

REVISION OF AFRICAN *LOPHOPS*, A RAPIDLY DIVERSIFIED LINEAGE
(HEMIPTERA: AUCHENORRHYNCHA: FULGOROIDEA: LOPHOPIDAE)

ADELINE SOULIER-PERKINS¹ AND MICHAEL WILSON²

¹Muséum National d'Histoire Naturelle, Mécanismes adaptatifs et évolution,
MECADEV-UMR 7179 MNHN-CNRS, Sorbonne Universités, 57 rue Cuvier, CP 50,
F-75005 Paris, France; e-mail: soulier@mnhn.fr

²National Museum and Galleries of Wales, Department of Zoology, Cathays Park,
Cardiff, CF1 3NP, UK

Abstract—The African and Middle East species of the genus *Lophops* Spinola, 1839 are revised and 7 new species are described: *L. bwamba*, *L. incognita*, *L. kwazulu*, *L. malagarassi*, *L. sigwalti*, *L. stilleri* and *L. watshami*. A key to the African species is provided.

Key words: Auchenorrhyncha, new species.

INTRODUCTION

The planthopper family Lophopidae is among the smallest of the 28 currently recognized families in the Fulgoromorpha, fossils included. It presently contains around 140 medium- to large-sized species in 40 genera (Bourgoin, 2015). These are distributed primarily in the tropical parts of the old world areas, but one genus (Soulie-Perkins, 2001) is found in the neotropics, *Carriona* Muir, 1931. Host plant data seems to show that most Lophopidae are recorded from monocotyledons, in particular from Arecaceae and Poaceae (71%); the remainder are from dicotyledons in the Rosidae and Asteridae families (Rahman and Nath, 1940; Ghauri, 1866; Woodward et al., 1970; Smith, 1980; Wilson, 1987; Wilson et al., 1994). Most Lophopidae species appear to be either monophagous (43%) or oligophagous (43%) as adults; nymphs are even more specialized, with approximately 67% being monophagous (Rahman and Nath, 1940; Smith, 1980; Wilson, 1987; Wilson et al., 1994). In Africa, only the genera *Lophops* Spinola, 1839 and *Elasmoscelis* Spinola, 1839 are present naturally. Their success and diversification on this continent seem to be linked with the savanisation that began 23 million years ago (Soulie-Perkins, 2000). The Asian genus *Pyrilla* Stål, 1859 is of economic interest, particularly in India, where it is a pest on sugarcane and sometimes damages a large percentage of the crop (Kumarasinghe and Wratten, 1996). These three genera, which seem to have a certain evolutionary success in term of species numbers, belong to the Lophopidae group in which their ancestor

switched host plant from Arecaceae to Poaceae (Soulie-Perkins et al., 2007).

Lophopidae is recognizable by two autapomorphies, both of which are linked to the female genitalia (Soulie-Perkins, 2001). The family appears closely related to the Eurybrachidae, and Emeljanov (1987) considers them as sister groups. Currently, the genus *Lophops* comprises 12 species, four of which are described from Africa, *L. africana* (Schmidt, 1912), *L. angustipennis* Sål, 1866, *L. servillei* Spinola, 1839 and *L. verschureni* Synave, 1962. In this work seven new species are described from the African continent.

MATERIALS AND METHODS

Specimens were borrowed from various institutes, which are listed under each species. Most specimens were dry mounted. The abdomen was removed and boiled for around 10–15 minutes in 5 ml of potassium hydroxide (10% solution). Gross dissection and cleaning of the abdomens were performed in 70% alcohol, after which the whole abdomen was transferred to glycerol. The pygofer was separated from the abdomen for examination. In at least one specimen from each species studied, the phallic complex was dissected to isolate the endosoma with its processes from the periandrium. The genitalia were fixed temporarily in glycerine jelly before being drawn using a camera lucida. After being drawn the terminalia are conserved in a capsule containing glycerol and placed on the pin with the specimen. The nomenclature of the genitalia follows Bourgoin (1987), Bourgoin and Huang (1990) and Soulie-Perkins (2001).

Photographs of the specimen were made with Nikon video camera SMZ 1500, images are produced using the software ACT-2U Combine Z5.

ABBREVIATIONS

AMNH: American Museum of Natural History, New York, N. Y., U.S.A.

NMHUK: Natural History Museum, London, UK.

CASC: California Academy of Sciences, San Francisco, California, U.S.A.

ISNB: Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium.

MMBC: Moravian Museum, Brno, Czech Republic.

MNHN: Muséum National d'Histoire Naturelle, Paris, France.

MNMS: Museo Nacional de Ciencias Naturales, Madrid, Spain.

MRAC: Musée Royal de l'Afrique Centrale, Tervuren, Belgium.

MRSN: Museo Regionale di Scienze Naturali, Torino, Italy.

NCIP: National Insect Collection, Pretoria, South Africa.

NHMW: Naturhistorisches Museum, Wien, Austria.

NMWC: National Museum of Wales.

ZIN: Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.

ZMA: Instituut voor Taxonomische Zoölogie, Amsterdam, The Netherlands.

ZML: Zoologiska Institutionen Zoologiska Museet, Lund, Sweden.

AdpP: Antero-dorsal part of periandrium

PvA: Antero-ventral process of aedeagus

PvpA: Postero-ventral process of aedeagus

PvfP: Postero-ventral folds of periandrium

- 2 Anal tube long, strongly narrowed at its first bend before epiproct, presence of a long postero-ventral process (Fig. 11) *L. servillei* Spinola
- Anal tube shorter and not strongly narrowed at its first bent before epiproct 3
- 3 Postero-ventral fold of periandrium (PvfP) developed into a spine shaped process (Figs. 4A, 14A, 15A, 16A) 4
- PvfP absent 7
- 4 PvfP comparable in length and thickness to PvpA emerging from periandrium (Figs. 4A, 14A, 15A) 5
- PvfP reduced in length compared to PvpA (Fig. 16A) *L. watshami* sp. n.
- 5 Antero-dorsal part of periandrium (AdpP) developed dorsally in a narrow structure (Fig. 14A) around four times greater in height than in width *L. stilleri* sp. n.
- AdpP developed dorsally but at the most two times greater in height than in width (Figs. 4A, 15A) 6
- 6 PvaA shorter than PvpA (Fig. 4B) *L. bwamba* sp. n.
- PvaA as long as PvpA (Fig. 15B) *L. verschureni* Synave
- 7 PvaA hidden in the periandrium folds (Figs. 2A, 5A, 6A) 8
- Apex of PvaA protruding from the periandrium folds (Figs. 8A, 13A) 10
- 8 PvaA shorter than PvpA (Fig. 7B) *L. kwazulu* sp. n.
- PvaA at least as long as PvpA (Figs. 2B, 4B) 9
- 9 Dorsal part of periandrium developed dorsally, all the margin of the extension is sinuous with the structure truncated dorso-posteriorly (Fig. 2A) *L. africana* (Schmidt)
- Anterior margin of the periandrium structure straight on nearly all its length, apical part curving down posteriorly and regularly (Fig. 5A) *L. incognita* sp. n.
- 10 PvfP developed dorsally in two structures spine shaped (Fig. 8A) *L. malagarassi* sp. n.
- PvfP developed dorsally into a large and single structure spine shaped (Fig. 13A) *L. sigwalti* sp. n.

KEY TO SPECIES FROM AFRICA

(BASED ON MALE CHARACTERS EXCEPT FOR *L. ANGUSTIPENNIS*)

Note that *L. pallida* is not included in key.

- 1 Length of vertex three times the length of the visible part of the frons in dorsal view ♀ length: 5–5.5 mm. Color generally off-white. *L. angustipennis* Stål
- Vertex shorter than three times the length of the visible part of the frons, on dorsal view. ♀ length longer than 5.5 mm. Brown in color 2

LOPHOPS SPINOLA, 1939

Fig. 1A–G

Lophops Spinola 1839: 387

TYPE SPECIES: *Lophops servillei* Spinola 1839: 387 by original designation.

SYNONYMS: *Brixioides* Kirby 1891: 139. synonymised by Melichar (1915); type species *Brixioides*

africanus Schmidt 1912. *Astorga* Kirkaldy 1906: 395. synonymised by Melichar (1915); type species *Astorga saccharicida* Kirkaldy, 1906. *Gozarta* Walker 1870: 116. synonymised by Melichar (1915); type species *Gozarta zebra* Walker 1870. *Cystingocephala* Stål 1855: 95. synonymised by Stål (1866); type species *Cystingocephala marginelineata* Stål 1855.

REDESCRIPTION

COLORATION: most species usually beige or pale brown with darker brown markings, some species much lighter in color, nearly cream. Some specimens, especially from South Africa, much darker. Brown stripes visible towards the edge of the fore wings (Fig. 1F). Head and frons displaying some brown stripes that can be more or less intense. Legs with variable brown spots and stripes. Hind tibia bearing laterally on the apical half two spines with darkened tips.

Head: in dorsal view (Fig. 1A), head moderately elongated forward, vertex longer than wide and bordered laterally by a marked carina, frons visible beyond vertex, approximately one third to half length of vertex. On the frons, median longitudinal carina also visible, compound eyes with anterior margins reaching the middle of the head. In lateral view (Fig. 1B), genae separated from the frons by a small carina, compound eyes generally ovoid, with a single lateral ocellus below, antennal pedicel enlarged with a series of small rounded protuberances (sensory plaques). In frontal view (Fig. 1C), head longer than wide. Median carina absent, sub-lateral carina extended to the clypeal suture. The median part of the disc is longitudinally hollowed, towards the base the frons expands over the majority of the width of the head, median ocellus absent. Median carina and lateral carina present on the clypeus. Rostrum short, extending to the hind coxa, last segment nearly as wide as long.

Thorax: pronotum in dorsal view (Fig. 1A) as wide as mesonotum with anterior margin curved behind the eyes, three medial carina present, of these the two outermost appear as a continuation of the lateral carina of the vertex, the third being on the midline. Lateral carina strongly curved anteriorly and meet the median carina. All three carina present also on the pronotum and the mesonotum. Tegulae clearly visible.

