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Revision of *Achrocerides* Hering, 1937 (Lepidoptera: Chrysopolomidae)

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Abstract

The taxonomy of the monotypic genus *Achrocerides* Hering, 1937 is revised using a combination of morphological and genetic evidence. *Achrocerides theorini* (Aurivillius, 1891) was determined to be a widespread, forest-dwelling species which shows high levels of intraspecific variability in both the external and genital morphology. Examination of the holotype of *Chrysopoloma flavoantennata* Berio, 1937 revealed this to be a rare species of *Achrocerides* exhibiting a large body size, and a new combination is introduced thus: *Achrocerides flavoantennata* (Berio, 1937) **comb. n.** Finally, a new species is identified from the Central African Republic and is herein described: *Achrocerides smithi* **sp. n.** The adults and genitalia of all taxa are illustrated, and a distribution map provided to facilitate identification.

Key words: Taxonomy, Afrotropics, new species, new combination, biogeography.

Introduction

The genus *Achrocerides* Hering, 1937 was established as a monotypic genus for *A. theorini* (Aurivillius, 1891) within Hering's (1937) revision of the small Afrotropical family Chrysopolomidae. There have been differing views on the taxonomic hierarchical placement of the Chrysopolomidae. Epstein (1996) considered the group to be a subfamily of Limacodidae based upon synapomorphies in the larvae. Conversely, Zolotuhin *et al.* (2014) concluded that Chrysopolomidae should be treated as a family due to observed differences in the genitalia musculature between Limacodidae and Chrysopolomidae. Recent Lepidopteran genetics work by Mayer *et al.* (2021) found strong clade support for the Chrysopolomidae, suggesting that either it should be given family status, or it should be treated a subfamily of Limacodidae along with the Dalcerinae (a small, Neotropical group). In this paper, we follow Zolotuhin *et al.* (2014), the most recent update to the groups' placement, although further investigation applying integrative taxonomy is needed.

Moths in the genus *Achrocerides* are typically tawny-brown in colour, speckled with dark scales, and possess a pale forewing discal spot and a post-medial grey-brown line on both the fore- and hindwing.

Hering (1937) considered the genus to occupy an isolated position within the group due to the uniquely shaped anterior transtilla processes in the male genitalia. Since then, *Achrocerides* has received no scientific attention aside from a short study by Zolotuhin *et al.* (2014) which concluded that *A. theorini* shared similar male genitalia to *Strigivenifera* Hering, 1937, another Chrysopolomid genus.

Achrocerides theorini appears to be a forest-dwelling species, existing in the Upper and Lower Guinean rainforest as well as throughout the Congo Basin and towards the montane forests in East Africa (de Prins & de Prins 2022; Dufrane 1945; Hering 1937). In the present paper, a combination of genitalia dissections and DNA barcoding of *Achrocerides* specimens from across its range has revealed the existence of a new species in the genus, which is described herein and compared with *A. theorini*. In addition, examination of the holotype of *Chrysopoloma flavoantennata* Berio, 1937 revealed it to be an additional, rare species of *Achrocerides* and a new combination is introduced.

Methods

Morphological studies

Images of adults were taken using a Nikon D90 camera equipped with a Nikkor AF Micro 60 mm lens. The genitalia were dissected and either left unstained or stained with Eosin Y applying standard methods of preparation (Lafontaine & Mikkola 1987), then embedded in Euparal on microscope slides. The genitalia preparations were photographed using a Canon EOS 700D camera mounted on a Leitz Diaplan compound microscope or a QImaging QICAM Fast 1394 Digital Camera mounted on a Leica BMLB microscope, equipped with an Object Imaging motorized plate, and piloted by Surveyor V.8.0.0.2. Digital images of the samples acquired at RMCA will be accessible on the RMCA Virtual Collection website (<https://virtualcol.africamuseum.be>).

Terminology of male genitalia morphology follows Zolotuhin *et al.* (2014), wherein ‘transtilla’ refers to a gnathos-like structure separated from the valve as found within the family Chrysopolomidae (Hering 1937; Zolotuhin *et al.* 2014).

Genetic studies

DNA barcodes were obtained by removing tarsal segments from 10 adult specimens and submitting them to the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph) for extraction, amplification and sequencing of cytochrome oxidase subunit I (COI-5P) (mitochondrial barcode region of 658 bp) applying Single Molecule Real-Time sequencing through the Sequel (PacBio) pipeline (Hebert *et al.* 2018). All sequences and metadata are accessible in the BOLD public dataset (dataset: <https://dx.doi.org/10.5883/DS-ACHRO>). Nine additional *Achrocerides theorini* sequences were obtained from publicly available data on BOLD (BOLD accession numbers: LIMBC826-11, LIMBC832-11–LIMBC837-11, LBEO2049-11, GWOSS371-11).

Sequences were aligned using MUSCLE in MEGA version X (Kumar *et al.* 2018) and genetic divergences within and between species were calculated using the Kimura 2-parameter model (Kimura 1980). Phylogenetic tree searches were performed using Maximum Likelihood (ML), performed on CIPRES using the RAxML BlackBox utility (Stamatakis *et al.* 2008) with default settings and a GTR+FO+G4m model. The tree was visualised in FigTree version 1.4.4.

Type label data

Information provided in quotation marks is transcribed verbatim. A different line is denoted with “/” and a new label with “//”.

Acronyms of institutions and collections:

ANHRT – African Natural History Research Trust, Leominster, UK
 MCG – Museo Civico di Storia Naturale di Genova, Genoa, Italy
 MfN – Museum für Naturkunde, Berlin, Germany
 MNHN – Muséum national d’Histoire naturelle, Paris, France
 MWW – Museum Witt, Weiden, Germany (former Museum Witt, Munich, Germany)
 NHMUK – Natural History Museum, London, UK
 OUMNH – Oxford University Museum of Natural History, Oxford, UK

RCPB – Research collection Patrick Basquin, Yvetot-Bocage, France
 RMCA – Royal Museum for Central Africa, Tervuren, Belgium
 SNHM – Naturhistoriska Riksmuseet, Stockholm, Sweden
 ZSM – Zoologische Staatssammlung München, Munich, Germany.

