flagellomeres without prominent dorsal setae 14
14. Flagellomeres 3–4 and 8–13 black, remaining yellow; basal flagellomeres at least 1.5× as long as wide; fore basitarsus slightly longer than fore tibia *Lygistorrhina chaoi* Papp, 2002 [Taiwan]
- Flagellomeres 3–4 and 8–14 black, remaining yellow; flagellomeres, except apical one as long as wide; fore basitarsus almost twice as long as fore tibia *Lygistorrhina cincticornis* Edwards, 1926 [Malaysia: Sarawak]

Discussion

Grimaldi & Blagoderov (2001) believed subgenus *L.* (*Lygistorrhina*) to be paraphyletic with respect to *L.* (*Probolaeus*) Williston, 1896, failing to identify a single synapomorphy for the group. However, in the former subgenus, pale bands, or spots on the abdomen, if present, occur at the base of segments, not apically as in *L.* (*Probolaeus*). This might be one of the synapomorphies of the subgenus, however, further studies are necessary to confirm monophyly of the genus.

Species of *Ceropegia* s.s. have an unusual pollination system in which their pollinators, which are always small Diptera, are temporarily trapped within flask-shaped flowers. Thus, they are frequently encountered in preserved botanical specimens (Ollerton *et al.* 2009, 2017). The *Ceropegia* flower from which the specimen of *L. woodi* was dissected was collected on dry hillsides surrounding Dhi Sufal, dominated by succulent *Euphorbia* species (J. Wood, personal communication). This is the first time a representative of Lygistorrhinae has been found in a hot, semi-arid climate (BSh). Typically, long-beaked fungus gnats come from areas with tropical (Af, Am, Aw, As) climates or temperate climates with a humid warm season (Cfa, Cfb, Cwb). In Dhi Sufal average reference evapotranspiration (ET0) is more than 3x higher than yearly precipitation (1664 vs 535 mm). The new species is particularly small,

and has a relatively short proboscis, extremely short interommatidial setae, and sparse body setation. This might be an adaptation to a kleptothermic lifestyle in arid conditions, when the gnats spend most of the time during the dry period inside flowers to avoid desiccation. *Ceropegia aristolochioides* ssp. *deflersiana* is known to be pollinated by at least four genera of Diptera and 11 other genera have been collected from its flowers. Thus, the plant's pollination system can be defined as functionally specialised but ecologically generalised *sensu* Ollerton *et al.* (2007). The role of *L. woodi* as a pollinator has not been confirmed as no pollinaria were found attached to the mouthparts. Its small size puts *L. woodi* at the extreme lower end of the size distribution of known *Ceropegia* pollinators (Ollerton *et al.* 2009) so it is feasible that future work may discover that it is a pollen vector for this plant.

Interestingly, *L. woodi* is not the only lygistorrhine species discovered in an area with extreme climatic conditions. Yang *et al.* (2023) reported a new species of *Matileola* Papp from Sejila Mountain, Xizang, China. Although the climate in this geographical area could be characterised as hemiboreal (Dwb), the species was collected at high altitude, ~4,000 masl. The locality has a subalpine cold humid climate with an annual average temperature of 3.5°C, monthly average temperatures varying from 11.15°C (July) to -4.1°C (January) and snow cover from November to March. It seems that the ecological range of Lygistorrhinae is wider than was previously thought. It is possible that Lygistorrhinae are much more common in bulk samples, such as Malaise traps, but being misidentified as Sciaridae or Cecidomyiidae.

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