

## New leafminers on *Senegalia mellifera* (formerly *Acacia mellifera*, Fabaceae) in Kenya (Lepidoptera: Nepticulidae & Cemostomidae) are some of Africa's smallest moths

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### Abstract

Two new species of leafminers, occurring on *Senegalia mellifera* (Vahl) Seigler & Ebinger in Kenya, are described: *Acalyptris melliferae* sp. nov. in Nepticulidae and *Leucoptera aurantia* sp. nov. in Cemostomidae. Both were found in the Rift valley, near Lake Bogoria. These species represent the first known leafminers on the African 'Acacia' genus *Senegalia*. We also provide arguments from phylogenetic studies to consider Cemostomidae as a separate family, rather than a subfamily in Lyonetiidae. A checklist of African species of Cemostomidae is appended, the genera *Crobylophora* Meyrick, 1880 and *Microthauma* Walsingham, 1891 are synonymised with *Leucoptera* Hübner, 1825 and the following new combinations are proposed: *Leucoptera byssinodes* (Meyrick, 1914) comb. nov., *L. speciosa* (Ghesquière, 1940) comb. nov., and *L. xanthochyta* (Meyrick, 1918) comb. nov. from *Crobylophora* and *L. metallifera* (Walsingham, 1891) comb. nov. from *Microthauma*.

**Key words:** Acacia, Africa, Rift Valley, *Acalyptris*, *Leucoptera*, new synonymy, new species, new combination

### Introduction

Leafmining Lepidoptera comprise some of the smallest known moths, especially in the family of the pygmy moths (Nepticulidae), where the smallest known species have forewing lengths between 1.1 and 1.5 mm and a wingspan between 2.6 and 3.0 mm (Stonis *et al.* 2021). We here report two of almost equally small species from African 'Acacia' trees in the Kenyan Rift Valley, in the families Nepticulidae and Cemostomidae.

Earlier no leafmining Lepidoptera had been reported from African 'Acacia' species, not even within the best studied family, the Gracillariidae (De Prins & De Prins 2011–2024a). This is in contrast to the Australian *Acacia* s. str. that are host to several Nepticulidae and Gracillariidae (Common 1990) and have a rich leafmining fauna (Bairstow *et al.* 2010; Sinclair & Hughes 2010; De Prins *et al.* 2025). It is also understandable, as the majority of the African species have extremely small and narrow leaflets, hardly suitable to harbour a complete leafmine, whereas the majority of Australian Acacia's have relatively large phyllodes.

African Acacia trees in the genera *Vachellia* Wight & Arn. and *Senegalia* Raf. are an important constituent of African Savannas and semi deserts. DJLA had the opportunity to search for Lepidoptera on Acacia's with Earthwatch volunteers near Lakes in the Kenyan Rift Valley between 2003 and 2009 (Agassiz 2009b). This fieldwork concentrated on caterpillars, which were subsequently reared to adults. Results have been published on Macrolepidoptera and some Microlepidoptera (Agassiz 2009b, a, 2011; Agassiz & Aarvik 2014; Agassiz & Bidzilya 2016). Leafmines tenanted by larvae were not easy to detect since they only existed for a few days. During the fieldwork leafmines were found only in *Senegalia mellifera* (Vahl) Seigler & Ebinger, that has relatively large leaflets. We report here two new species, respectively belonging to the genera *Acalyptris* Meyrick, 1921 (Nepticulidae) and *Leucoptera* Hübner, 1825 (Cemostomidae). In addition, some species of *Bucculatrix* Zeller, 1839 (Bucculatricidae) were found that prepare short leafmines during their first instar. They will be described elsewhere.

## Material and methods

The specimens were collected and reared following the methods described in Agassiz (2009b).

The genus *Acacia* sensu lato was recently divided into a number of distinct genera, including *Senegalia* Raf., which occurs in Africa and the Americas, while *Acacia* sensu stricto is limited to Australia (Kyalangalilwa *et al.* 2013). In this paper we follow these taxonomic changes. The labels under the specimens, that were prepared before the split of the genus *Acacia* and its nomenclature was generally accepted, carry the name of the hostplant as “*Acacia*”. Locality labels for *Acalyptris* were replaced in 2025 after discovering an error in the coordinates. Extra information, not present on the labels, is indicated in square brackets. The collected material is divided between the museums in Leiden and London. Holotype labels are shown in Figs 2 and 22.

**Morphology.** Genitalia were dissected by EvN, at the same time extracting DNA from the abdomen, using a slightly adapted protocol according to Knölke *et al.* (2005). Genitalia were embedded in euparal, males usually stained with phenosafranin, females with chlorazol black. Dissected specimens receive a label with the 4-digit EvN slide number, and a registry number for the DNA extract, calculated by adding 20,000 to the slide number, resulting in numbers as “RMNH.INS. 23628”. For specimens that are deposited in London, the RMNH number appears on a DNA voucher label, and the specimen received a NHMUK number.

Wing preparations were made from descaled wings in ethanol, stained with phenosafranin and embedded in Euparal.

Genitalia slides for NHMUK were renumbered with the BM(NH) system.

Measurements of genitalia were obtained from digital images, using calibrated scaling in the Zeiss AxioVision software. Genitalia measurements are rounded off to the nearest 5 µm. Forewing length was measured from tip of fringe to attachment on thorax, also from digital images.

**Photography.** Moths were photographed either with an AxioCam MRC 5 digital camera attached to a motorized Zeiss SteREO Discovery V12, using the Module Extended Focus and Zeiss AxioVision software to prepare a picture in full focus from a Z-stack of ca 10–40 individual photos, or with an MRC 5 camera on a Zeiss Stereo SV11 microscope. Leafmines were also photographed with this system, using dark field illumination. Genitalia were photographed with the same camera on a manually operated Zeiss Axioskop H, without using extended focus.

**DNA barcoding.** Our methodology has been described before (van Nieuwerken *et al.* 2012; Doorenweerd *et al.* 2015). Some DNA extracts for which amplification of DNA failed were analysed in the Naturalis Laboratories with genome skimming (Schell *et al.* 2025), in this case the paratype of *Acalyptris melliferae* and both barcoded specimens of *Leucoptera*. The Bioinformatics Analysis followed White *et al.* (2025). We present neighbor-joining trees, under the Kimura 2-parameter model, of the selected taxa and some relatives, partly found by data mining BoldSystems, and prepared with tools in BoldSystems version 4 (Ratnasingham & Hebert 2007). These trees are for showing relative distances and not to be interpreted as phylogenetic trees, although some phylogenetic signal is visible. The DNA barcode data as used here are given in detail in the public BOLD dataset DS-SENEGLM (<https://dx.doi.org/10.5883/DS-SENEGLM>), including GenBank accession numbers.

## Abbreviations of the depositories

NHMUK: Natural History Museum, London, UK;

RMNH: Naturalis Biodiversity Center, Leiden, Netherlands.

## Results

### Nepticulidae

Nepticulidae Stainton, 1854, or pygmy moths are overall poorly known from Africa, with the exception of southern Africa, where thanks to the extensive rearing work by Lajos Vári many species were reared and a total of 129 species has been described until now (Scoble 1983; van Nieuwerken 2020). From Kenya we only know one named species: *Stigmella pelanodes* (Meyrick, 1920) (van Nieuwerken *et al.* 2016b), but collections harbour a number of other species. The genus *Acalyptris* is one of the larger genera in Africa, with currently 22 species known from

southern Africa (van Nieukerken *et al.* 2016b) and several unnamed ones from other parts of Africa, including Kenya. Until recently the genus had 112 named species globally (van Nieukerken *et al.* 2016b; Stonis *et al.* 2020a; Stonis *et al.* 2020b), but by moving the species of the *A. latipennata* group to the new genus *Dvidulopsis* Stonis & Diškus, 2025 (Stonis *et al.* 2025), and by adding the species described here, 106 species remain in *Acalyptris*. It is especially diverse in tropical regions and deserts. It has a large host range, in Africa nine plant families are hitherto recorded (Scoble 1980), including Fabaceae (*Brachystegia* Benth.) for *Acalyptris fuscofascia* (Scoble, 1980). Our new species is thus the second African species feeding on Fabaceae. So far all African species belong to the *A. platani* group (van Nieukerken *et al.* 2016b) and with the new species the total of African named *Acalyptris* is now 23. The known species were revised by Scoble (1980), then under the generic name *Niepeltia* Strand, 1934.