Other abbreviations:

BIN – Barcode Index Number
 BOLD – Barcode of Life Data System
 DRC – Democratic Republic of Congo
 LG – Genitalia slide prepared by Gyula M. László
 TT – Genitalia slide prepared by Tabitha R. Taberer

Results

Phylogenetics

The results of the ML phylogenetic analysis on the barcode sequences were ultimately deemed uninformative for *Achrocerides* at the species level for the following reasons. Firstly, the analyses were performed multiple times rooted each time with a different outgroup taxon of other Chrysopolomidae genera (including *Chrysopoloma* Druce, 1886 and *Strigivenifera* Hering, 1937) which resulted in the poor resolution of terminal taxa, whereby the genetic distance to the outgroup appeared so large that any potential clusters within *Achrocerides* could not be distinguished. Secondly, through further morphological investigations, it became apparent that only *A. theorini* had been sampled (the other two taxa of the genus introduced herein are based primarily on genital characters) and thus taxon sampling was incomplete. With the addition of the two other members of the genus as discussed herein, the resolution of the phylogeny would likely be improved.

The intraspecific variability in DNA barcodes of *A. theorini* was moderately high with an average pairwise distance of 3.52(±0.11)%, with sampled individuals falling into several BINs on BOLD. In an unrooted phylogeny (Fig. 21), there appeared to be some geographic clustering between Central and West Africa yet there were large amounts of unexpected variations within the West African specimens. Two main clusters of specimens from this region were recovered although they could not be separated by biogeography, and the variability within West Africa was very high (0.00–5.67%, n=15). Furthermore, within just Cote d'Ivoire alone, the pairwise distance in DNA ranged from 0.31–4.38% (n=3). The phylogenetic results thus support the morphological conclusion found herein that *A. theorini* is a widespread species with high levels of variation in COI-5P, external morphology and in male genitalia.

The placement of *Achrocerides* within the wider Chrysopolomidae will be discussed in greater detail in a forthcoming publication but, so far, phylogenetic analysis of the Chrysopolomidae revealed it to be closely related to *Scotinocerides nigrociliata* (Aurivillius, 1905) (Taberer, in prep).

Taxonomy

Achrocerides Hering, 1937

Hering, 1937, *Annals of the Transvaal Museum*, 17: 241.

Re-description of genus: Moths of medium size, ground colour beige to tawny-brown, sparsely speckled with dark scale spots. Antennae bipectinate in male, filiform in female, ochreous yellow; head tawny brown, palps ochreous orange. Forewing rounded, with pale rounded discal spot, grey-brown post-medial line, kinked near outer margin at vein M1; postmedial area with a diffuse grey-brown triangular patch between veins R3 and M1; hindwing rounded with undulate margin at tornus, grey-brown medial line, speckled with dark scales in distal half; often with pale, diffuse grey-brown triangular patch on outer margin between veins M1 and M2. In the male genitalia, the paired posterior processes of transtilla are long, narrow, pointed apically, fused medially with a membrane; paired anterior processes narrow, moderately long, fused medially with a membrane. Valve broad basally, abruptly tapered medially, distally truncate or triangular with rounded apex. Juxta strongly sclerotised with bilobate base, with two long, apically pointed lateral processes. Phallus relatively long, ridged distally, membranous, with slight apical split; vesica very short, membranous.

Here, the female of *A. theorini* is described for the first time. A description of the male genitalia is provided by Hering (1937), although it is revised here based on additional specimens from a wide variety of localities.

Diagnosis: When comparing the external appearance of *Achrocerides* with other members of the subfamily *Chrysopolominae*, members of the genus share similarities with *Chrysopoloma* in particular the pale, rounded discal spot on the forewing. For instance, *C. rudis* is highly reminiscent of *Achrocerides* due to also possessing medial lines on the fore- and hind wing, as well as having dark scales on the wings. Despite this, the antennae of *Achrocerides* are yellow compared to the black antennae of *Chrysopoloma* species, and, in the male genitalia, *Achrocerides* possesses two long, narrow anterior processes of the transtilla whilst in members of the allied genus this process is single, broad and generally rounded. The genitalia of *Achrocerides* are most reminiscent of those of *Strigivenifera* showing two long, distally tapering juxta processes. Externally, however, *Achrocerides* lacks the defined brown wing venation of *Strigivenifera* whilst possessing speckled dark scales which are absent in the related genus.

Species content

Achrocerides theorini (Aurivillius, 1891) (Figs. 1–5, 11–15)

Lasiocampa theorini Aurivillius, 1891, *Entomologisk Tidskrift*, **12**: 228, pl.2, fig.3. Type locality: Gabon [Gabon]; based on the whereabouts of Fritz Theorin in the 1880's, "Gaboon", as the label of the specimen reads, refers to the mouth of the "Gaboon River", or the modern-day Gabon Estuary at Libreville.

Type material. Syntype ♂ in SMNH with the following labels: "Lasiocampa / Theorini / Auriv. typ." // "Gaboon" // "Theorin." (examined).

Taxonomic note. In the original description of *L. theorini*, only the binomial combination and the locality were given in the legend for the plate on which a drawing of a male of this new species was figured. A male type, with labels that matches collector and locality mentioned by Aurivillius, is known from the SMNH and we consider this to be a syntype, probably the only one. Aurivillius described this species in full the year after, in 1892, in *Entomologisk Tidskrift*, **13**: 198, noting and also describing a female from Staudinger's collection. Moreover, Hering (1937: 241, pl. IX, fig.4) figured a "♂ (Type, Berlin Museum)". However, neither the female described in 1892 by Aurivillius, nor the male figured by Hering in 1937 were mentioned in the original description and thus they cannot be considered types.