Wings: fore wings (Fig. 1F) with region between the costal and the costal margin divided into a

strip of rhomboid (columnar) shaped cells, from the base to the node. Hind wings (Fig. 1G) with the 2 anal veins, the post cubital vein, the 3 cubital veins and sub-costal vein clearly visible.

Legs: fore legs (Fig. 1E) with the femur and tibia flattened, but do not appear foliaceous or lamelliform. Hind tibia (Fig. 1D) with two pre-apical lateral stout spines. The apical part of the tibia bears a series of short spines generally organized on three rows. The first hind tarsal segment is partially covered with a smooth pad of dense microsetae and bears two spines at one apical angle and one at the other. The first segment is three fifths the total length of the tarsal segments.

Size: length: 5–9 mm (measured from the top of the head to the end of the fore wing, when at rest).

REMARKS

Four species have been described from Africa: *Lophops servillei* Spinola, 1839, *Lophops angustipennis* Stål, 1866, *Lophops africana* (Schmidt, 1912) and *Lophops verschureni* Synave, 1962. The type specimen for *Lophops pallida* Melichar, 1902, from the Middle East, has been examined and the male genitalia figured to ensure it was not conspecific with any new species described here. With the exception of *L. angustipennis*, which is lighter in color (especially the specimens from Sudan and N. Nigeria nearly cream color) and smaller in size, all species are externally similar in size, color and the length of the vertex. The most reliable differences between species are found in the male terminalia, particularly in the pygofer, anal tube and phallic complex. The descriptions of the seven following species are based largely on those characters.

DESCRIPTION OF SPECIES (IN ALPHABETICAL ORDER)

The phallic complex of the Lophopidae is composed of a succession of sclerified and membranous structures allowing it to unfold. It seems protected dorsally by the anal tube and latero-ventrally by the gonostyli. It is composed of two distinctive structures, the periandrium and the aedeagus *s. l.* which is composed by the aedeagus *s. s.* and the endosoma. The ductus seminis is located within the aedeagus *s. l.* and its opening is ventrally orientated for the Lophopidae. Two parts compose the periandrium, the first is

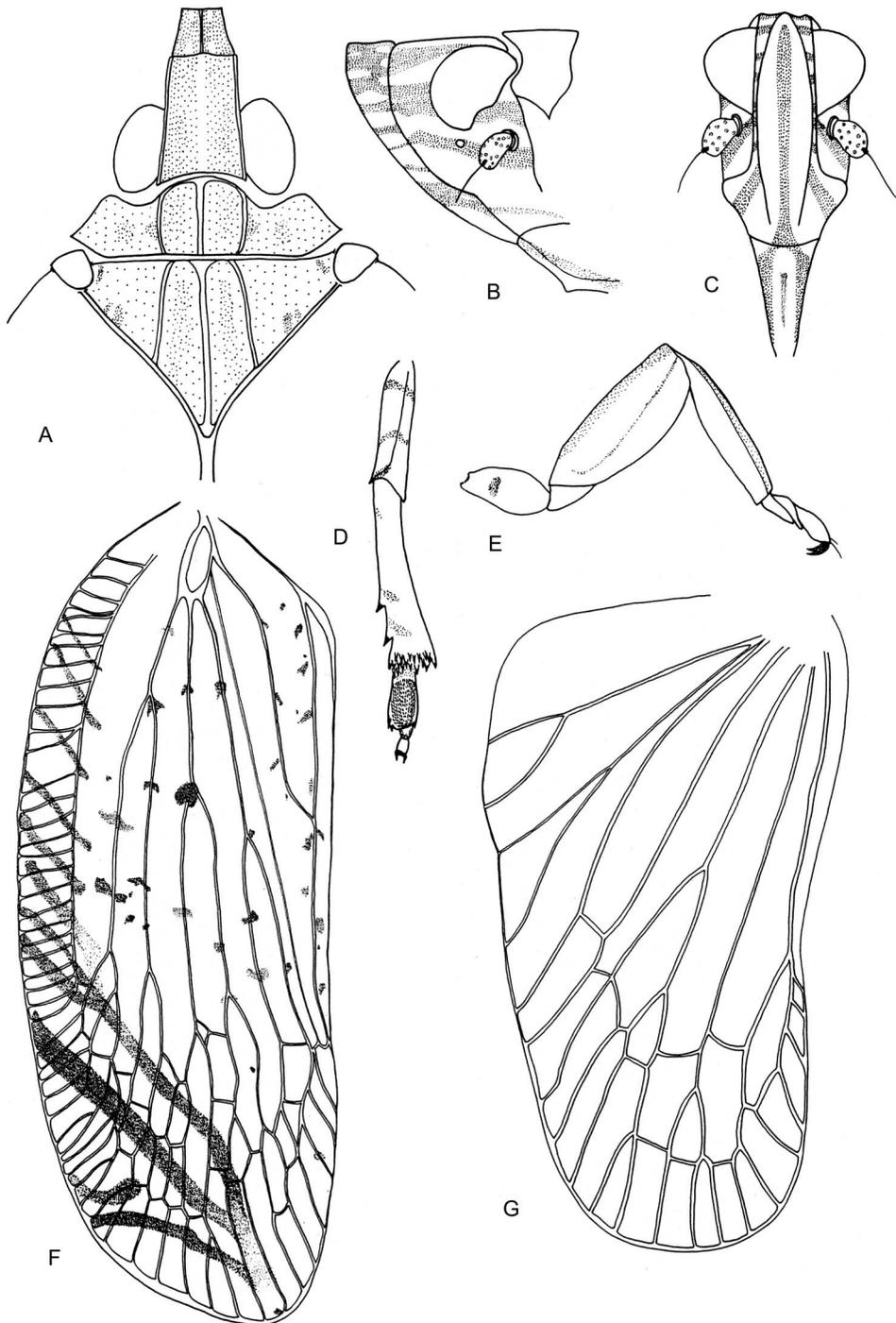


Fig. 1. *Lophops* sp. A. Head and thorax, dorsal view. B. head on lateral view. C. Head, lateral view. D. Metathoracic tibia and tarsus. E. prothoracic leg. F. Tegmina. G. hind wing.

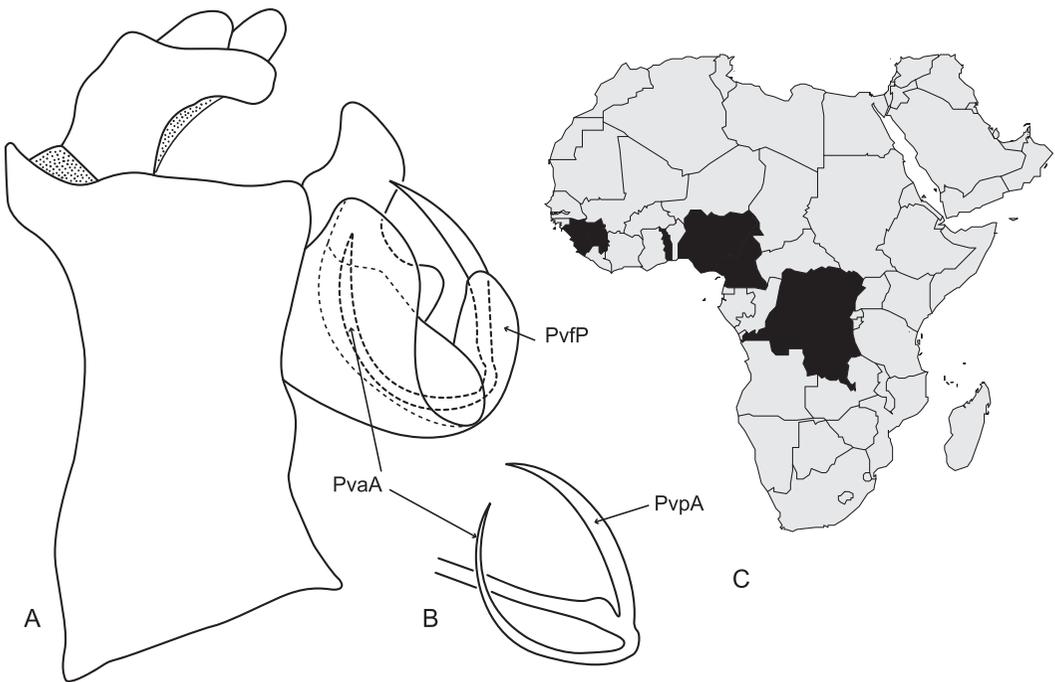


Fig. 2. *Lophops africana* (Schmidt, 1912) **A.** Pygofer, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

external and the second is internal. They correspond to Snodgrass's (1935) description of the phallosome and endosoma respectively. At the level of the basal window, the thickening of the diaphragm is at the origin of the periandrium. For all Lophopidae studied, the periandrium can be divided into a dorsal part and a ventral part, both of them composed of a phallosome external and sclerotized and an internal membranous endosoma. This distinction between a dorsal and a ventral periandrium is made for practical reasons but they remain as a single morphological entity. The dorsal part of the periandrium is generally more developed than the ventral part. Within *Lophops* species different folds of dorsal periandrium can be identified. The periandrium is shaped like a tube around the aedeagus s. l. The endosoma links the opening of the ductus seminis and the aedeagus s. s. and is a membranous structure. The endosoma is reduced in the Lophopidae and generally present only dorsally. The aedeagus s. s. is attached to the base of the endosoma and is sclerotized. Dorso-laterally, it is well developed and bears an anterior (PvaA) and posterior (PvpA) ventral processes.

Lophops africana (Schmidt, 1912)

Fig. 2A–C

Brixioides africana Schmidt, 1912: 358, transferred to *Lophops* by Melichar, 1915

DIAGNOSIS: *L. africana* is one of the largest species of the genus and has a pygofer with a general trapezoid shaped.

DESCRIPTION: Male terminalia: in lateral view, pygofer of trapezoid shape, the anterior margin slightly longer than posterior margin but roughly parallel. Anal tube without postero-ventral process. Periandrium with a dorsal extension clearly visible (Fig. 2A), with a sinuous margin clearly truncated posteriorly. Postero-ventral folds of periandrium (PvfP) slightly developed dorsally into a rounded process. The PvpA seems to emerge from it. Antero-ventral part of periandrium developed laterally and covers laterally the base of the antero-dorsal extension of periandrium. PvaA longer than PvpA (Fig. 2B). Small outgrowth on the aedeagus present at the base of PvpA.