There are only a few DNA barcodes available of African *Acalyptris*, North Africa excluded, and only one of a previously named species: *Acalyptris fuscofascia*. We compare the barcode of *A. melliferae* with African and Arab species, and include a few other species in the *A. platani* group (Fig. 14).

## Genus *Acalyptris* Meyrick, 1921

### *Acalyptris melliferae* van Nieukerken & Agassiz sp. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:7A147DB9-F309-4BA3-89E4-DEFBD697FD64>

(Figs. 1–18)

“*Acalyptris AcaciaKenya*”; informal name by Doorenweerd *et al.* 2016: Figure S1, Table S1. [also temporary name in BOLD Systems and Genbank]

#### Type material

**Holotype.** KENYA • ♂; Rift Valley, Lake Bogoria; alt. 1000 m; 0°15'N 36°05'E; 11 Nov. 2004; D.J.L. Agassiz leg.; em[erged] 22 Nov. 2004; l. on *Acacia mellifera*; B.M. ♂ Genitalia slide No. 34304, RMNH Microlepidoptera Genitalia slide E.J. van Nieukerken 3628 ♂; DNA voucher sample id: RMNH.INS.23628, BOLD: NEPTA001–13, BIN: BOLD:ACG8699; NHMUK013702421.

**Paratypes** (3 ♂, 1 ♀). KENYA • 1 ♂; same label data as Holotype; em[erged] 21 Nov. 2004; Genitalia slide EvN4059; DNA voucher sample id: RMNH.INS. 24059, BOLD: NEPTA1537–15, BIN: BOLD: ACY4492; RMNH.INS.24059. • 1 ♂, 1 ♀; same label data as Holotype; Genitalia slides EvN5613 ♂, EvN5054 ♀; RMNH. INS.25613; RMNH.INS.25054. • 1 ♂; same label data as Holotype; B.M. ♂ Genitalia slide No. 34305 (EvN4060); DNA voucher sample id: RMNH.INS.24060; NHMUK013702422.

**Other material.** KENYA • 2 adults, without abdomen; same locality data as Holotype; RMNH.INS.1557481, RMNH.INS.1557482. • 17 leafmines; same locality data as Holotype; RMNH.INS.1557205.

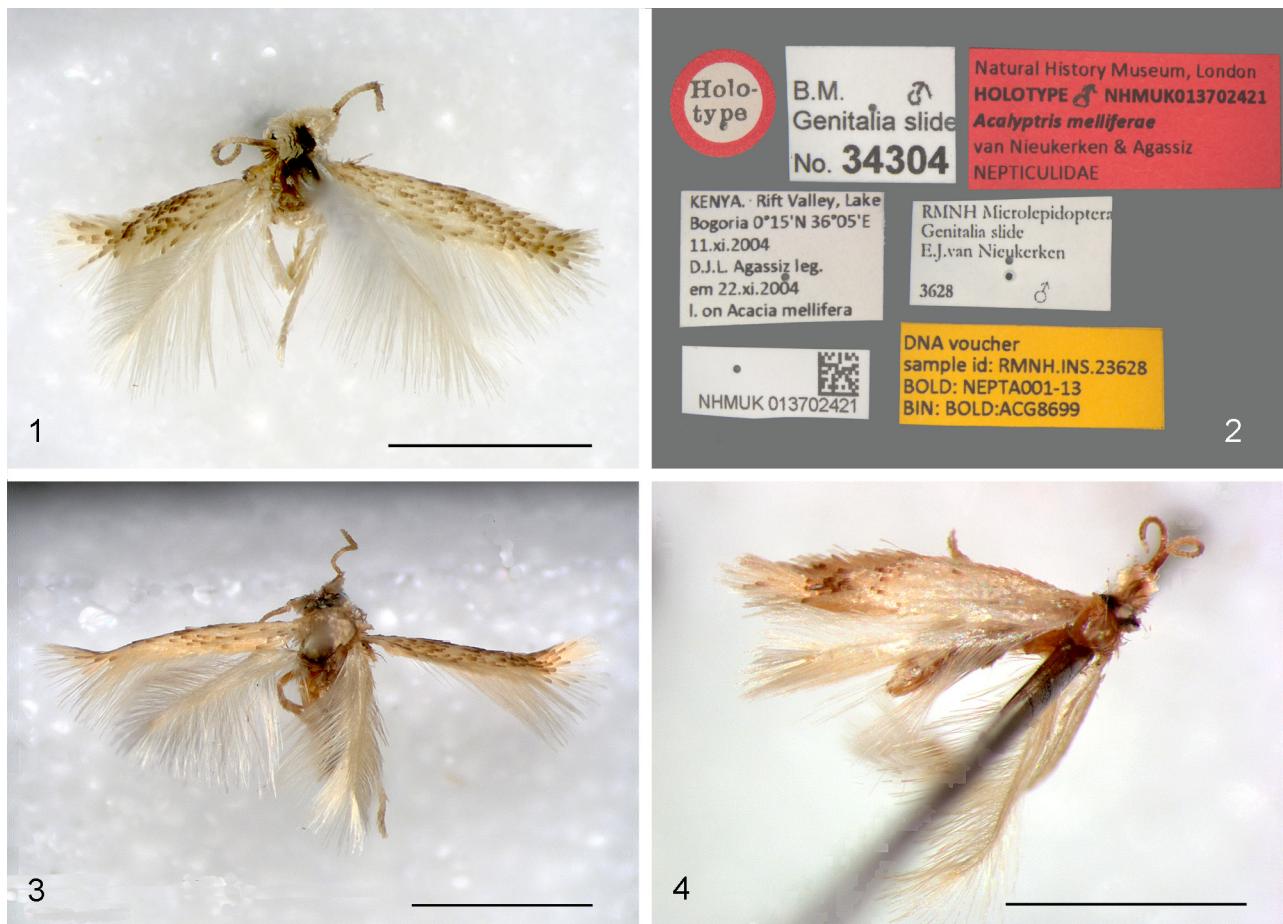
**Diagnosis.** Very small pale moth without conspicuous external characters. Male genitalia diagnostic by the simple valva without any inner projection and the presence of lateral support rods. The genitalia of *A. combretella* (Vári, 1955) and *A. zeyheriae* (Scoble, 1980) somewhat resemble it, but have the valvae more narrowing towards apex and lack lateral support rods.

**Description.** Male (Figs. 1–3). Forewing length 1.4–1.53 mm, wingspan ca 3–3.1 mm. Head: frontal tuft variable, from completely ochreous to mixed ochreous and fuscous, collar ochreous white. Scape relatively large, ochreous. Antenna pale brown, with 21–25 articles, including scape. Thorax and forewing ochreous, with dispersed brown tipped scales. Hindwing pale; costal bristles absent. Abdomen dark ochreous, including vestiture on genitalia; anal tufts inconspicuous. Special scaling absent.

Female (Fig. 3). Forewing length 1.54 mm, wingspan not measured. Antenna with 18 articles, including scape. Otherwise as male.