Additional material examined. **Angola.** 1 male, Quicolungo, 120 km N. of Lucala, 800 m, iv.1936, Braun, R. leg., unique QR code: NHMUK 014201447, gen. slide No.: NHMUK 010317727 (NHMUK). **Burkina Faso.** 8 males, Boromo, Forêt de Sorobouli, 247m, 11°46'53"N, 2°54'S, 4–5.vii.2013, Ph. Moretto leg. (RCPB). **Cameroon.** 3 males, Campo Ma'an National Park (Lowland rainforest), 950 m, 2°16'56.4"N, 9°57'03.5"E, 10–22.iii.2018, Fotsing, E., Ishmael, K., Miles, W., Sáfián, Sz. leg., ANHRT:2018.3, gen. slide Nos.: TT 175, TT 176 (ANHRT); 3 males, Edea-Douala, 29.vii.1992–24.ii.1993, Bouyer, Th. leg.; 1 male, Eloumden, 28–29.x.1992, Bouyer, Th. leg.; 1 male, Ebodje Akok, 23–24.xii.1992, Bouyer, Th. leg.; 1 female, Nkolbisson, vi.1965, de Miré, B. leg.; 1 male, Mount Cameroon, Bonenza, 180 m, 9°5.3'E, 4°2.6'N, 14.i.1989, gen. slide No.: TT 208 (RMCA); 1 male, Nguila, 10.iv.1977, Ph. Darge leg.; 1 male, Mt Nkolbiyong, 1156m, 3°50'N, 11°21'E, xi.1974, Ph. Darge; 1 male, Meyo Region, 2018, G. Faravel leg.; 1 male, Mbalmayo Region, i.2012, J. Nicat leg.; 1 female, Mbalmayo Region, iii.2012, J. Nicat leg.; 1 female, Mbalmayo Region, vii.2012, J. Nicat leg.; 1 male, Ebogo, vi.2011, J. Nicat leg. (RCBP). **Central African Republic.** 2 males, Sebokele Forest, 3.xi.1980, P. Basquin leg.; 1 male, Sebokele Forest, 15.ii.1980, P. Basquin leg., gen. slide No.: TT 222; 1 male, Sebokele Forest, 24.v.1979, P. Basquin leg.; 1 male, Sebokele Forest, 26.v.1979, P. Basquin leg.; 1 male, Loko, 17.vi.1977, P. Basquin leg., coll. Ph. Mathias; 1 male, Lobaye-Loko, 8.vii.1982, P. Basquin leg.; 1 male, Lobaye-Loko, 5.ii.1978, P. Basquin leg., gen. slide No.: TT 220; 1 male, Lobaye-Loko, 7.ii.1978, P. Basquin leg.; 1 male, Lobaye-Loko, 30.xii.1978, P. Basquin leg.; 1 male, Lobaye-Molangué, 3.vi.1979, P. Basquin leg., gen. slide No.: TT 219; 1 male, Bozo Savane, 12.vi.1981, P. Basquin leg., gen. slide No.: TT 221 (RCPB). **Cote d'Ivoire.** 1 male, Taï National Park, Taï Research Station, 174 m, 5°50'00"N, 7°20'32"W, 25.iii–17.iv.2017, Aristophanous, A., Aristophanous, M., Geiser, M., Moretto, P. leg., ANHRT:2017.25, BOLD process id.: ANLMN8499-21; 1 male, Kakpin Village, Comoe, Open Forest, 259 m, 8°36'59.8"N, 3°46'37.7"W, 27.vi.–02.viii.2015, Aristophanous, M., Moretto, P., Ruzzier, E. leg., ANHRT:2017.14; 1 male, Gbando Village (Sudanian forest