SPECIMENS EXAMINED: HOLOTYPE ♂: [Zaire] labelled: Busira, 12.x.1905, Waelbroeck (MRAC).

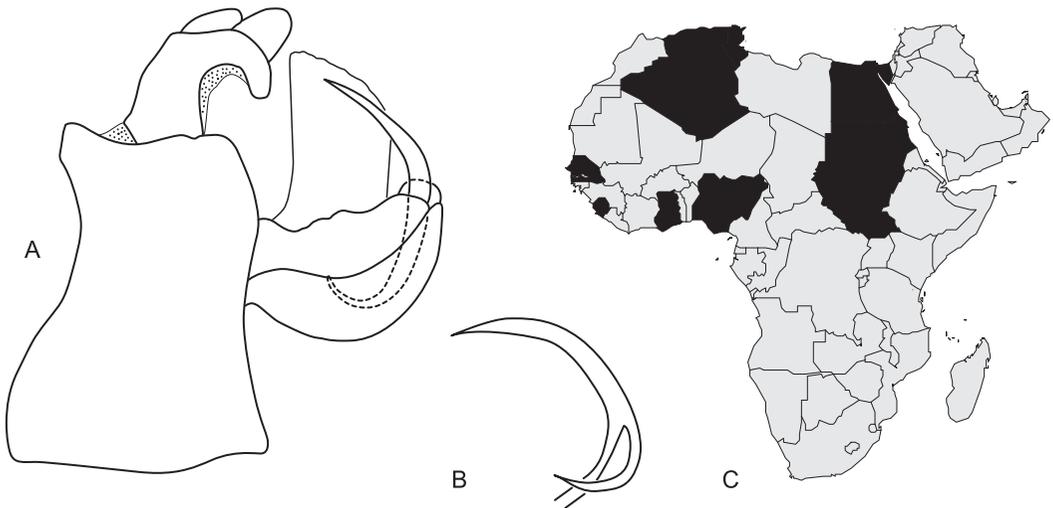


Fig. 3. *Lophops angustipennis* Stål, 1866 **A.** Pygofer, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

OTHER MATERIAL EXAMINED: Zaire: 1♂ 3♀, Tshumbiri, Forest, 3.XI.1927, F. M. Harper, (NHMUK); [Cameroun] Camerouns: 5♂ 3♀, Sasse-Sappo-buea, III.1952, S. Tita, (CASC); 2♂, Escalera, 1903, (NHMUK); 1♂ 1♀ Nkoemvaon, XIII.1979, D. Jackson, (NHMUK); 1♂ 2♀, 25 Km wsw Douala, Madeka, Secondary, forest and plantations, 18.I.1978, (ZML); 3♂ 2♀, lab. ent. Escalera, 1899, L. Conradt (MNMS). Equatorial Guinea: numerous specimens (MNMS); 1♂, Nimba, 2.VI.1942, M. Lamotte, (MNHN); [Fernando Póo] 1♂, Banapa, Escalera, (MNMS). 1♂: Fernando Póo, Basile 400-600 m, VIII.1901, (MMBC), Melichar collection, under the name of *L. servillei*; 1♂, Botonós, I. 1933, F. Bonet-J. Gil, (MNMS); 1♂, Ranapá, VI.1919, Escaleraa, (MNMS); 4♂ 6♀, Santa Isabel, 1933, F. Bonet-J. Gil, (MNMS); 1♂ 1♀, Sta. Isabel, 9.VI.48, E. Ortiz, (MNMS); Nigeria: 1♂, Biafra, Cabo S. Juan, VIII.1901, Escalera, (MNMS); 1♂, Calabar, (NHMUK); 1♂, Ibadan, 27.III.1919, A. W. J. Pomeroy, (NHMUK); Central African Republic: 3♂, La Maboke, 19.I.1973, 16.II.1973, 9.VIII.1973, Michel Boulard, (MNHN); Sierra Leone: 2♂, Charlotte village, SE of Freetown, 13°12'W. 8°25'N., 25.XI.1993, L. Cederholm, (ZML).

DISTRIBUTION (Fig. 2C): Cameroon, Fernando Póo, Guinea, Nigeria, Sierra Leone, West Africa and Zaire and according to Synave (1963) also in Togo (specimen not examined).

Lophops angustipennis Stål, 1866
Fig. 3A–C

Lophops angustipennis Stål, 1866: 202

DIAGNOSIS: this species differs from all other African species in being shorter, lighter in color and in the shape of the vertex, which is nearly three time longer than the visible part of the frons and three time wider basally than the most anterior part of the frons.

DESCRIPTION: Male terminalia: in lateral view, angle between dorsal and posterior margins of pygofer rounded (Fig. 3A), seems truncated. Anal tube strongly bent at apex in a short postero-ventral process. Periandrium with an important dorsal extension with its anterior and posterior margins straight and parallel, apex truncated posteriorly. Ventral periandrium not developed into a postero-dorsal extension. PvpA longer and thicker than PvaA (Fig. 3B).

Size: ♂ length: 5–5.5 mm.

SPECIMENS EXAMINED: HOLOTYPE: Sénégal, Siginoret, (NHMW). **OTHER MATERIAL EXAMINED:** Algeria: 1♂, Oase Drah NE Biskra, 12.V.1984, J. P. Duffels (ZMA). Ghana: 1♂, Afienea, 14-16.IX.73, R. Linnuavori (AMNH); Sierra Leone: 1♂ 1♀, Charlotte village, SE of Freetown, 13°12'W. 8°25'N., 25.XI.1993, L. Cederholm (ZML); 1♂ 1♀, Freetown, Cape Sierra hotel area, 13°17'W. 8°31'N., 23.XI.1993, L. Cederholm (ZML). Sudan: 2♂, darfur, Safaha-Abu Matariq,

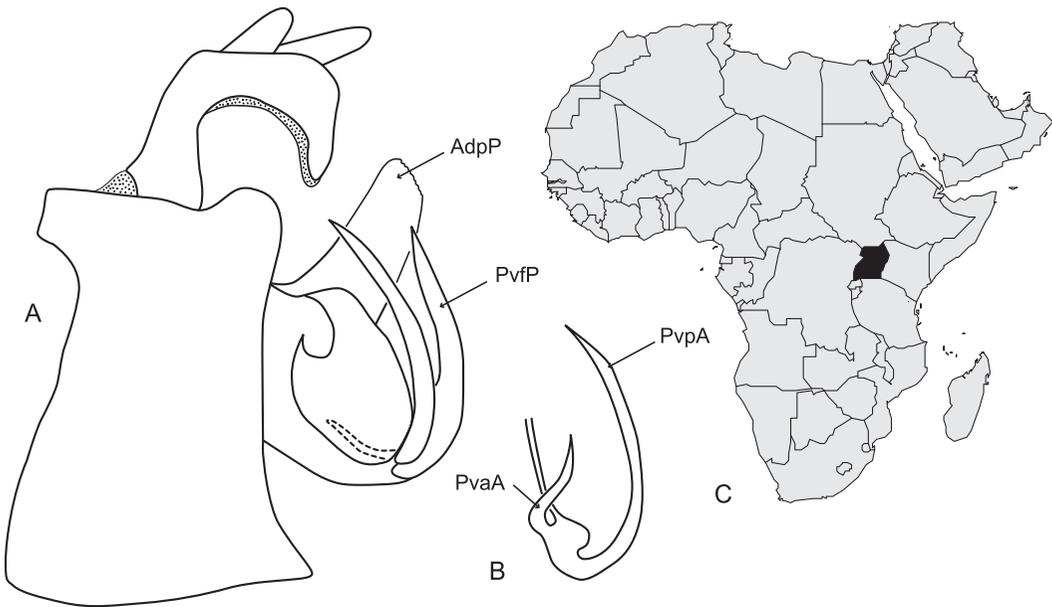


Fig. 4. *Lophops bwamba*, new species. **A.** Pygofer, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

30.IV.-2.V.1963, R. Linnuavori (AMNH); 1♂ 1♀, Upper Nile, Renk-Malakal, 3-5.I.1963, R. Linnuavori (NHMUK). Nigeria: 1♂, Bauchi, 1-12.IV.1990, J. C. Deeming (NMWC).

REMARKS: the holotype of this species is a female and the determination here is based on the male terminalia following the interpretations of Synave (1962) and Linnuavori (1973).

DISTRIBUTION (Fig. 3C): Algeria, Ghana, Nigeria, Senegal, Sierra Leone, Sudan and according to Linnuavori (1973) also in Egypt and Tunisia (specimens not examined).

Lophops bwamba, Soulier-Perkins new species
Fig. 4A-C

DIAGNOSIS: the ventral periandrium is developed posteriorly into a structure shaped as a long and robust spine pointing dorsally. This structure distinguishes this species from all the others.

DESCRIPTION: Male terminalia. Dorsal margin of the pygofer straight except for its last posterior third part which is rounded dorsally, posterior margin lightly curved anteriorly. Anal tube long, stretching posteriorly beyond the posterior pygofer margin, apex transformed in a long postero-ventral process (Fig. 4A). Nearly all PvpA visible (Fig. 4B) and three times longer than the

PvaA which is hidden in the fold of the periandrium (Fig. 4A). Dorsal part of the periandrium with a median extension jagged on its dorsal surface, anterior and posterior margins nearly parallel. Ventral part of the periandrium extended posteriorly into a long and robust spine comparable in shape and size to the PvpA.

Size: length: 7 mm.

ETYMOLOGY: Species named after the region where the specimen was collected.

SPECIMENS EXAMINED: HOLOTYPE ♂: [Uganda] Bwamba, VII-VIII. 1946, Van Someren, (NHMUK).

DISTRIBUTION (Fig. 4C): Uganda.

Lophops incognita, Soulier-Perkins, new species
Fig. 5A-B

DIAGNOSIS: the equal lengths of both aedeagus processes with their regular shape along with the posterior fold of the ventral periandrium are characteristic for this species.