Male genitalia (Figs 5–10). Capsule length 205–210 µm. Vinculum anteriorly concave, ventral plate not large. Tegumen rounded, forming obtuse pseuduncus; uncus an inverted V, with pointed central process, in lateral view split distally; gnathos with long narrow central element, almost touching uncus. A pair of lateral support rods from gnathos, run along vinculum lateral arms (Fig. 7). Valva narrow, simple, hardly narrowing towards apex; length 160–180 µm. Transtilla without transverse bar, sublateral process distinct. Phallus 225–255 µm long, with bifurcate ventral carinae, tightly fused to V-shaped ventral process; a pair of straight, narrow, dorsal carinae present; vesica with numerous small cornuti and one large curved cornutus (Fig. 10).

Female genitalia (Figs 11–13). T8 narrow, two small lateral groups of scales and setae. Anal papillae with ca 15 setae on either side. Apophyses straight, slender, anteriores and posteriores almost equal in length. Vestibulum with elaborate sclerotisations, with flaplike extensions laterally. Corpus bursae in single slide compact, probably unripe, without pectinations; with wide, up to 7–8 cells wide reticulate signa, margins crenate, length ca. 190 µm. Ductus spermathecae probably lost in preparation.



**FIGURES 1–4.** *Acalyptris melliferae* sp. nov., adults. 1, male holotype, NHMUK013702421; 2, labels of holotype; 3, male paratype, RMNH.INS.24059; 4, female paratype RMNH.INS.25054. Scales 1 mm.

**Biology.** Hostplant. *Senegalia mellifera* (Vahl) Seigler & Ebinger (Fabaceae).

Egg: under- or upperside of leaflet.

Leafmine (Figs 15–18) starts as narrow (often greenish) gallery, gradually widening, later frass black and more distinct; mine suddenly enlarging in elongate blotch with frass heaped at base. Larval exit on upperside.

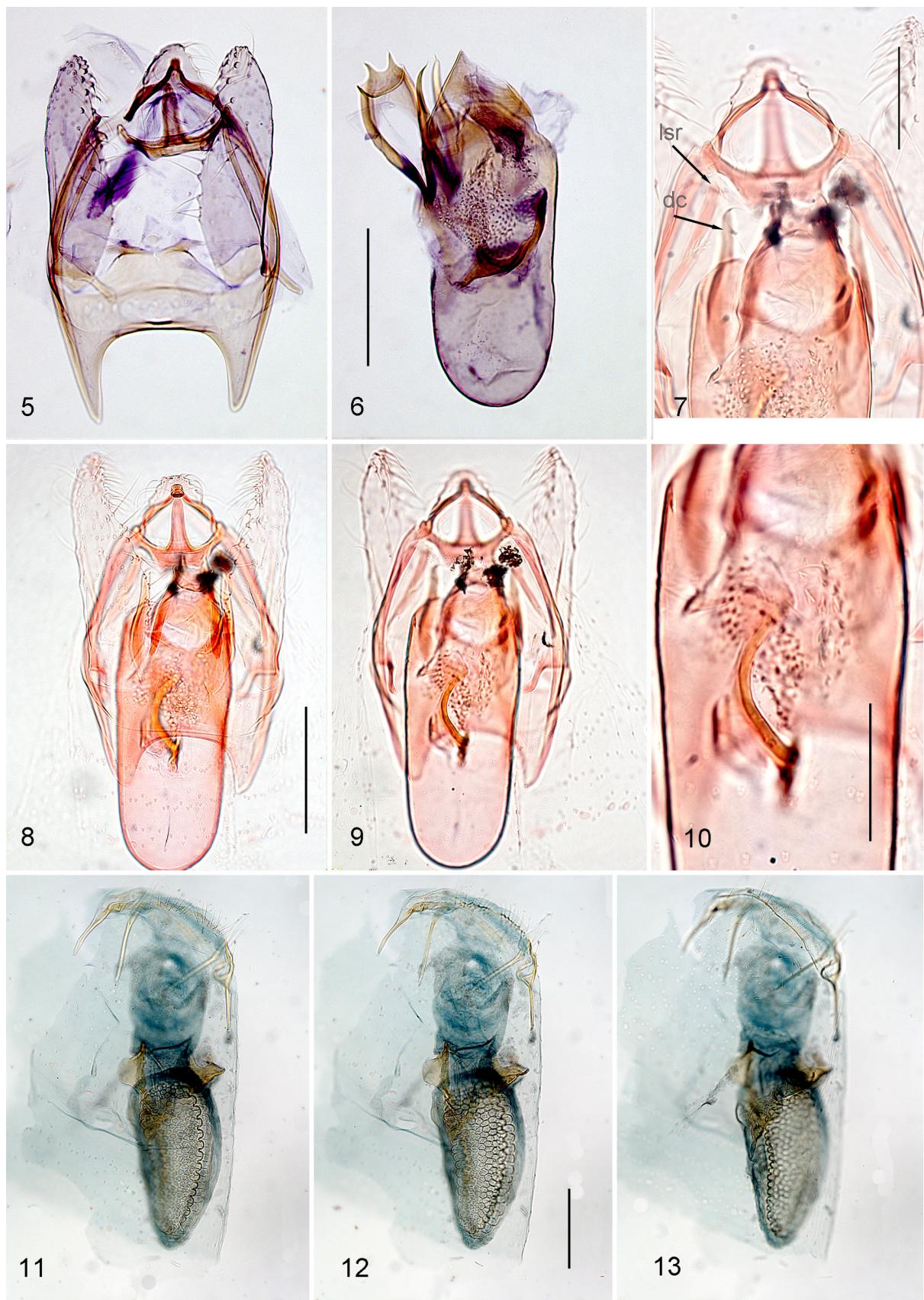
**Distribution.** Kenya: Rift valley.

**DNA barcodes.** We successfully barcoded the holotype and one paratype. Although we do not see any morphological differences, these barcodes differ 8.97%, but are still each other's nearest neighbours (BIN's resp. BOLD:ACG8699, holotype, BOLD:ACY4492 PT RMNH.INS.24059).