with Gallery forest), 417 m, 9°34'17.1"N, 6°41'1.1"W, 15–22.vi.2018, Aristophanous, M., Miles, W., Moretto, P., Ouattara, Y. leg., ANHRT:2018.28; 1 male, Comoe, Zamou, 279 m, 8°35'32.5"N, 3°46'7.0"W, Moretto, P., leg., ANHRT:2018.29, BOLD process id.: ANLMN8498-21, gen. slide No.: TT 133; 1 female, Touba, Biémasso, 441 m, 8°04'19.9"N, 7°33'5.6"W, 9.vii.2014, Moretto, P. leg., ANHRT:2018.29, BOLD process id.: ANLMN8500-21; 2 males, Parc National d'Azagny, entrée Sonaye (Secondary forest), 60 m, 5°14'32"N, 4°48'5"W, 25–28.xi.2021, Moretto, P., Mulvaney, L., Takano, H. leg., ANHRT:2021.8; 3 males, Parc national du Mont Sângbé (Forest/savannah mosaic), 422 m, 8°07'05"N, 7°19'09"W, 14–20.xi.2021, Moretto, P., Mulvaney, L., Takano, H. leg., ANHRT:2021.8; 3 males, Station d'Ecologie de Lamto (Riverine Forest), 95 m, 6°13'2"N, 5°1'32"W, 21–25.xi.2021, Moretto, P., Mulvaney, L., Takano, H. leg., ANHRT:2021.8 (ANHRT); 2 males, Abidjan, vii.1966, Allard, V., leg. (RMCA); 1 male, Forêt du Banco, x.1963, Piart, J., Griveaud, P. leg.; 1 male, Azaguié, ix.1964, Griveaud, P. leg. (MNHN); 1 male, Comoe, Zamou, 278m, 08°33'32"N, 3°46'07"W, 3.xi.2016, P. Moretto leg. (RCPB). **DR Congo.** 1 male, Tshopo-Lindi, Watershed, N.E. Stanleyville [Kisangani], 1600 ft, iv.1921, Barns, T.A. leg., unique QR code: NHMUK 014201445, gen. slide No.: NHMUK 010317724; 1 male, Upper Lowa Valley, North side, ix.1921, Barns, T.A. leg., unique QR code: NHMUK 0142101446, gen. slide No. NHMUK 010317726 (NHMUK); 1 male, 17 km N Kisangani, Masako Field Station, 388 m, 0°36'N, 25°15'E, 2–8.ii.2008, Gurkovich, Zolotuhin leg., BOLD process id.: LBEO2049-11 (ZSM); 1 female, Bas-Congo, Luki-Mayumbe Nature Reserve, 320 m, 5°27'S, 13°05'E, 12.iv.2006, De Prins, J. leg., gen. slide No.: CHRY-11-79 (Kurshakov pr.), BOLD process id.: LIMBC837-11; 1 female, same site, 29.xi.2008, De Prins, J., De Prins, W. leg., BOLD process id.: LIMBC836-11; 29 males, Uele, Paulis, 1.x.1955–30.xi.1959, Fontaine, M. leg., gen. slide Nos.: CHRY-11-74, CHRY-11-73 (Kurshakov, pr.); 3 males, Equateur, Bokuma, 16.ii.1952, Lootens, P. leg., gen. slide No. TT 203; 2 males, same site, ii.1936–11.ii.1952, Hulstaert, G. leg., gen. slide No.: CHRY-11-85 (Kurshakov, pr.); 1 female, Equateur, Flandria, vi.1934, Hulstaert, G. leg., gen. slide No.: TT 204; 1 male, Stanleyville, 19.ix.1955, Fontaine, M.; 1 male, same site, vi.1926, Colin, J. leg., gen. slide No. TT 202; 1 male, Kisangani, 19.iii.1971, Taverniers, J. leg.; 1 male, same site, v.1972, Allard, V. leg.; 1 male, Eala, viii.1936, Ghesquière, J., gen. slide No.: CHRY-11-81 (Kurshakov pr.); 3 males, 1 female Sankuru, Katakombes, 19.iii.1952–7.v.1953, Fontaine, M. leg., gen. slide Nos.: CHRY-11-82, CHRY-11-83 (Kurshakov pr.); 1 male, Sankuru, Komi, vi.1929, Ghesquière, J. leg.; 4 males, Luluabourg, 2.xi.1951–10.v.1953, Fontaine, M. leg.; 1 male, same site, 22.viii.1955, Seydel, Ch. leg., gen. slide No. CHRY-11-86 (Kurshakov, pr.); 1 male, Ubangi, Yakoma, 28.x.1951, Van Riel, F. leg.; 1 male, Luena, 1.xii.1984, Bouyer, Th. leg., gen. slide No.: CHRY-11-75 (Kurshakov pr.); 1 male, Bambesa, 27.iv.1937, Vrydagh, J. leg.; 2 males, Punia, Lufutu, 1937, Wauters leg.; 1 male, Bamaniana, 4.viii.1964, Hulstaert, G. leg.; 1 male, Bamange, ii.1959; 1 male, Ubangi, Gemena, 22.xii.1935, Henrard leg.; 1 male, 1 female, Uele-Itimbiri, La Kulu, 1931, Branden, J. Van den leg.; 1 male, Bokela, 12.xii.1938, Hulstaert, G. leg.; 1 female, Tshuapa, Bamanya, 30.iii.1973, Hulstaert, G. leg.; 1 male, Sankuru, Lunzele, 12.ix.1950, Hostie, P. leg. (RMCA). **Gabon.** 1 male, Mikongo (Rougier), Monts de Cristal, 430 m, 0°29'47"N, 11°10'42"E, 28.vii–12.viii.2019, Albert, J.-L., Aristophanous, M., Bie Mba, J., Dérozier, V., Moretto, P. leg., ANHRT:2019.17, gen. slide No.: TT 131 (ANHRT); 1 male, Ntoun, x.1985, Pauly, A. leg. (RMCA); 1 male, Ipassa, 31.iii.1977, Pierre, J. leg.; 1 male, Ipassa, 11.vi.1973, Bernardi, G. leg.; 1 male, Belinga, Camp Central, 700m, 12.iv.1963, Bernardi, G. leg. (MNHN); 1 male, Libreville, 8.iv.1977; 1 male, Tchimbale, iii.2014, Ph. Oremans; 1 male, Monts de Cristal, 700m, 20.vi.1991, P. Basquin leg.; 1 male, Kango-Ekouk, 100m, 19.x.1991, P. Basquin leg.; 1 male, Monts de Cristal, Kinguele-Barrage, 400m, 6.iv.2019, P. Basquin leg.; 1 male, Mitzi-Oveng, 1.iv.1991, P. Basquin leg.; 1 male, Mvoum, 1.vi.1989, P. Basquin leg.; 1 male, Cap Esterias, 16.x.1990, P. Basquin leg.; Leconi, 400m, 30.v.1992, P. Basquin leg. (RCPB). **Guinea.** 1 male, Massadou campsite, Forêt Classée de Ziam, 541 m, 8°20'36.25"N, 9°26'14.70"W, 8–13.iii.2019, Sáfián, Sz., Simonics, G., Florczyk, K., Koivogui, S. leg., ANHRT:2019.10; 1 male, 1 female, Nimba Mountains, Société des Mines de Fer de Guinée concession area, 700 m, 7°42'2.83"N, 8°23'58.60"W, 16–25.viii.2017, Sáfián, Sz. leg., ANHRT:2017.36; 1 male Guinée Forestière, Bossou Forest and Institut de Recherche Environnementale de Bossou (lowland forest-farmland), 690 m, 7°38'32"N, 8°30'30"W, 24–31.vi.2019, Dérozier, V., Suah Dore, J., Koivogui, S., Miles, W., Sáfián, Sz., Warner, R. leg., ANHRT:2019.11 (ANHRT); 1 male, Tondon, viii–ix.1956, Labour, L. leg.; 4 males, Nimba, vii–xii.1951, Lamotte, M., Roy, R. leg.; 1 male, Sérédou, 17.iii.1958, Pujol, R. leg.; 1 female, Sérédou, 18.ii.1958, Pujol, R. leg.; 1 female, Sérédou, 28.ii.1958, Pujol, R. leg. (MNHN). **Ghana.** 1 male, Eastern Region, Bunso Arboretum, 10–18.ix.2010, Dall'Asta, U., Dall'Asta, A. & Sáfián, Sz. leg., BOLD process id.: LIMBC835-11; 2 males, Bia Conservation Area, Bongo