DESCRIPTION: Male terminalia: on lateral view, pygofer with base wider than top, anterior margin largely rounded anteriorly in its lower part, dorsal margin slightly concave with last posterior third part rounded dorsally. Ventral margin slightly elongated posteriorly into a little protuberance.

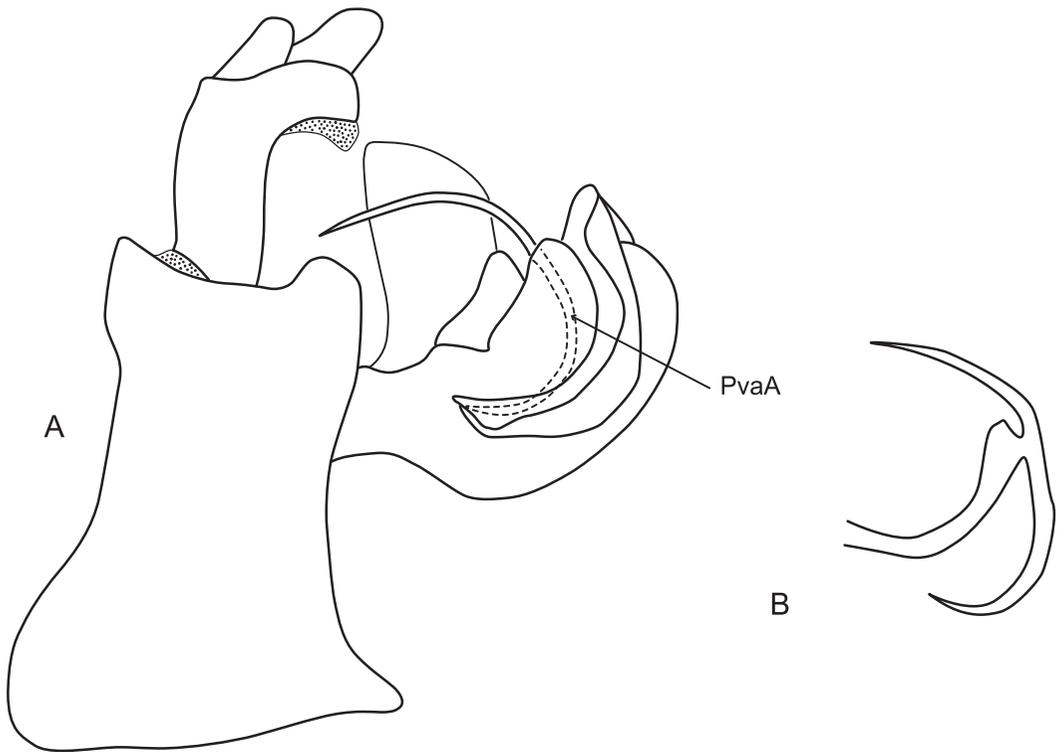


Fig. 5. *Lophops incognita*, new species **A**. Pygofer, anal tube and phallic complex, lateral view. **B**. Aedeagus processes, lateral view.

Anal tube without postero-ventral process. Most of the PvpA visible, PvaA hidden in the perianthium folds (Fig. 5A). Both process are long and thin, regularly curved with a small outgrowth at their base (Fig. 5B). Dorsal part of perianthium with a median extension shaped as a rectangle rounded at the top. Ventral part of perianthium with a posterior fold unique for this species.

Size: length not available since the only specimen belonging to this species is broken between the head (also damaged) and the thorax.

ETYMOLOGY: From the Latin word *incognita* meaning unknown which is almost the case for the geographical distribution of this species. It is feminine since *Lophops* is of a feminine gender.

SPECIMENS EXAMINED: HOLOTYPE ♂: [Africa, 4.VII.1939, (NHMUK)].

REMARKS: other than being collected in Africa in 1939, we have no other locality information. However, because the **terminalia** are distinct we feel justified in describing so that it may be recognized when it is recollected.

DISTRIBUTION: Africa.

Lophops kwazulu, Soulier-Perkins, new species
Figs. 6A–D and 7A–C

DIAGNOSIS: distinguished from other species by the PvaA much shorter than PvpA and the numerous teeth that the dorsal perianthium extension bears.

DESCRIPTION: **Male terminalia**: pygofer with posterior margin concave anteriorly, a dorsal margin regular and nearly flat and an anterior margin with a clear and distinctive anterior setback of its apical dorsal section. Anal tube finishing into a small pointed process directed ventrally (Fig. 19). Anterior margin of dorsal perianthium extension gently curved up to its dorsal tip, dorsal margin strongly bent, small teeth all along it, posterior margin straight. PvpA 3 to 4 times longer than PvaA. The posterior curve from PvpA to PvaA is regular and continuous. No outgrowth can be observed at the base of the aedeagus processes (Fig. 20).

Size: ♂ length: 6–7 mm.

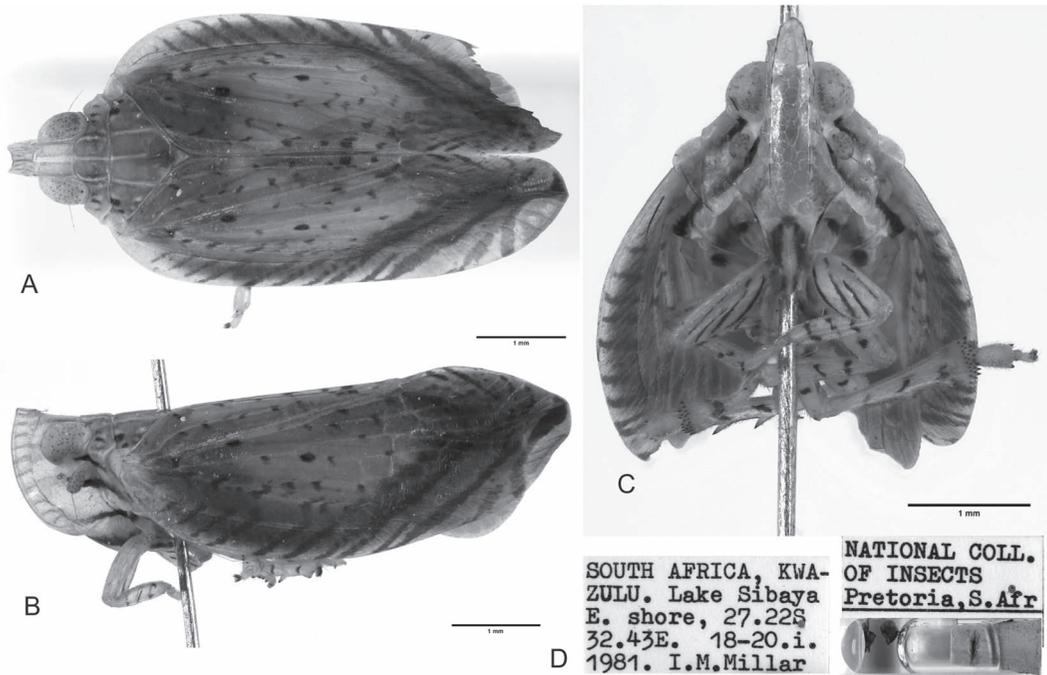


Fig. 6. *Lophops kwazulu*, new species. **A.** Habitus dorsal view. **B.** Habitus lateral view. **C.** frontal view. **D.** Labels and vial containing genitalia.

ETYMOLOGY: species named after the region where the specimen was collected, name placed in apposition.

SPECIMENS EXAMINED: HOLOTYPE ♂: [South Africa, Kwazulu, lake Sibaya E. shore, 27°22'S, 32°43'E, 18-20.I.1981, I. M. Millar (NCIP). Paratypes: Kenya: 2♂, Ramisi, on sugar cane, III.1972, J. R. Williams (NHMUK); 1♂ Ramisi, 13.VII.1971, G. W. Oloo (NHMUK); South Africa: 1♂, St Lucia Estuary, 24.X.1966, E. Bornman (NCIP); 2♂, Tvl New Agatha State for, 23°57'S, 30°07'E, 1100 m, 15.I.1991, I. M. Millar (NCIP); 1♂, Tvl Blyderivierspoort Nat. Res. FH Odendaal Hol. Resort 24°24'S, 30°47'E, 27.II.1991 M. Stiller (NCIP); 1♂, Natal, St Lucia, 28.VIII.1992, K. J. Huisman (ZMA); 1♂, Natal Fannies Island Camp St. Lucia 28°10'S, 32°25'E, 14-16.I.1981, I. M. Millar (NCIP); 4♂, Port St. John, Pondoland, 15-31.V.1923, V.1924, R. E. Turner (NHMUK); 1♂, Umtweni, Natal, 9-14.III.1961, A. L. Capener (MNW).

OTHER MATERIAL EXAMINED: the females examined and collected from Kenya and South Africa at the same time and locality as some of the above males. They are not included in the type series

since we don't have any morphological characters allowing us to be completely sure that they belong to the same species. Kenya: 1♀, Ramisi, on sugar cane, III.1972, J. R. Williams (NHM); South Africa: 13♀, Port St. John, Pondoland, 15-31.V.1926 and 5.VII.1926, R. E. Turner (NHMUK).

DISTRIBUTION (Fig. 21): Kenya and South Africa.

Lophops malagarassi, Soulier-Perkins, new species
Fig. 8A-C

DIAGNOSIS: the large developed antero-ventral periandrium wrapped around the PvaA which emerges apically from it distinguishes clearly this species from all the others.