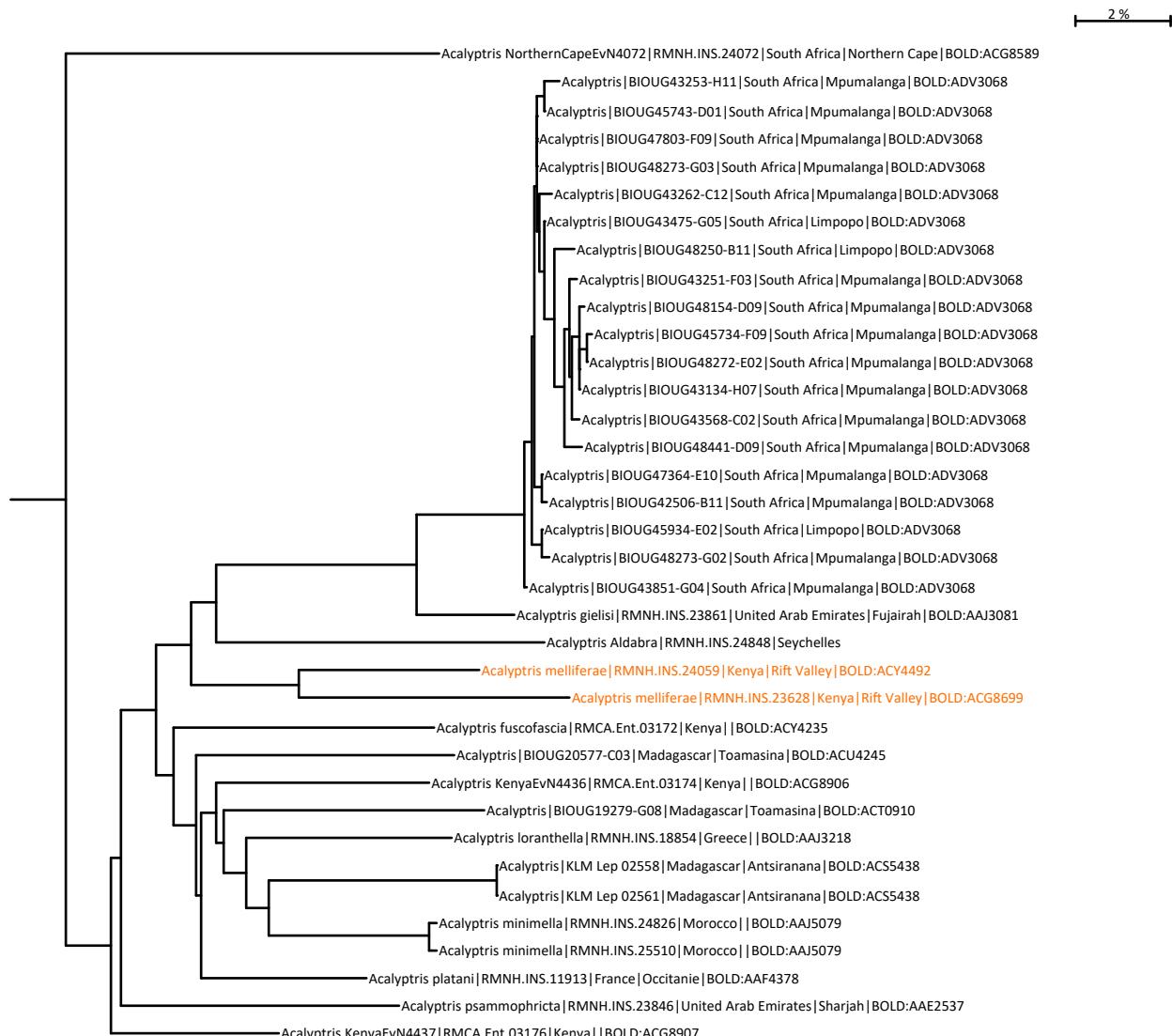
For the Holotype also a sequence of Elongation Factor 1 $\alpha$  is available (Genbank KX281563).

In Fig. 14 we show a Neighbor Joining tree of African *Acalyptris* barcodes plus some European and one Arabian species. *Acalyptris melliferae* groups with the *Acalyptris* from Aldabra, *A. gielisi* van Nieukerken, 2010 from the Emirates and a closely related South African species with BIN: BOLD:ADV3068. The identity of this species is unknown, but it is possible that it concerns *A. lanneivora* (Vári, 1955) that was shown to be very similar in morphology to *A. gielisi* (van Nieukerken 2010). This cluster is in this tree sister to European members of the *A. platani* group and *A. fuscofascia*, described from South Africa and here recorded as new for Kenya (RMCA. Ent.03171, Arabuka Sokoko Forest, 20 km W Gede, 25.iii.2004, J. & W. de Prins).

**Etymology.** The specific name, *melliferae*, a noun in genitive case, refers to the hostplant of the species.



**FIGURES 5–13.** *Acalyptaris melliferae* sp. nov., genitalia in ventral view. 5–6, male genitalia of holotype, phallus separated, B.M. slide No. 34304; 7–10, male paratype, phallus in situ; 8, 9 focussed on different levels; 7, detail lateral support rods and phallus tip; 10, detail of large cornutus, slide EvN4059; 11–13, female genitalia, focussed on different levels, slide EvN5054. lsr = lateral support rods, dc = dorsal carinae. Scales 100  $\mu$ m, 50  $\mu$ m (7, 10).

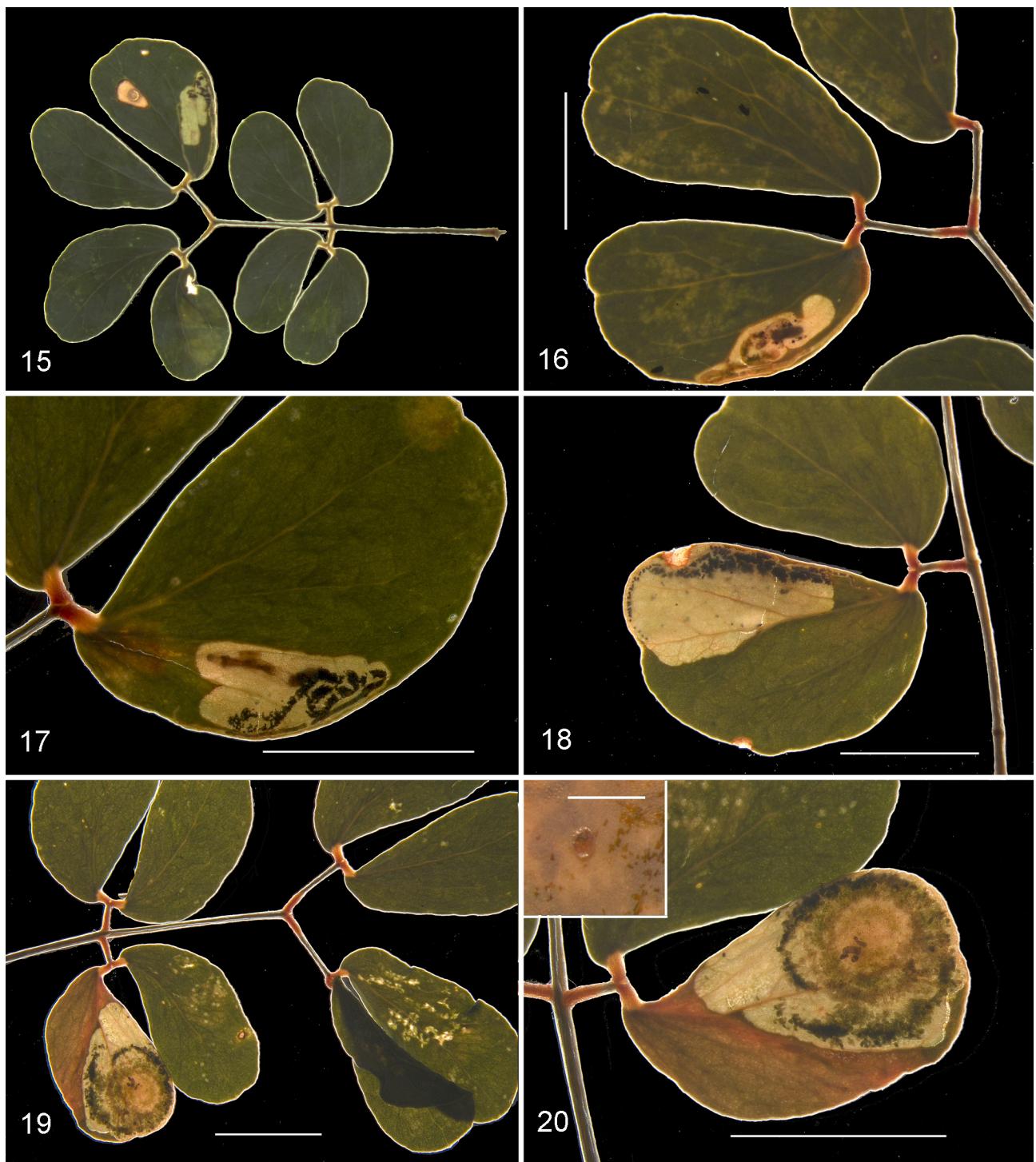


**FIGURE 14.** Neighbor joining tree of DNA barcodes (COI gene) of *Acalyptris* species: all known barcodes from Africa, a few from Europe and Arabian Peninsula for reference.