Camp, 15–16.i.2009, Dall'Asta, U. leg., BOLD process ids.: LIMBC833-11, LIMBC834-11; 1 male, Ashanti, Bobiri, 4 km NE Kubease, 230 m, 6°41'N, 1°20'W, 25.v.2011, De Prins, W., De Prins, J. leg., gen. slide No.: TT 197; 1 male, Bunso, 22–30.x.2009, Sáfián, Sz. leg., gen. slide No.: CHRY-11-77 (Kurshakov pr.), BOLD process id.: LIMBC832-11 (RMCA); 1 male, Volta, 802 m, 6°50'20.3"N, 0°25'49.9"E, 10.iii.2006, Ochse, M. leg., BOLD process id.: GWOSS371-11 (ZSM). **Kenya**. 1 male, Western Province, Kakamega Forest National Reserve, primary forest, 1500 m, 11.iii.2002, 0°12'48.2"N, 34°30'50.0"E, Kühne, L. leg., BOLD process id.: LIMBC826-11 (ZSM). **Liberia**. 7 males, Welezu camp, Wonegizi Nature Reserve, Lofa County, 551 m, 8°4'57.11"N, 9°34'47.86"W, 19–27.iii.2019, Sáfián, Sz., Koivogui, S. leg., ANHRT:2019.7; 1 male, Nimba County, Yekepa residential area, 510 m, 7°34'26.78"N, 8°32'31.88"W, 10–31.iii.2017, Sáfián, Sz., Simonics, G. leg., ANHRT:2017.36, gen. slide No. TT 135, BOLD process id.: ANLMN8485-21; 1 male, 1 female, Nimba Mountains, Mount Gangra Western slope, 700 m, 7°33'29.73"N, 8°38'16.4"W, 16–17.iii.2017, Sáfián, Sz., Simonics, G. leg., ANHRT:2017.36, gen. slide No.: LG 5794 (ANHRT); 1 male, Yekepa, 7.iv.2013, ex coll. Collet, Ph. (MNH). **Nigeria**. 1 male, near Bonny, 11.iv.1902, Gordon, C.J.M., gen. slide No. TT 195 (OUMNH); 1 male, Okomu Forest, 5.iv.1991, Knoop, A.A., gen. slide No. CHRY-11-76 (Kurshakov pr.). **Republic of the Congo**. 1 male, Brazzaville, Niari, v.1981, Allard, V. leg. (RMCA). **Sierra Leone**. 4 males, Kono Province, Gori Hills, near Giehum, 375 m, 8°27'47.2"N, 10°46'17.0"W, 22–29.ii.2020, Sinyaev, V. Kalnoi, G. leg., ANHRT:2022.14, BOLD process ids.: ANLMN8486-21, 8488-21, 8487-21, 8489-21; 1 male, Kalainkay, near Kamabai, Northern Province, 80 m, 9°10'52"N, 11°56'44"W, Smith, R., Takano, H. leg., ANHRT:2018.18, BOLD process id.: ANLMN8490-21, gen. slide No.: TT 134 (ANHRT); 3 males, Kenema, ix–x.1974, Allaer, A. leg., gen. slide No.: CHRY-11-78 (P. Kurshakov pr.); 2 males, Sierra Leone (RMCA). **Togo**. 1 male, Akawolo, ix.2014, local collector, ANHRT:2020.5, BOLD process id.: ANLMN8484-21 (ANHRT). **Uganda**. 1 male, western Kibale Forest, Chimps' Nest, 1187 m, 0°23'47"N, 30°23'03"E, 19–21.iii.2013, Fiebig, R., Fiebig, S., Stadie, D. leg., gen. slide No. 31.061 (MWW); 1 male, Entebbe, 10.iii.1969, gen. slide No. TT 196 (OUMNH); 1 male, Bwindi North, Kanungu, ix.2005, J.P. Lequeux leg.; 1 male, Semliki, Bundibugyo, x.2005, J.P. Lequeux leg.; Rakai, Katera Forest, vii.2012, J.P. Lequeux leg.; 1 male, Mayuge, South Busoga, viii.2012, J.P. Lequeux leg.; 1 male, Mukono, Kerenge Island, ix.2011, J.P. Lequeux leg.; 1 male, Sesse, Bugalla Island, x–xi.2012, J.P. Lequeux leg. (RCBP).