DESCRIPTION: Male terminalia: pygofer with posterior margin almost straight except for a small ventral posterior protuberance, dorsal margin almost straight as well except for the third anterior part oriented dorso-anteriorly (Fig. 8A). Anal tube without postero-ventral process. Dorsal periandrium extension largely developed and rounded and bearing a series of small teeth

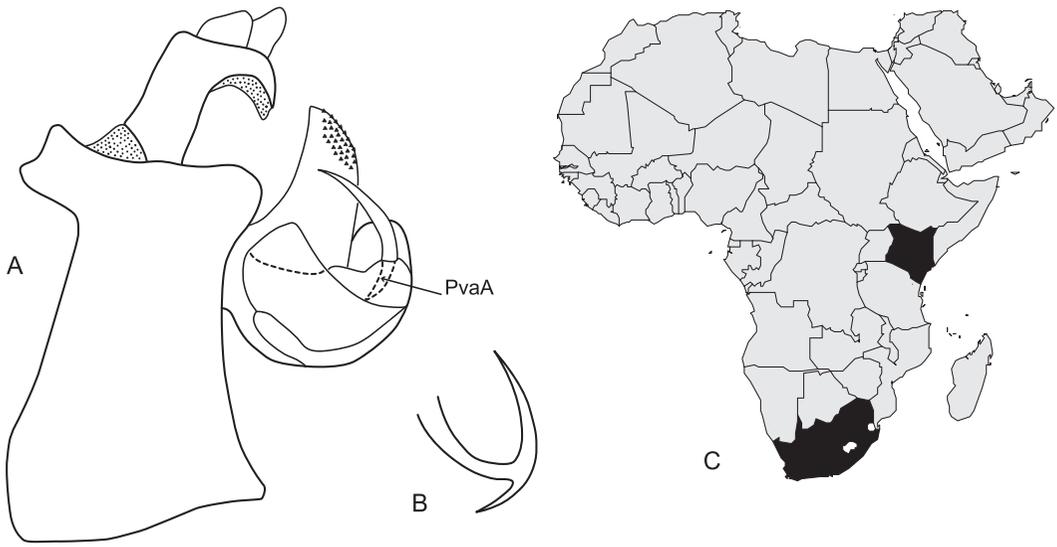


Fig. 7. *Lophops kwazulu*, new species **A.** Pygopher, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

apically. PvpA and PvaA long and thin (Fig. 8B), PvpA largely visible and apex of PvaA emerging from the periandrium folds. Antero-ventral part of the periandrium developed laterally wrapped around the PvaA. Postero-ventral part of periandrium giving a structure spine shaped oriented dorsally.

Size: ♂ length: 8 mm.

ETYMOLOGY: species named after the Malagarassi River, which is one of the longest rivers in Tanzania where the specimen was collected.

SPECIMENS EXAMINED: HOLOTYPE ♂: Tanzania, Malagarassi, Moyowasi-Muringa, 10.VII.1951, H. O. Backlund (ZML). **OTHER MATERIAL EXAMINED:** ♀ from the same locality and collected at the same time than the holotype (ZML)

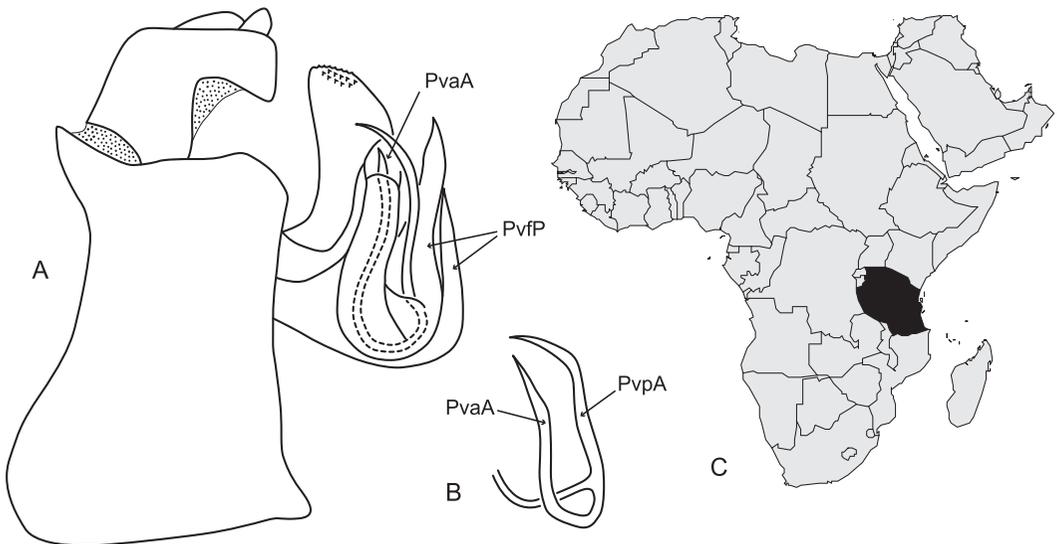


Fig. 8. *Lophops malagarassi*, new species **A.** Pygopher, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

DISTRIBUTION (Fig. 8C): Tanzania.

Lophops pallida Melichar, 1902

Figs. 9A–D and 10A–D

Lophops pallida Melichar, 1902: 90

DIAGNOSIS: distinct from the others by the double folding of the Antero-ventral part of perianthrium.

DESCRIPTION: **Male terminalia:** dorsal margin of the pygofer declining posteriorly, not straight but with an undulation in the middle, ventral margin extending posteriorly into a small rounded process. Anal tube without postero-ventral process (Fig. 10A). Dorsal part of perianthrium with a median extension largely rounded apically and bearing some small teeth. Antero-ventral part of perianthrium developed into two folds in which the PvaA is completely hidden (Fig. 10B). PvpA clearly visible, both process long, PvpA thicker than PvaA, a small outgrowth at their base (Fig. 10C).

Size: ♂ length: 7.3 mm. ♀ length: 8 mm for the syntypes. The specimens from the United Arab Emirates are shorter ♂: 7 mm, ♀: 7.4 mm and the specimen from Dlabola's collection is even shorter: 6 mm.

SPECIMENS EXAMINED: SYNTYPES ♂ and ♀: Persien, Zwischen Tamin beim Kuh-i-Tuftan (Kirman) und Enarick, von Zarudny 19–24. viii.98 (ZIN).

OTHER MATERIAL EXAMINED: United Arab Emirates: 1♂ 1♀, Wadi Wurayah, 165 m, N 25°24'E 56°17', 15.iv.2010, V. M. Gnezdilov, on *Saccharum ravennae* (L.) Murr. (ZIN); Saudi Arabia: 1♂, A.S. Tailhouk, 29.X.77 Sayhat Arabia, Dlabola's collection (MNHN).

DISTRIBUTION: Iran, Oman, Saudi Arabia and United Arab Emirates.

REMARKS: the distribution of this species extends into the Arabic peninsula along the Persian Gulf, but the Red Sea seems to draw a boundary between the area occupied by this species and *L. angustipennis*.

Lophops servillei Spinola, 1839

Fig. 11A–C

Lophops servillei Spinola, 1839: 388

DIAGNOSIS: distinguished from others by the size of its anal tube and the pear shape of the phallic complex.

DESCRIPTION: **Male terminalia:** dorsal margin of the pygofer undulating with anterior apex lower than the posterior apex. Anal tube long, it extends largely beyond the posterior margin of pygofer, strongly narrowed at its first bent before the epiproct, presence of a long postero-ventral process (Fig. 11A). In lateral view phallic complex appears pear shaped, Dorsal perianthrium extension regularly narrowing dorsally, finishing in a small rounded apex. Postero-ventral part of perianthrium developed dorsally, finishing in a pointed apex and reaching the same height as the dorsal perianthrium extension. PvpA and PvaA both short (Fig. 11B).

Size: ♂ length: 7–8 mm.

REMARKS: Spinola (1839) in his description stated that the type specimen was a male. The holotype was examined but its abdomen is now lost. Synave (1962) figured the male terminalia of this species. We followed his species concept and all the specimens examined are identical to his drawing. Although widely distributed in Africa this species does not appear in large numbers in the collections.

SPECIMENS EXAMINED: HOLOTYPE ♂: South Africa Cap[e]. B[onne]. Esp[erance]., collection de Mr Serville, (MRSN). OTHER MATERIAL EXAMINED: Africa: 1♂ 1♀, Signoret, (NHMW); Benin: 1♂, Abomey-Calavi 20 Km N, on cotton, VII.1988, J. S. Noyes, (NHMUK); Ghana: 1♂, Dixcove, near Takoradi, 31.X.1993, S. Dery, (NMWC); 1♂, Central Region, Ayensudo near Cape Coast, ex Coconut palm, 4.II.1994, S. Dery, (MNWC); Guinea: 1♂, 2♀, Nimba, VII-XII. 1951, Lamotte, (MNHN); 5♂, 2♀, Nimba, XII.1956-V.1957, Lamotte, (MNHN); Ivory Coast: 1♂, Bouaké, 29..III.1949, Delattre, (MNHN); Central African Republic: 1♂, Tombongo, 25.II.1968, M. Boulard, (MNHN); Senegal: 1♂, Casamance, Ziguinchor, 3.I.1980, B. Sigwalt, (MNHN); Sierra Leone: 1♂, Freetown, Cape Sierra, hotel area 13°17'W 8°31'N, 23.XI.1993 swept along roadsides, L. Cederholm, (ZML); Chad: 1♂, N'Djamena, 20.VIII-9.IX.1978, G.G.M. Schulten, (ZMA).

DISTRIBUTION (Fig. 11C): Benin, Central African Republic, Chad, Ghana, Guinea, Ivory Coast, Senegal, Sierra Leone, South Africa, and according to Melichar (1915), also in Cameroun and Fernando Poo (specimens not examined).



Fig. 9. *Lophops pallida* Melichar, 1902 A. Habitus lateral view. B. Habitus frontal view. C. Habitus dorsal view. D. Labels.