**Remarks.** *Acalyptris melliferae* belongs to the *Acalyptris platani* group, the group to which all known Afrotropical species and most European species belong (van Nieuwerken 2007; van Nieuwerken *et al.* 2016b). Male genitalia in this group are characterized by absence of the transverse bar of transtilla, valva usually with elaborate inner processes, vinculum with posterior ventral plate, joining to phallus carinae. Female genitalia have elaborate vaginal sclerites, and conspicuous elongate reticulate signa. It shares the presence of lateral support rods with *A. lanneivora* and *A. gielisi* (Scoble 1980; van Nieuwerken 2010) and many North American species (Wilkinson 1979). In the phylogeny by Doorenweerd *et al.* (2016) it also groups in the *A. platani* group, as sister to *A. gielisi*.

The large difference in the DNA barcode is unusual and difficult to explain based on single specimens only. It is possible that one of these is either caused by a pseudogene or by a technical error. The sequence of the paratype was obtained by genome skimming and assembled by subsequent Bioinformatics, and although it seems that differences occur over the full length of the barcode, a chimaera sequence cannot be excluded a priori. Still, we prefer to present these barcodes, as a natural cause is also possible. Variation within a population has been noted in DNA barcodes of other Lepidoptera species, e.g. *Acalyptris janzeni* van Nieuwerken, 2016 (van Nieuwerken *et al.* 2016a) and especially in the gelechiid moth *Megacraspedus lanceolellus* (Zeller, 1850) (Huemer & Karsholt 2018). So far obtaining barcodes of other specimens failed.

With its size, *A. melliferae* ranks amongst the ten smallest Nepticulidae globally (Stonis *et al.* 2021).



**FIGURES 15–20.** Leafmines on leaves or leaflets of *Senegalia mellifera*. 15–18, *Acalyptris melliferae*, RMNH.INS.1557205; 19, 20, *Leucoptera aurantia*, RMNH.INS.1557206, inset in 21 shows egg on leaf upperside. Scales: 5 mm, for inset 0.5 mm.

### Cemistomidae

The Cemistomidae Spuler, 1899 (=Leucopteridae Chapman, 1902) are in most recent works considered a subfamily of Lyonetiidae, but several recent phylogenetic studies have shown that the former subfamilies Cemistominae and Lyonetiinae never form a monophylum, but that cemistomines can be found in different places of the tree, either in the Gracillarioidea or in the Yponomeutoidea (Mutanen *et al.* 2010; Sohn *et al.* 2013; Heikkilä *et al.* 2015; Kawahara *et al.* 2019; Li *et al.* 2021). Mayer *et al.* (2021) found *Leucoptera coffeella* (Guérin-Meneville & Perrotet, 1842)

as sister to Lyonetiinae + Bedelliidae, rendering Lyonetiidae paraphyletic. Li *et al.* (2021) even found this species in some analyses as sistergroup to Phylloconistinae, nested within Gracillariidae. That result was probably caused by long branch attraction, but the overall picture is that placement of cemistomines in Lyonetiidae receives no support from genome, nor from morphology (Sohn *et al.* 2013). Whereas the cited papers choose not to change the classification, both Lopez-Vaamonde *et al.* (2018) and Lees and Minet (2022) did so and raised the group to family status within the Gracillarioidea rather than the Yponomeutoidea. We follow the family level here, but keep it for now in the Yponomeutoidea, with which it shares the main apomorphy: the pleural lobes on the 8th abdominal segment in the male (Kyrki 1984; Sohn *et al.* 2013). In the 20<sup>th</sup> century the group was more often cited as a family, either as Cemistomidae (Grandi 1931; Hering 1933) or as Leucopterygidae (Vári 1955).

The genus *Leucoptera* Hübner, 1825 is the largest genus with an estimated 90 species globally. Mey (1994), in his revision of European species, treated the genera *Proleucoptera* Busck, 1902, *Paraleucoptera* Heinrich, 1918 and *Perileucoptera* Silvestri, 1943 as synonyms of *Leucoptera* in the absence of any phylogenetic study, but did not mention the genus *Crobylophora* Meyrick, 1880 (= *Microthauma* Walsingham, 1891) with ca 15 species, that in fact is not very different either. We follow Mey here and place the new species in *Leucoptera* and synonymise the genera *Crobylophora* and *Microthauma* with *Leucoptera*. Currently 19 Afrotropical species are known in *Leucoptera* and *Crobylophora* (De Prins & De Prins 2011–2024b). With the new species the total is 20. We list all species in the appendix and recombine the species from *Crobylophora* with *Leucoptera*. Most species were described from southern Africa, but several coffee leafmines from Central African countries such as Congo, Tanzania and Kenya (Ghesquière 1940; Washbourn 1940). Kenya is the type country for the coffee pest *Leucoptera meyricki* Ghesquière, 1940. Before 1940 this species was mistaken for *L. coffeella*, described from the Neotropics (but see below). From Madagascar two unnamed species are known (Lees & Minet 2022).

Of the 52 *Leucoptera* and *Crobylophora* species of which the host is known, almost half feed on Fabaceae (25 species), ten on Rubiaceae, three each on Celastraceae and Sapindaceae. Eight more families have just one or two species feeding on them. Despite the dominancy of Fabaceae in the global host record, *Leucoptera aurantia* is the first named Fabaceae feeding species known from the Afrotropical region; however, a leafmine with larva was discovered in a herbarium specimen from *Vigna heterophylla* A. Rich., collected in Senegal by Jan Wieringa (Wieringa 9296), and successfully barcoded (RMNH.INS.31402). The fact that Rubiaceae are the most recorded host family in Africa is probably biased, as the economically important coffee leafminers are best studied (Ghesquière 1940; Washbourn 1940).

Apart from the new species, there exist currently no correctly identified DNA barcodes of the named African species. A large number of DNA barcodes on BOLD systems simply appear as *Leucoptera* sp. or even Lyonetiidae, and have been collected as adults in malaise traps. There are two records of reared *Leucoptera*'s from South Africa that have been reared by Allison Sharp: CLV8177 from *Psydrax lividus* (Hiern) Bridson (Rubiaceae), apparently an unnamed species, and CLV8192 from *Parinari capensis* Harv. (Chrysobalanaceae). The latter most likely represents *Leucoptera parinaricola* Vári, 1955. Further, several — as yet unidentified — barcodes from Madagascar, Kenya and South Africa in BIN BOLD:AAJ2440 form the proof of the occurrence of *Leucoptera coffeella* in Africa, whether original or introduced. Finally three incomplete *Leucoptera* barcodes from the island Aldabra could represent the species *L. aldabrana* Legrand, 1965, but the genitalia ought to be checked for certainty. Available African barcodes that are now identified as *Leucoptera* are presented in Fig. 35, together with a few European representatives.