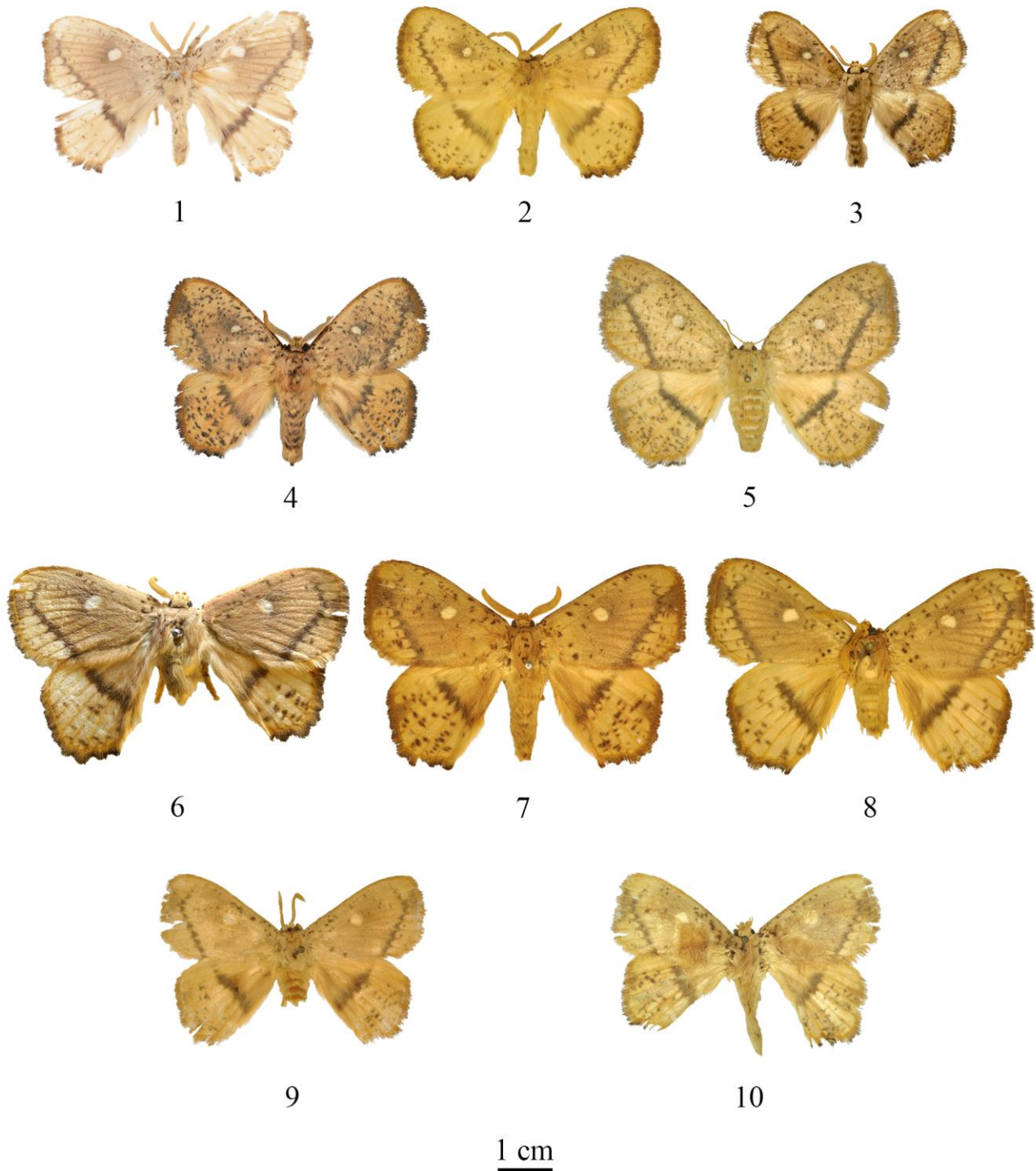
There are two dissection-confirmed male specimens of *A. theorini* in NHMUK from “South Africa” which are clearly *patria falsa*. Both specimens have the accession number B.M.1926-239 which refers to a large collection of Lepidoptera purchased from the natural history dealer Frederick Henry Rosenberg containing part of Colonel Charles Swinhoe's collection. The handwriting on the labels matches that of Swinhoe, who was renowned for his work on the Asian lepidoptera fauna, and it is likely that the mislabelling event took place before the collection ended up in the hands of Rosenberg and NHMUK.

Description

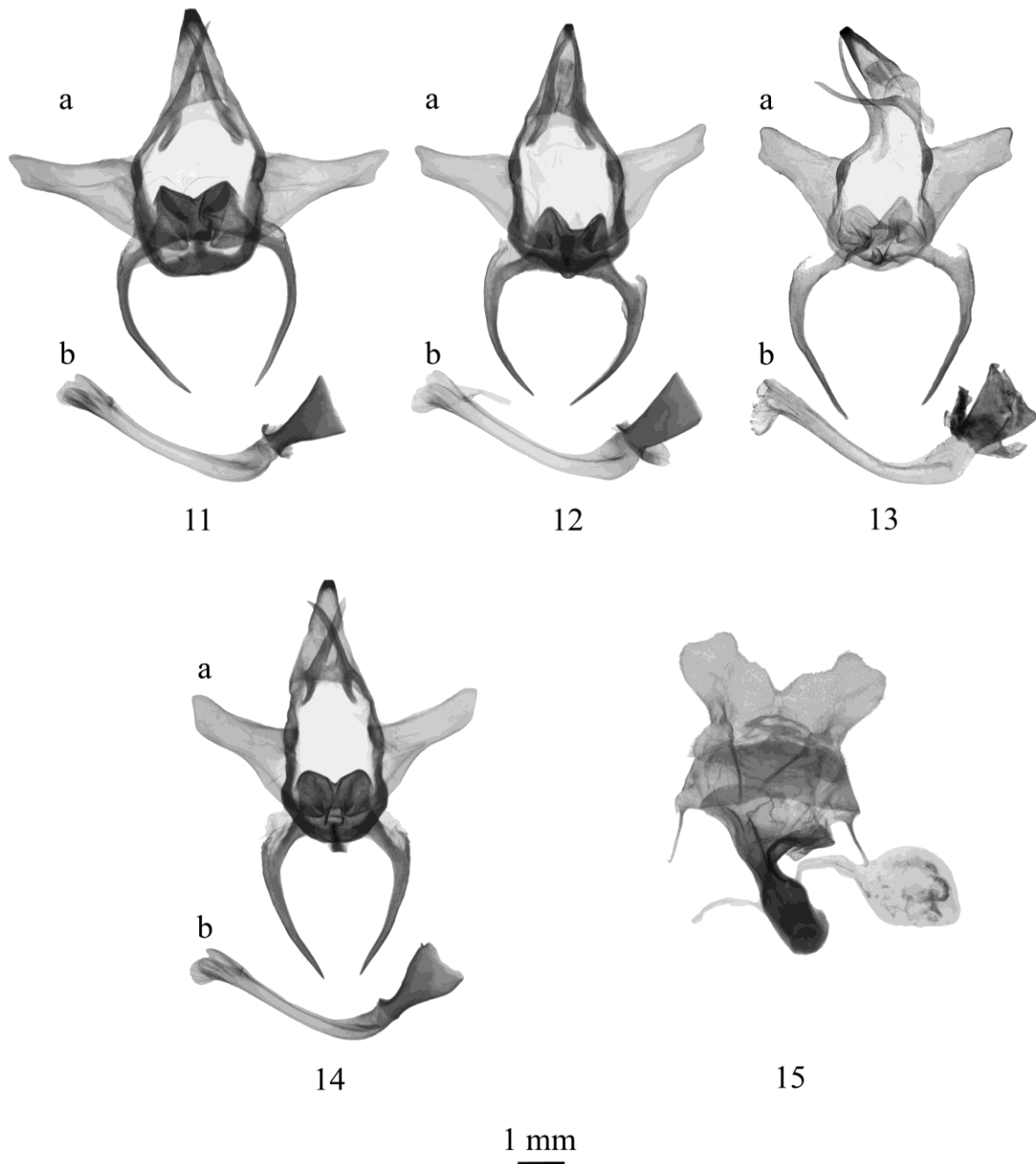
Male. Forewing length 18–22.5 mm. Head, collar, tegula, and thorax beige to tawny brown. Antenna bipectinate; antennae and palps ochreous yellow. Legs beige laterally with sparse dark scale spots, ochreous yellow medially. Abdomen uniformly cream to ochreous beige, sometimes with a few, irregular dark scales. Forewing. Broad, rounded; ground colour beige to tawny-brown, although slightly paler from post-medial line to outer margin; wing speckled sparsely with dark scales that are mostly concentrated along costal margin and near thorax. Post-medial line grey, with scaling extending on the veins distally; post-medial line kinked at vein M1 near outer margin. Postmedial area with a diffuse grey-brown triangular patch between veins R3 and M1; discal spot light beige, rounded, with diffuse margin. Fringe long, slightly darker than ground colour, cilia sometimes black in distal half. Hindwing. Rounded, with undulate margin at tornus. Ground-colour same as forewing or slightly paler beige; medial line dark grey-brown, wider than that of forewing. Sparse dark scales concentrated in the distal half. Outer margin with a small, diffuse, pale grey-brown triangular patch between veins M1 and M2. Fringe long, slightly darker than ground colour, cilia black in distal half. Underside of wing uniformly pale beige with some irregular clusters of grey scales concentrated mostly along the costal margin of fore- and hindwing. Forewing discal spot traceable. Outer margin with diffuse pale grey-brown triangular patch between veins R3 and M1 on forewing and between veins M1 and M2 on hindwing. Fringe darker than ground colour; cilia sometimes black in distal half.