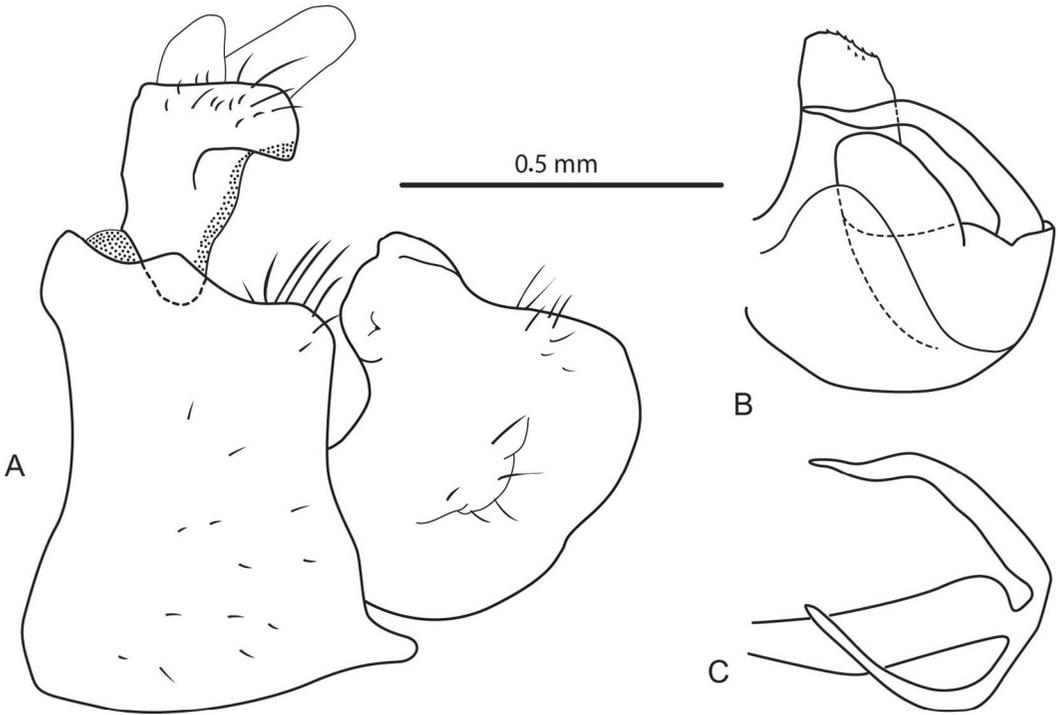


Fig. 10. *Lophops pallida* Melichar, 1902 **A.** Pygopher, anal tube and gonostilus, lateral view. **B.** Phallic complex, lateral view. **C.** Aedeagus processes, lateral view. **D.** Distribution map.

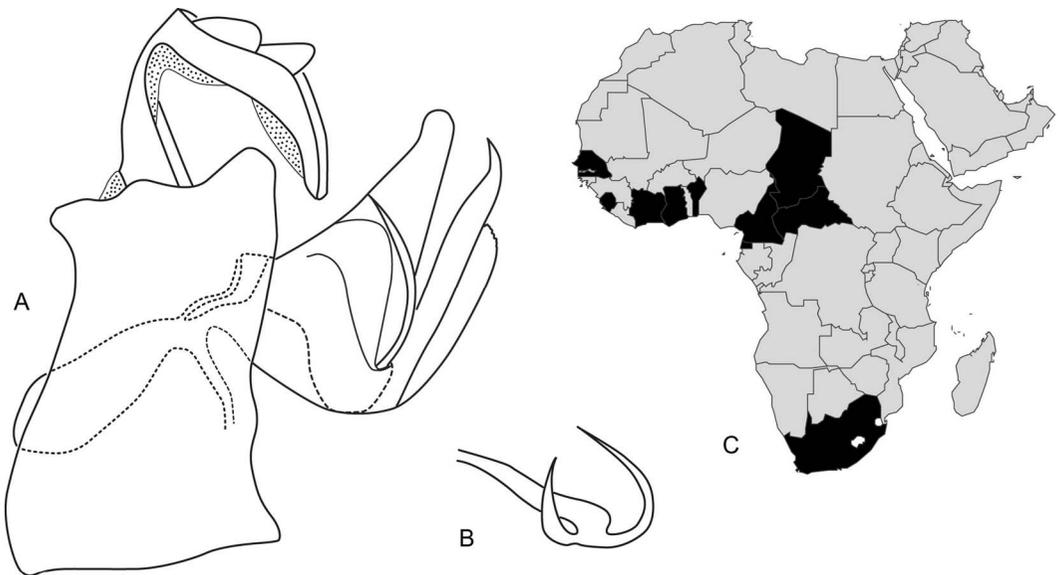


Fig. 11. *Lophops servillei* Spinola, 1839 **A.** Pygopher, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

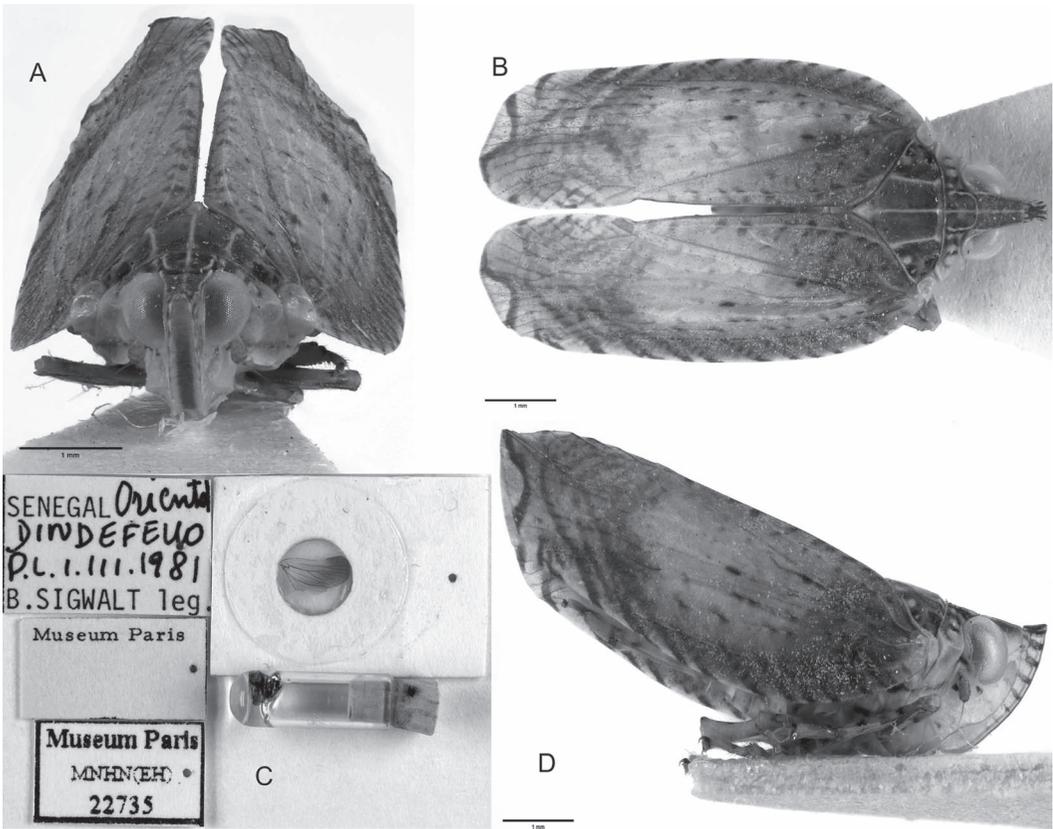


Fig. 12. *Lophops sigwalti*, new species. **A.** Habitus frontal view. **B.** Habitus dorsal view. **C.** Labels and vial containing genitalia. **D.** Habitus lateral view.

Lophops sigwalti Soulier-Perkins, new species
Figs. 12A–D and 13A–C

DIAGNOSIS: characteristic by its pygofer dorsal margin sinuous and presenting an outgrowth dorsally before its posterior apical part.

DESCRIPTION: **Male terminalia:** dorsal margin of pygofer sinuous, posterior margin curved anteriorly (Fig. 13A). On lateral view, anal tube narrow below the epi- and paraproct. Dorsal periandrium extension sinuous like for *L. africana*. Postero-ventral periandrium extension extending slightly dorsally in a pointed protrusion. Apex of PvaA emerges from anterior ventral periandrium fold. PvpA and PvaA both long and thin but PvaA longer than PvpA, small outgrowth present at their base (Fig. 13B).

Size: ♂ length: 7 mm.

ETYMOLOGY: species named after its collector B. Sigwalt.

SPECIMENS EXAMINED: HOLOTYPE ♂: Senegal, Orient, Dindefeuo, 1.III.1981, B. Sigwalt, MNHN (EH)22735 (MNHN).

DISTRIBUTION (Fig. 13C): Senegal.

Lophops stilleri Soulier-Perkins, new species
Fig. 14A–C

DIAGNOSIS: dorsal periandrium extension much narrower than for all the other species and followed by a second dorsal extension of a similar shape but shorter and straighter.

DESCRIPTION: **Male terminalia:** Posterior margin of pygofer straight except for the small posterior extension at its ventral apex, anterior margin with a clear anterior setback of its apical dorsal section. Anal tube with a small postero-ventral process (Fig. 14A). Dorsal periandrium extension narrow but clearly developed dorsally, rounded apically, presence of a second dorsal extension behind the

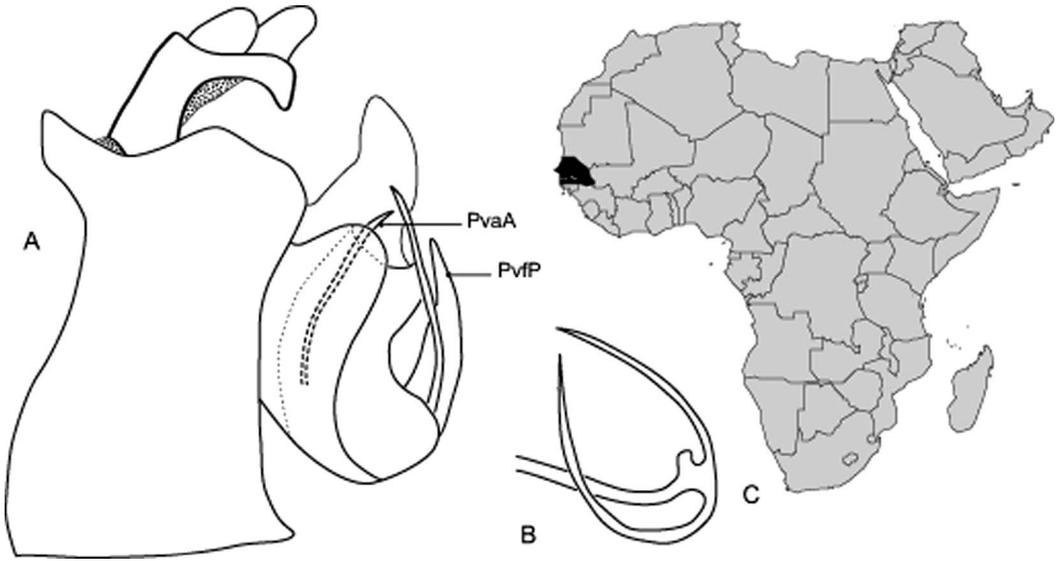


Fig. 13. *Lophops sigwalti*, new species. **A.** Pygopher, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

first one with a similar shape but shorter. Antero-ventral part of periandrium developed laterally and covering part of the bottom posterior part of dorsal periandrium extension, apex of PvpA emerging from it. Postero-ventral part of periandrium developed into a structure spine shaped,

pointing anteriorly. PvpA and PvaA both long and thin a narrow but pronounced outgrowth present at their base (Fig. 14B).