## Genus *Leucoptera* Hübner, 1825

### *Leucoptera aurantia* van Nieukerken & Agassiz sp. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:07E2F990-1B7A-425B-A482-E25582046BC9>

(Figs. 19–35)

### Type material

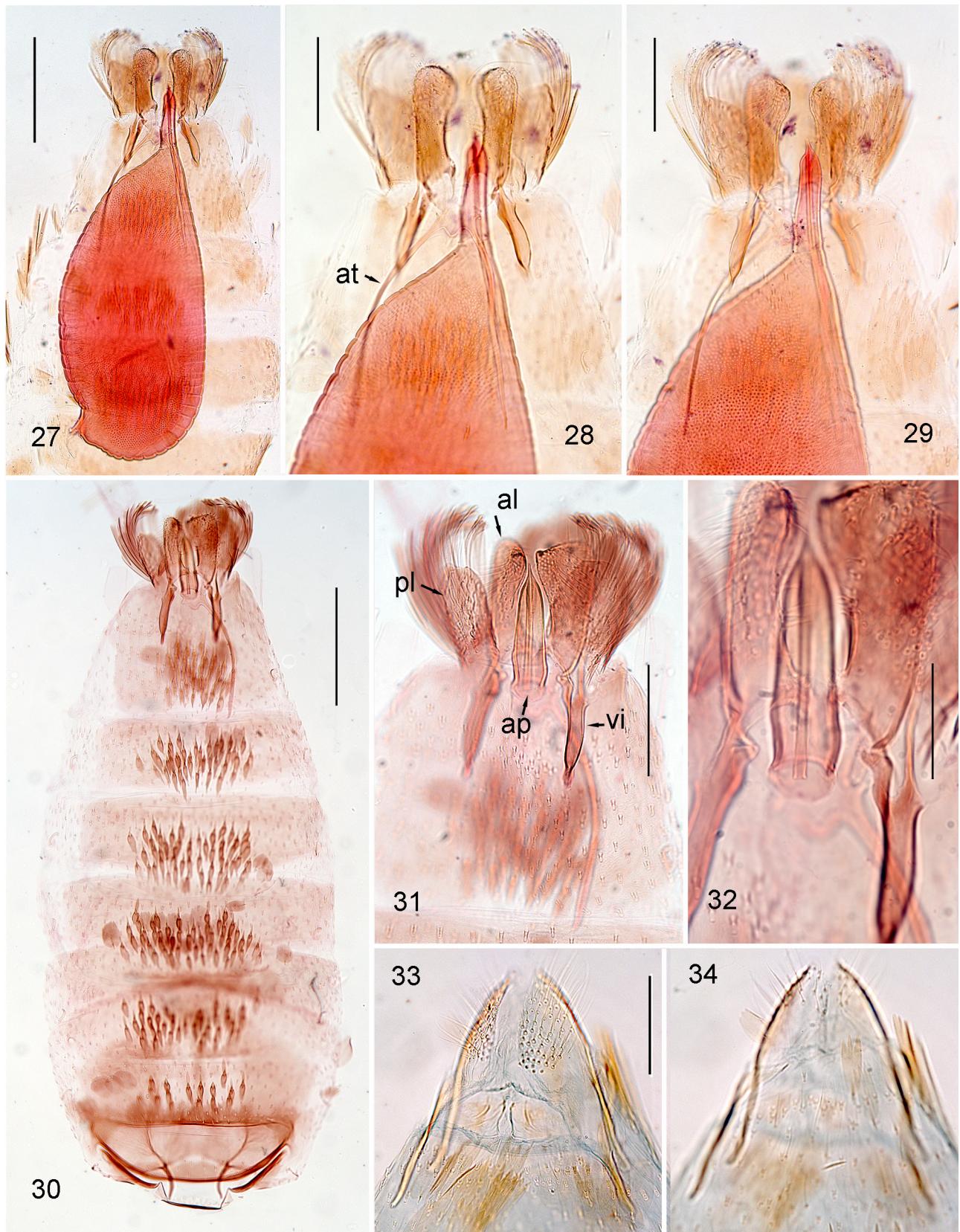
**Holotype.** KENYA • ♂; Rift Valley, L[ake] Bogoria; alt. 1000 m; 0°15'N 36°5'E; D.J.L. Agassiz leg.; em[erged] 22.viii.2007; e.l. *Acacia mellifera*; B.M. ♂ Genitalia slide No. 34306, RMNH Microlepidoptera Genitalia slide E.J. van Nieukerken 5055 ♂; DNA voucher, sample id: RMNH.INS.25055, BOLD: LRMNH085–18; NHMUK013702412.



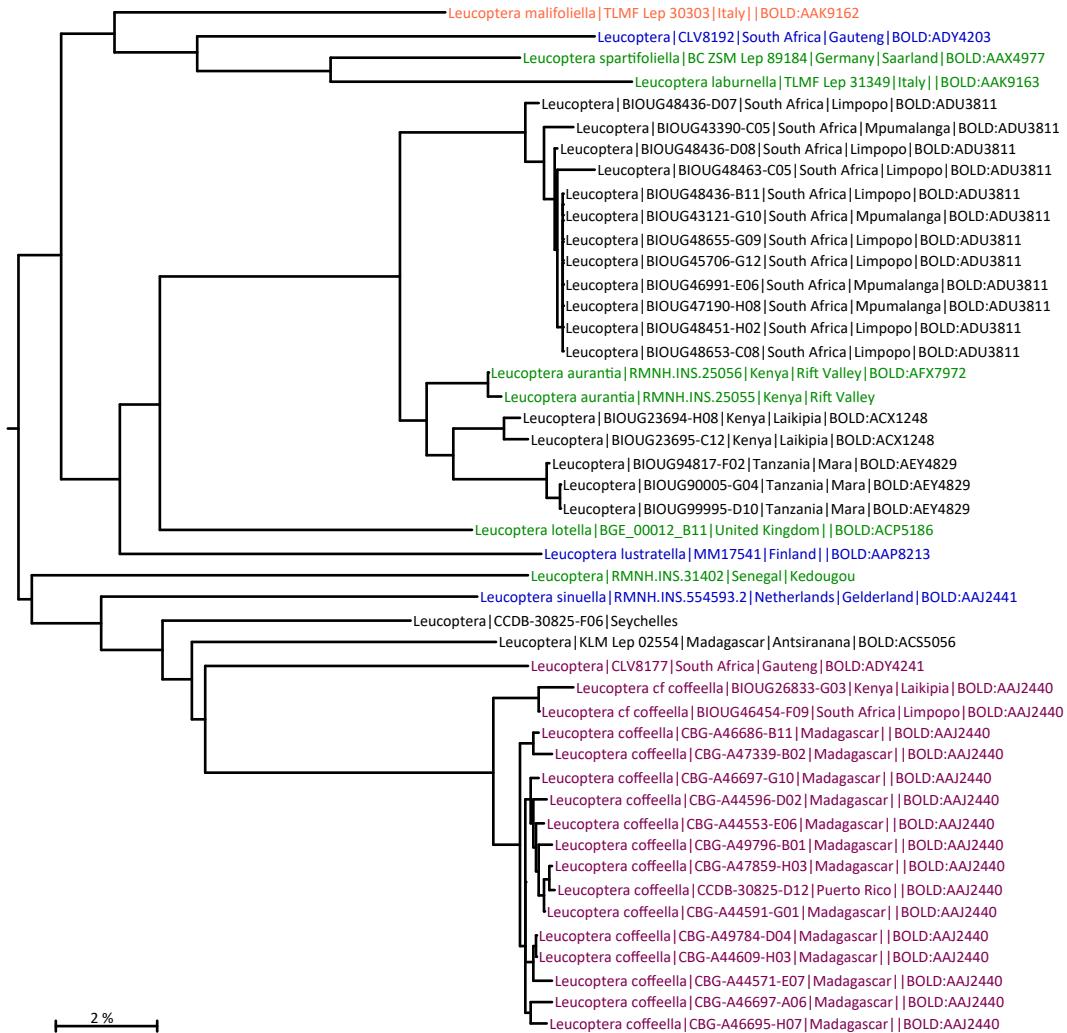
**FIGURES 21–26.** *Leucoptera aurantia* sp. nov., adults. 21, male holotype, NHMUK013702412; 22, labels of holotype; 23, female paratype, RMNH.INS.25056; 24, male paratype, RMNH.INS.1557484; 25, 26, venation of male paratype, slide EvN5651, RMNH.INS.25651, 26, left forewing, 27 left hindwing. Scales 1 mm, 200 µm for wings.

**Paratypes** (8 ♂, 4 ♀). KENYA • 1 ♂; same label data as Holotype; RMNH.INS.1557484. • 1 ♀; same label data as Holotype; em[erged] 26.viii.2007; Genitalia slide BM34307 (EvN5615) ♀; DNA voucher RMNH.INS.25615; NHMUK013702416. • 2 ♂ 1 ♀; same label data as Holotype; em[erged] 30 & 31.viii.2007; NHMUK013702413 (♂), NHMUK013702414 (♂), NHMUK013702415 (♀). • 2 ♂ 2 ♀; same label data as Holotype; em[erged] 22, 30.viii.2007; Genitalia slides EvN5614 ♂, EvN5056 ♀; RMNH.INS.25614 (♂), RMNH.INS.1557485 (♂), RMNH.INS.25056 (♀), RMNH.INS.1557486 (♀). • 1 ♂; same label data as Holotype; em[erged] 30.viii.2007; Wing slide EvN5651; RMNH.INS.25651. • 1 ♂; Rift Valley, Lake Bogoria E; alt. 1000 m; 0°15'N 36°7'E; D.J.L. Agassiz; em[erged] 21.xi.2005; l. on *Acacia mellifera*; RMNH.INS.1557483. • 1 ♂; same collection data as previous; em[erged] 25.xi.2005; NHMUK013702417.

**Other material.** KENYA • 1 leafmine; 1 Nov. 2004; RMNH.INS.1557206.



**FIGURES 27–34.** *Leucoptera aurantia* sp. nov., genitalia. 27–29, male genitalia of holotype, ventral view, different levels of focussing, B.M. slide No. 34306; 30–32, male paratype, ventral view, slide EvN5614, bulbus ejaculatorius taken out (not figured), 30, complete abdomen; 31, 32, details terminalia; 33, 34, female genitalia, dorsal view of terminalia, paratype, slide EvN5056. Scales 200 µm (27, 30), 100 µm (28, 29, 31, 33, 34), 50 µm (32). al: anellar lobe or valva; ap: apical part of bulbus ejaculatorius; at: apophyse of transtilla; pl: pleural lobe; vi: vinculum lobe.



**FIGURE 35.** Neighbor joining tree of DNA barcodes (COI gene) of *Leucoptera* species: all known barcodes from Africa that could be reliably identified as *Leucoptera* and a few European species for reference. Colours indicate hostplant families: green = Fabaceae, red = Rosaceae, purple = Rubiaceae (incl. *Coffea*), blue = other families (resp. Chrysobalanaceae, Hypericaceae and Salicaceae).

**Diagnosis.** This small species differs from most congeners by the distinctly orange pattern, whereas in most *Leucoptera* this pattern is yellow, and the shining lead grey ground colour. The very large bulbus ejaculatorius in the male is also characteristic.

**Description.** Adult (Figs 21–24). Head smooth, no hairscales. Wingspan males 3.6–4.2 mm (n=8), females 3.9–4.4 mm (n=3). Forewing length males 1.5–2.0 mm ( $1.8 \pm 0.2$ , n=8), females 1.7–2.0 mm (n=3). Head: Antenna lead grey, in males with 27–34 articles (n=7), including scape, in females with 30–37 articles (n=3). Scape enlarged, forming eyecap. Face smooth, shining silvery white, palpi not visible externally; vertex shining lead grey, smoothly covered with lamellar scales. Thorax, tegulae and forewing basis shining lead grey, similar to vertex; forewing with an oblique, orange-yellowish fascia from middle of costa running to about 3/5 of dorsum, not or slightly edged basally with darker grey scales, distally clearly edged, a second orange-yellow patch follows after a narrow, straight, grey fascia. This orange patch does not reach dorsum; along costa it is followed by three short black streaks; at tornus by darker shining grey scales and apically by a distinct black dot. Fringe line with dark tipped scales, fringe silvery white with two black lines forming a sharp to right angle. Hindwing very narrow, silvery white. Abdomen dorsally dark grey, vertically silvery white; abdominal terga II to VII with many spines (Fig. 31).

Venation (Figs 25, 26). The venation is extremely reduced, in forewing with two main veins,  $Rs+M$  and probably  $Cu$ ; from  $Rs$  two barely visible veins run to costa. Hindwing with one barely visible vein.

Male genitalia (Figs 27–32). Vinculum or  $S_8$  reduced to a pair of narrow anterior appendices; apically with two pairs of narrow valval like appendages, the inner pair representing the anellar lobes or the valvae (cf Mey 1994), with blunt apex; length ca. 120–130  $\mu m$  long; the outer pair representing the pleural lobes (“Lateralloben” in Mey 1994) or  $T_8$  in the terminology of Bradley and Carter (1982), heavily setose. Transtilla with a pair of very long and narrow anterior apophyses. Phallus with extremely large, slightly asymmetric, bulbus ejaculatorius and a short, narrow apical part (by Mey termed aedeagus), with central ductus ejaculatorius; wall of bulbus distinctly porous. Total length of phallus ca. 685  $\mu m$ .

Female genitalia (Figs 33, 34). Apophyses relatively short and straight, posteriores ca 205–220  $\mu m$  long. Internal genitalia not well developed in examined specimens (not matured).

**Biology.** Hostplant. *Senegalia mellifera* (Vahl) Seigler & Ebinger.

Egg: on leaf upperside, in centre. Leafmine (Figs 19, 20, only one available) a typical *Leucoptera* mine, a more or less circular upperside blotch, using more than half leaflet, no trace of an initial gallery. Frass more or less in concentric circles, grey to black. Exit slit on leaf upperside.

**Distribution.** Kenya: Rift valley.

**DNA barcodes** (Fig. 34). We have a full barcode of a paratype, and a partial barcode of the holotype (375 basepairs). The barcode belongs to BIN BOLD:AFX7972. Its nearest neighbour is BOLD:AEY4829 at 3.42% with three Malaise trapped specimens from Tanzania, Serengeti. Two barcodes in BIN BOLD:ACX1248 from Kenya, Mpala Research Centre & Olduvai at a distance of 3.9–4% are probably also closely related, a single photo on BOLD (BIOUG23694-H08) clearly shows a female *Leucoptera*. The cluster BOLD:ADU3811, with a similarity of 94.77%, from South Africa, Kruger NP, is another related *Leucoptera* species. Together these African taxa group with the European *Leucoptera lotella* (Stainton, 1859)

**Etymology.** The specific name, *aurantia*, is the female form of the Latin adjective *aurantius* (orange), referring to the orange fasciae on the forewings.

**Remarks.** Both on DNA barcodes and in the morphology, *L. aurantia* belongs to the *lustratella*-Gruppe of Mey (1994). It shares the large bulbus ejaculatorius with *L. lotella* and *L. onobrychidella* (Klimesch, 1937) and the setose appendices of the anellus with *L. onobrychidella*. Apart from *L. lustratella* (that feeds on Hypericaceae), the members of this group feed on Fabaceae.

## Discussion

We report on the first leafminers on African “Acacia”, currently the genus *Senegalia*. We have not found any reference to other leafminers occurring on this genus or the genus *Vachellia* Wight & Arn. from Africa. This is most likely a sign of the poor knowledge of leafminers in Africa in general. Apart from studies on economically important leafminers, e.g. on coffee (Ghesquière 1940; Washbourn 1940; Bradley 1958), grapes (van Nieuwerken & Geertsema 2015; Steyn *et al.* 2021), soybean, cashew, tomatoes etc. (references too numerous to cite), there are hardly any inventories or taxonomic studies on native leafminers in natural areas. An exception are the cited papers by Lájos Vári from South Africa, dealing with only some lepidopteran families, and a more recent study on African Lithocolletines (De Prins & Kawahara 2012). As we have shown, the widespread *Acacia* trees form a potential habitat for leafminers, and also for miners of other parts of the tree, such as the thorns, from where a single agromyzid was described: *Melanagromyza acacia* Spencer, 1963 (Spencer 1963). The small size of leaflets of most other *Acacia*’s will probably make them unsuitable for leafminers that can only develop in a single leaflet.