Size: ♂ length: 6–7 mm.

ETYMOLOGY: species named after one of the specimens collector, Michael Stiller.

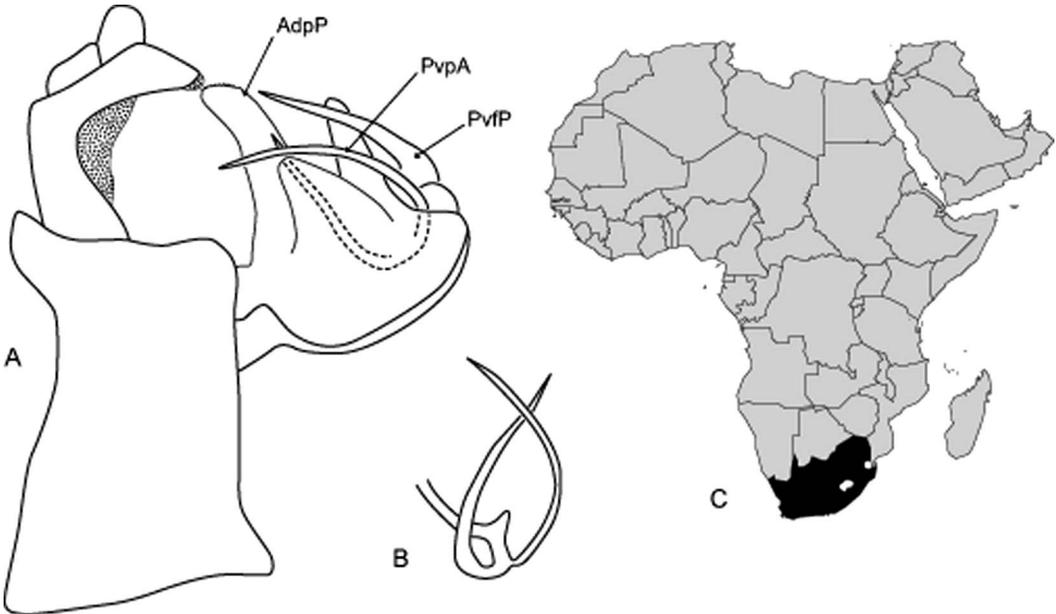


Fig. 14. *Lophops stilleri*, new species. **A.** Pygopher, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

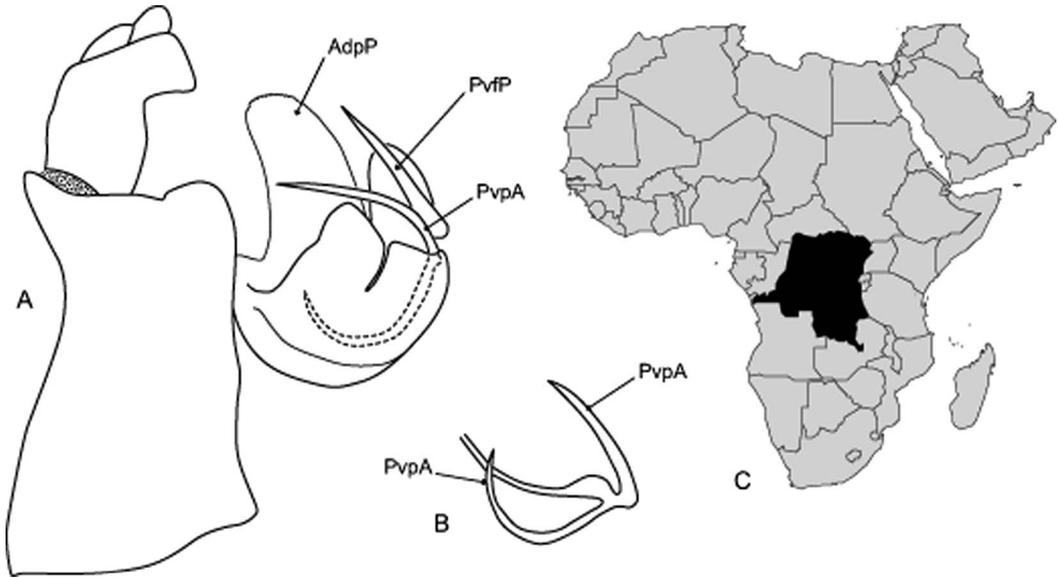


Fig. 15. *Lophops verschureni* Synave, 1962. **A.** Pygofer, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

SPECIMENS EXAMINED: HOLOTYPE ♂: South Africa: Transvaal, Rustenburg, 8.XII.1969, A. Pienaar, (NCIP). PARATYPES: South Africa: 2♂, Pretoria, on grass, 15.II.1950, E. K. M, (NCIP); (1♂ deposited NHMUK). 2♂, Tvl, Rustenburg Nature, 25°40'S, 27°12'E, 17-20.III.1980, 17-20.III.1984, C. Moolman, (NCIP); 1♂, Tvl, Palala 24°16'S 28°30'E, 17.I.1991, M. Harney, (NCIP); 1♂, Tvl, Waterberg, NE of Thabazimbi, 24°27'S 29°24'E, 1-3.V.1992, M. Stiller, (NCIP); 1♂, N. W. Tvl, Mogol Nature reserve Ellisras Dist. 23°58'S 27°45'E, 19-23.XI.1979, C. Cok, (NCIP); 2♂, Tvl, O.T.K. reserve nr Loskopdam, 25°27'S 29°24'E, 9-11.XII. 1985, I. M. Millar and C. G. Moolman (NCIP), (1♂ deposited MNHN).

DISTRIBUTION (Fig. 14C). South Africa.

Lophops verschureni Synave, 1962

Fig. 15A–C

Lophops verschureni Synave, 1962: 18–22

DIAGNOSIS: the two dorsal periandrium extensions with their shapes, large and round distinguish clearly this species from all the others.

DESCRIPTION: Male terminalia: dorsal margin of pygofer with its last posterior third part slightly rounded dorsally but not as marked as for *L. bwamba* and *L. incognita*. Anal tube without

postero-ventral process, posterior margin straight after the paraproct. Dorsal periandrium extension developed dorsally and large, regularly rounded at apex. Second dorsal periandrium extension present just behind the first one, same shape but shorter. Antero-ventral part of periandrium not largely extended latero-dorsally but PvaA completely hidden in it. Postero-ventral part of periandrium developed into a straight structure spine shaped, pointing antero-dorsally. PvaA slightly longer and thinner than PvpA, small enlargement at their base.

Size: ♂ length: 7–8 mm.

SPECIMENS EXAMINED: HOLOTYPE ♂: Zaire: [labelled Congo Beige], P.N.G., mission de Saeger, II/hc/4, 26.VII.1951, J. Verschuren, 2161, fauchage de haute savane devant la ligne de feu allumé artificiellement, (MRAC). Paratypes 5♂: Zaire: P.N.G., Mission H de Saeger, 14.VIII.1951, 29.X.1951, 5.V.1952, 5.VIII.1952, H. de Saeger. 17.VIII.1951, J. Verschuren, (ISNB).

DISTRIBUTION (Fig. 15C). Zaire.

Lophops watshami Soulier-Perkins, new species

Fig. 16A–C

DIAGNOSIS: the development of the postero-ventral part of periandrium is characteristic for this species. It is spine shaped but short and

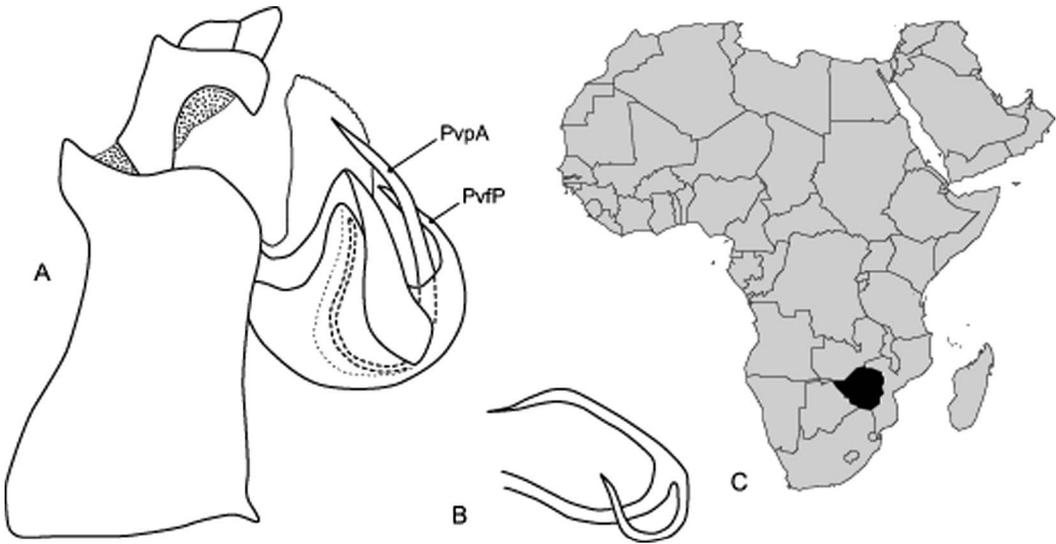


Fig. 16. *Lophops watshami*, new species. **A.** Pygofer, anal tube and phallic complex, lateral view. **B.** Aedeagus processes, lateral view. **C.** Distribution map.

slender when compared to the similar structures in *L. verschureni*, *L. sigwalti* or *L. stilleri*.

DESCRIPTION: Male terminalia: pygofer with posterior margin mostly straight with a small pointed process at its base, pointing postero-ventrally, dorsal margin truncated posteriorly into a large curve joining gently the posterior margin. Dorsal perianthium extension largely developed dorsally rounded at apex but a little truncate posteriorly in comparison to *L. verschureni*. Antero-ventral part of perianthium developed into a latero-dorsally double folding (Fig. 16A). PvaA completely hidden in it. Postero-ventral part of perianthium developed into a small structure spine shaped, half the length of the PvpA visible on lateral view. PvpA 2 times longer than PvaA, no enlargement or outgrowth present at their base (Fig. 16B).

Size: ♂ length: 6–7 mm.

ETYMOLOGY: species named after one of the holotype collector A. Watshami.

SPECIMENS EXAMINED: HOLOTYPE ♂: Zimbabwe: Harare, IV-VI.1985, A. Watsham, (NHMUK). PARATYPE ♂: Zimbabwe: same data as holotype (NHMUK). **OTHER MATERIAL EXAMINED:** a female collected at the same time and locality was examined but excluded from the type series (NHMUK).

DISTRIBUTION (Fig. 16C). Zimbabwe.

DISCUSSION

In most cases only differences in the male terminalia characters allow us to distinguish *Lophops* species. The apparent lack of morphological differences other than on the genitalic appendages, could be caused by a rapid and recent diversification of this genus in Africa. We know that *Lophops* species feed on Poaceae (Soulier-Perkins et al., 2007) and it is only when its host plant was available that it could have invaded this continent. With Palynology studies, the first records of Poaceae, on the African continent, can be traced back to middle Eocene (Van der Hammen, 1983) then, the ancestors of *Elasmoscelis* and *Lophops* may have arrived in Africa as early as 42 Ma. It is most likely that the diversification of those lineages has followed the expansion of savannah throughout Africa during the Miocene 23 Ma (Soulier-Perkins, 2000) and such recent diversification could explain why they are so few characters allowing us to identify the species. The hypothesis of sexual conflict between male and female over the control of fertilization is supported by the Lophopidae phylogeny (Soulier-Perkins, 2001) and with the evolution of sexual morphological traits we can expect that morphological changes occur of the phallic complex. This is most likely why the characters, allowing us to identify African *Lophops* to species level, are carried by the male terminalia. Those observations suggest that

the African representatives of *Lophops* are the result of a rapid radiation on that continent. However, further investigations are needed using molecular techniques that would test this hypothesis of rapid radiation for *Lophops*.

ACKNOWLEDGEMENTS

For the loan of material, we would like to thank the following persons: Dr R. T. Schuh (AMNH), Mr M. D. Webb (NHMUK), Dr P. Grootaert (ISNB), Dr H. Dall'Asta (MRAC), Dr D. J. Preston (NCIP) and Dr A. J. P. Duffels (ZMA). Our gratitude goes as well to L. Fauvre for the pictures of *L. pallida*, *L. kwazulu* and *L. sigwalti*.

LITERATURE CITED

- Baker, C. H. 1925. Some Lophopidae (Fulgoroidea) of the Indo-Malayan and Papuan Regions. *Treubia* 6: 271–296.
- Bourgoin, T. 1987. A new interpretation of the homologies of the Hemiptera male genitalia, illustrated by the Tettigometridae (Hemiptera, Fulgoromorpha). Proceedings of the 6th Auchenorrhyncha meeting, Turin, Italy, 7–11 September 1987 pp 113–120.
- Bourgoin, T. 2015. FLOW (Fulgoromorpha Lists on The Web): a world knowledge base dedicated to Fulgoromorpha. Version 8 [15/05/2015]. <http://www.hemiptera-databases.org/flow/>
- Bourgoin, T. and J. Huang. 1990. Morphologie comparée des genitalia males des Trypetimorphini et remarques phylogénétiques (Hemiptera: Fulgoromorpha: Tropiduchidae). *Annales de la Société Entomologique de France* 26(4): 555–564.
- Dlabola, J. 1986. Neue arten der fulgoromorphen zikaden-familien vom mittelmeergebiet und nahen osten (Homoptera, Auchenorrhyncha: Cixiidae, Meenoplidae, Derbidae, Dictyopharidae, Lophopidae und Issidae). *Acta Musei Nationalis Pragae*, B, 42 (3–4): 169–196.
- Emeljanov, A. F. 1987. The phylogeny of the Cicadina (Homoptera, Cicadina) based on comparative morphological data. *Morphological Principles of insect Phylogeny*. Translated All-Union Entomological Society 19–109.
- Ghauri, M. S. K. 1966. *Zophiuma lobulata* sp. n. (Lophopidae: Homoptera), a new pest of coconut in New Guinea. *Annals and Magazine of Natural History* 9: 557–561.
- Kirby, W. F. 1891. Catalogue of the described Hemiptera Heteroptera and Homoptera of Ceylon, based on the collection formed (chiefly at Pundaloya) by Mr. E. Ernest Green. *Journal of the Linnean Society of London, Zoology* 24: 72–176.
- Kirkaldy, G. W. 1906. Leafhoppers and their natural enemies (Pt IX Leafhoppers. Hemiptera). *Bulletin of the Hawaiian Sugar Planters Association Division of Entomology* 1(9): 271–479.
- Kumarasinghe, N. C. and S. D. Wratten. 1996. The sugarcane lophopid planthopper *Pyrilla perpusilla* (Homoptera: Lophopidae): a review of its biology, pest status and control. *Bulletin of Entomological Research* 86(5): 485–498.
- Linnavuori, R. 1973. Hemiptera of the Sudan, with remarks on some species of the adjacent countries 2. Homoptera Auchenorrhyncha: Cicadidae, Cercopidae, Machaerotidae, Membracidae and Fulgoroidea. *Notulae Entomologicae* 53: 65–137.
- Melichar, L. 1902. Homopteren aus West-China, Persien, und dem Süd-Ussuri-Gebiete. *Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de St.-Petersbourg* 7: 76–146.
- Melichar, L. 1915. Monographie der Lophopiden. *Annales Musei Nationalis Hungarici* 13: 337–385.
- Metcalf, Z. P. 1952. New names in the Homoptera. *Journal of the Washington Academy of Science* 42: 226–231.
- Metcalf, Z. P. 1955. General catalogue of the Homoptera. fasc. IV: Fulgoroidea, part 17: Lophopidae. North Carolina State College, Raleigh, U.S.A., 75 pp.
- Muir, F. A. G. 1931. New and little-known Fulgoroidea from South America. *Proceedings of the Hawaiian Entomological Society* 7: 469–480.
- Rahman, K. A. and R. Nath. 1940. Bionomics and control of the Indian sugar-cane leafhopper, *Pyrilla perpusilla*, Wlk (Rhynchota, Fulg.). *Punjab Bulletin of Entomological Research* 31: 179–190.
- Schmidt, E. 1912. Beitrag zur Kenntnis der Homopteren-Fauna Afrikas. *Revue Zoologique Africaine* 1(3): 356–364.
- Smith, E. S. C. 1980. *Zophiuma lobulata* Ghauri (Homoptera: Lophopidae) and its relation to the finshafen coconut disorder in Papua New Guinea. *Papua New Guinea Agricultural Journal* 31: 37–45.
- Snodgrass, R. E. 1935. *Principles of insect morphology*. McGraw-Hill Book Co., Inc., New York and London. 1–667 pp.
- Soulier-Perkins, A., 2000. A phylogenetic and geotectonic scenario to explain biogeography of the Lophopidae (Hemiptera, Fulgoromorpha). *Palaeogeography, Palaeoclimatology, Palaeoecology* 160(3–4): 239–254.
- Soulier-Perkins, A., 2001. The phylogeny of the Lophopidae (Hemiptera, Fulgoromorpha) and the impact of sexual selection and coevolutionary sexual conflict. *Cladistics* 17:1–24.
- Soulier-Perkins, A., D. Ouvrard, M. Attié and T. Bourgoin. 2007. Evolutionary patterns in biogeography and host plant association: 'taxonomic conservatism' in Lophopidae (Hemiptera: Fulgoromorpha). *Systematic Entomology* 32: 305–311.
- Spinola, M. 1839. *Essai sur les Fulgorelles, sous-tribu des Cicadaires, ordre des Rhyngotes*. *Annales de la Société Entomologique de France* 8: 339–454.
- Stål, C. 1859. *Novae quaedam Fulgorinorum formae speciesque insigniores*. *Berliner Entomologische Zeitschrift*. Berlin 3: 313–327.
- Stål, C. 1866. *Hemiptera Africana*. Stockholm, 4: 276 pp.

- Synave, H. 1962. Lophopidae (Homoptera -Fulgoroidea). Park National de la Garamba, mission H. de Saeger 1949-1952, fascicule 28, pp 3-36.
- Synave, H. 1963. Homoptera in la Reserve Naturelle intégrale du Mont Nimba fasc. v. Memoires de l'institut Français d'Afrique Noire, Dakar 66: 447-478.
- Van Der Hammen, T., 1983. The palaeoecology and palaeogeography of savannas. *In*: F. Bourlière (ed.), Tropical Savannas: Ecosystems of the World. Elsevier, Amsterdam, pp 19-35.
- Walker, F. 1870. Catalogue of the Homopterous insects collected in the Indian Archipelago by Mr. A.R. Wallace, with descriptions of new species. Journal of the Linnean Society of London, Zoology 10: 82-193.
- Wilson, M. R. 1987. The Auchenorrhyncha (Homoptera) associated with palms. Proc. 2nd International Workshop on Leafhoppers and Planthoppers of Economic Importance, C.I.E., London, pp. 327-342.
- Wilson, S. W., C. Mitter, R. F. Denno and M. A. Wilson. 1994. Evolutionary Patterns of Host Plant Use by Delphacid Planthoppers and their relatives. *In*: Planthoppers their Ecology and Management, Chapman and Hall pp 7-113.
- Woodward, T. E., J. W. Evans and V. F. Eastop. 1970. Hemiptera. *In* C.S.I.R.O. The insects of Australia. Melbourne Univ. Press, Carlton, Australia.