Currently there are large numbers of barcoded invertebrates from Malaise trapping programmes in Africa, initiated by BOLD data systems (e.g. Stewart *et al.* 2024), often only identified to family. Although they clearly show the rich diversity, no beginning has been made to link these data to named species, for which it would be essential either to have barcodes from the old type material or a morphological comparison between the barcoded specimens and the collection material. Challenges are the fact that the Malaise trappings are conserved in ethanol, usually losing the scaling and characteristic patterns of the moths, and the fact that for so many species recent descriptions and illustrations are lacking. Also these trapped specimens will not tell anything about hostplants or leafmines. Projects that also barcode larvae from leafmines could contribute to a better knowledge, as ultimately links between adults and larvae will be made.

Savanna predominantly occupied by *Acacia* is a widespread habitat in sub-Saharan Africa but it is threatened on account of increased population and associated development. It is therefore important to document the fauna which uses it, so that conservation efforts can be informed.

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## Appendix

### Checklist of African Cemostomidae

With type localities (TL) and hostplants (H). The original genus is given in brackets.

*Leucoptera* Hübner, 1825: 426.

Type species *Tinea spartifoliella* Hübner, 1813, designated by Walsingham 1914: 348.

*Cemostoma* Zeller, 1848: 272.

Type species *Tinea spartifoliella* Hübner, 1813, designated by Fletcher 1929: 43.

*Crobylophora* Meyrick, 1880: 177. **syn. nov.**

Type species *Crobylophora chrysidiella* Meyrick, 1880, designated by Fletcher, 1929: 59.

*Microthauma* Walsingham, 1891: 127. **syn. nov.**

Type species *Microthauma metallifera* Walsingham, 1891, original designation and monotypy.

*Proleucoptera* Busck, 1902: 98.

Type species *Leucoptera smilaciella* Busck, 1900, original designation.

*Paraleucoptera* Heinrich, 1918: 193.

Type species *Cemostoma albella* Chambers, 1871, original designation.

*Perileucoptera* Silvestri, 1943: 193.

Type species *Elachista coffeeella* Guérin-Méneville & Perrottet, 1842, by monotypy.

1. *aldabrana* Legrand, 1965: 31 (*Leucoptera*)

TL: Seychelles: Aldabra

2. *aurantia* van Nieukerken & Agassiz **sp. nov.** (*Leucoptera*)

TL: Kenya, Rift Valley; L[ake] Bogoria.

H: *Senegalia mellifera* (Vahl) Seigler & Ebinger (Fabaceae)

3. *auronivea* (Walker, 1875): 193. (*Cemostoma*)

TL: Saint Helena

4. *autographa* Meyrick, 1918: 40 (*Leucoptera*)

TL: South Africa: KwaZoeloe-Natal, Durban

5. *bifasciatella* Mey, 2020: 208 (*Leucoptera*)

TL: South Africa: Eastern Cape, Camdeboo, Graaff-Reinet District

6. *byssinodes* (Meyrick, 1914): 208 **comb. nov.** (*Crobylophora*)

TL: Malawi: Mt. Mulanje [Nyassaland, Mt. Mlanje].

7\*. *caffeina* Washbourn, 1940: 460 (*Leucoptera*)

TL: Tanzania [Tanganyika Territory], Moshi, Lyamungu [station];

H: *Coffea* spp., *Pavetta* spp. (Rubiaceae).

*daricella* auctt.

8. *clerodendrella* Vári, 1955: 339 (*Leucoptera*)

TL: South Africa: Gauteng, Pretoria, Hennops River.

H: *Volkameria glabra* (E.Mey.) Mabb. & Y.W.Yuan [originally as *Clerodendrum glabrum*] (Lamiaceae)

9\*. *coffeella* (Guérin-Méneville & Perrottet, 1842): 15 (*Elachista*)

TL: France, Guadeloupe.

H: *Coffea* spp. (Rubiaceae)

*noctuella* (Madinier, 1870) unavailable

TL: France, Martinique

10. *coma* Ghesquière, 1940: 81 (*Leucoptera*)

TL: Democratic Republic of the Congo: Banalia [Stanleyville].

H: *Coffea canephora* Pierre ex A. Froehner [originally as *Coffea robusta* ?] (Rubiaceae)

11. *loxaula* Meyrick, 1928: 396 (*Leucoptera*)

TL: Zimbabwe: [S. Rhodesia], Bulawayo.

H: *Pavetta gardeniifolia* Hochst. ex A.Rich. [as *Pavetta assimilis*, Vári 1955] (Rubiaceae)

12. *meyricki* Ghesquière, 1940: 80 (*Leucoptera*)  
 TL: Kenya: Kabete.  
 H: *Coffea* spp. (Rubiaceae).  
*coffeella* sensu Meyrick, 1922: 557
13. *metallifera* (Walsingham, 1891): 127 **comb. nov.** (*Microthauma*)  
 TL: South Africa: KwaZulu-Natal, Estcourt.
14. *methoria* (Ghesquière, 1940): 81 **comb. nov.** (*Crobylophora*)  
 TL: Democratic Republic of the Congo: Nioka.  
 H: *Coffea arabica* L. (Rubiaceae)
15. *obelacma* Meyrick, 1918: 41 (*Leucoptera*)  
 TL: South Africa: Gauteng, Pretoria
- 16\*. *parinaricola* Vári, 1955: 340 (*Leucoptera*)  
 TL: South Africa: Gauteng, Pretoria.  
 H: *Parinari capensis* Harv. (Chrysobalanaceae).
17. *pulchricola* Vári, 1955: 341 (*Leucoptera*)  
 TL: South Africa: Gauteng, Africa: Pretoria.  
 H: *Ochna pulchra* Hook. (Ochnaceae).
18. *scammatias* Meyrick, 1909: 26 (*Leucoptera*)  
 TL: South Africa: Gauteng, Africa: Pretoria
19. *speciosa* (Ghesquière, 1940): 82 **comb. nov.** (*Crobylophora*)  
 TL: Democratic Republic of the Congo: Rutshuru.  
 H: *Coffea arabica* L. (Rubiaceae).
20. *xanthochyta* (Meyrick, 1918): 41 **comb. nov.** (*Crobylophora*)  
 TL: South Africa: Gauteng, Africa: Pretoria

#### Notes

7\*. In the paper where Walshbourn described *L. caffeinea*, he mentioned specimens reared from *Cremonospora africana* (now *Cremaspora triflora* (Thonn.) K.Schum. subsp. *triflora*, Rubiaceae) that he believed to belong to a new species.

9\*. Most older records of *L. coffeella* from Africa refer in fact to *L. meyricki* (Ghesquière 1940; Bradley 1958), but there are indications that *L. coffeella*, common in the Neotropics, should originate from Africa, as *Coffea* does not occur as native plant in the Neotropics. Green (1984) hypothesized a potential origin from Réunion, but without any proof of its occurrence. However, there are now quite a few barcoded specimens on BOLD systems from Madagascar, Kenya and South Africa (BIOUG46454-F09) that have the same barcode as Neotropic *L. coffeella*, in BIN BOLD:AAJ2440 (see also Fig. 35); these could have been caused by reintroduction from the Neotropics, or have their origin in Africa. Unfortunately there are yet no DNA data available for other African coffee miners.

16\*. See above for a barcoded specimen, potentially of this species.