Female. Forewing length 26–28 mm. Body and wing colour as in male, varying from beige to tawny brown, but with more numerous dark brown or black scales speckled on fore- and hindwing. Antennae filiform. Forewing. Broad, rounded, slightly more angular at apex than in males. Hindwing. Rounded, with

undulate margin at tornus; colour and fringe as in male. Underside of wing paler than upperside, both fore- and hindwing uniformly pale beige with numerous grey scales speckled on both wing sets.

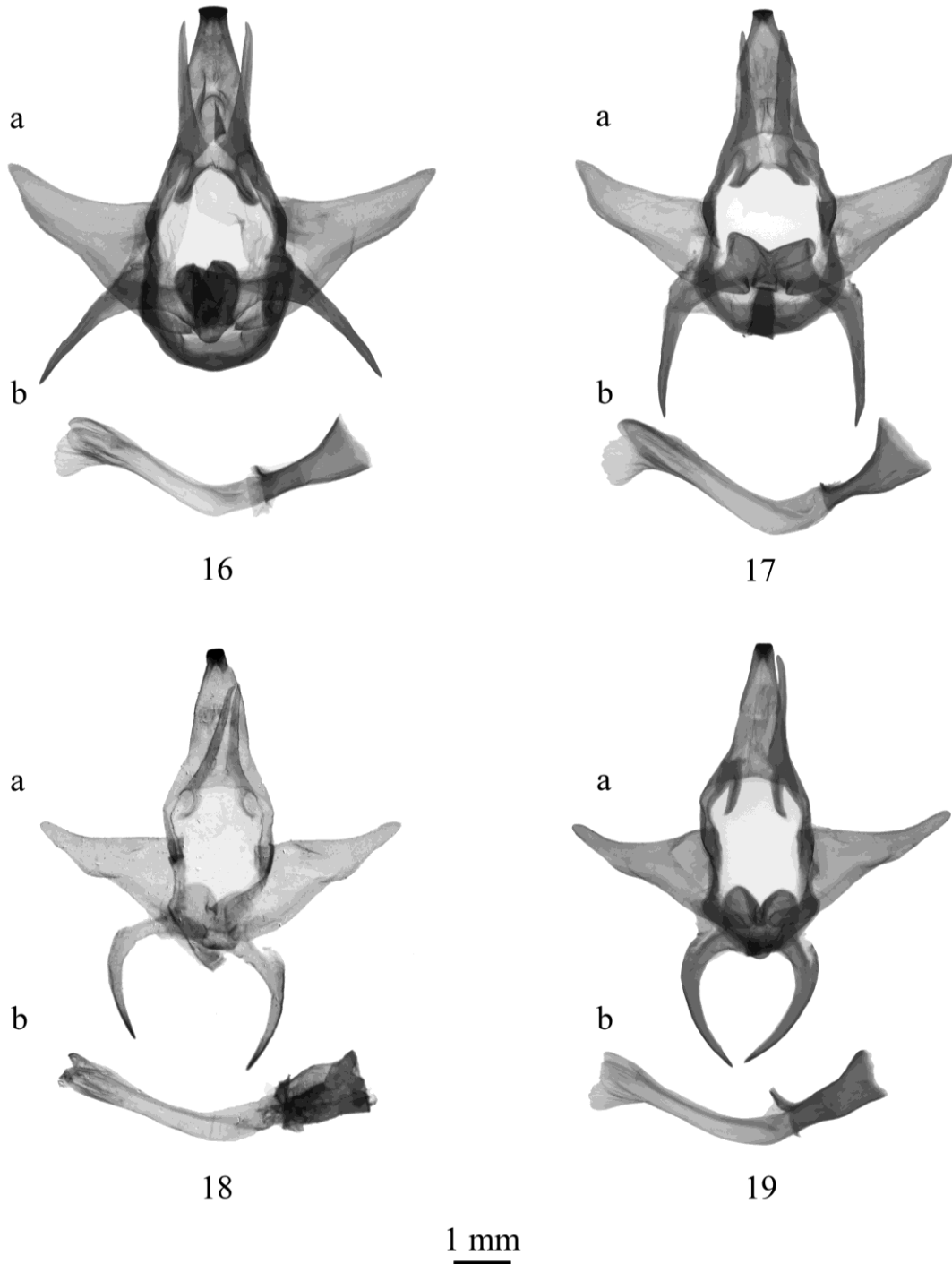


Figures 1–10. Adults. Figs. 1–5: *Achrocerides theorini*. 1: ST, Male, Gaboon [Gabon] (SMNH); 2. Male, Angola, Quicolungo (gen. slide No. NHMUK 010317727) (NHMUK); 3. Male, Sierra Leone, Kono Province (ANHRT); 4. Male, Uganda, Kibale Forest (gen. slide No. 31.061) (MWW); 5. Female, Liberia, Nimba Mountains (gen. slide No. LG 5794) (ANHRT). Figs. 6–8: *Achrocerides flavoantennata* **comb. n.**, 6: HT, male, DRC, (GU 2010-02) (MCG); 7. Male, DRC, Kabunga (gen. slide No. TT 132) (ANHRT); 8. Male, DRC, Maniema (gen. slide No. CHRY-11-80) (RMCA). Figs. 9–10: *Achrocerides smithi* **sp. n.**, 9: HT, male, Central African Republic, La Maboke (gen. slide No. CHRY-11-84) (RMCA); 10: Male, Central African Republic, La Maboke (gen. slide No. TT 201) (RMCA).



Figures 11-15. Genitalia (a: clasper apparatus, b: phallus). *Achrocerides theorini*. 11: Male, Gabon, Mikongo (Rougier) (gen. slide No. TT 131) (ANHRT); 12: Male, DRC, Tshopo-Lindi (gen. slide No. NHMUK 010317724) (NHMUK); 13: Male, DRC, Bokuma (gen. slide No. CHRY-11-85) (RMCA); 14: Male, Liberia, Nimba County (gen. slide No. TT 135) (ANHRT); 15: Female, Liberia, Nimba Mountains (gen. slide No. LG 5794) (ANHRT).

Male genitalia. Uncus elongate, triangular with truncate apex, heavily sclerotised apically. Tegumen narrow. Transtilla comprised of two long slender, apically pointed posterior processes, and two very narrow, short, apically rounded anterior processes connected medially by a thin membrane. Juxta with large, bilobate base, with small, strongly sclerotised, rectangular process antero-medially, and with two very long, thin, tapering, distally pointed lobes accompanying phallus laterally. Vinculum broad, rounded. Valve variable in length; wide at base, constricted medially, truncate distally with rounded, slightly protruding costal edge. Phallus curved in proximal third, thin, long, proximally surrounded with heavily sclerotised manica fused ventrally to caudal lobes of juxta, weakly sclerotised distally with apical split. Vesica extremely short, membranous.



Figures 16-19. Genitalia (a: clasper apparatus, b: phallus). Figs. 16-17: *Achrocerides flavoantennata* **comb. n.**, 16: Male, DRC, Kabunga (gen. slide No. TT 132) (ANHRT); 17: Male, DRC, Moutombe [=Mondombe] (gen. slide No. TT 198) (RMCA). Figs. 18-19: *Achrocerides smithi* **sp. n.**, 18. HT, Male, Central African Republic, La Maboke (gen. slide No. CHRY-11-84) (RMCA); 19: Male, Central African Republic, La Maboke (gen. slide No. TT 201) (RMCA).

Female genitalia. Papilla analis broad, lobed, medially deeply notched, very finely setose. Apophysis posterioris long, narrow, rounded apically. Eighth tergite broad, short, posterior margin evenly convex, anterior margin slightly concave, moderately sclerotised; apophysis anterioris as long as posterior one, narrow, apically hooked. Ostium small, semi-circular, with longitudinally striate, trapezoidal ante-vaginal plate bearing two rounded posterior protrusions. Antrum extremely broad distally, very short, funnel-like, strongly sclerotised; ductus bursae very short, heavily sclerotised; cervix bursae oblong, very heavily

sclerotised, corpus bursae membranous, posterior half narrow, tubular; anterior part ovoid. Signum bursae absent.

Taxonomic note. Dissection of numerous *A. theorini* specimens collected from West, Central, and East Africa revealed the existent of a single widespread taxon. Slight variation was noted in the male genitalia in terms of the length and shape of the distal edge of the valve, although no geographical trends were identified. For example, the majority of specimens from West Africa possess a short valve, almost rectangular in shape, although this was also seen in some specimens from central DRC (e.g. CHRY-11-83 and CHRY-11-85). Furthermore, *A. theorini* specimens vary widely in external morphology in terms of size and wing colouration with no obvious geographic clustering or congruence in the genitalia. Without clear geographic circumscription and in the absence of consistent differences in external and genital morphology, *A. theorini* is treated as a widespread species that exhibits high levels of intraspecific variation.

Diagnosis. The distinctive characters between *A. theorini*, *A. flavoantennata* **comb. n.**, and *A. smithi* **sp. n.** are discussed under the diagnoses of the latter two species.

Distribution (Fig. 20). This species was previously known from Cameroon, DRC, Gabon, Ghana, Nigeria and Uganda. Through this research, it is now also known from Angola, Cote d'Ivoire, Guinea, Kenya, Liberia, Republic of the Congo, Sierra Leone and Togo. Based on the locality data of the examined specimens, *A. theorini* is a forest-dwelling species that occurs throughout the Guinean-Congolian rainforests and towards the montane forests of East Africa.

Achrocerides flavoantennata (Berio, 1937) **comb. n.** (Figs. 6–8, 16–17)

Chrysopoloma flavoantennata Berio, 1937, *Annali del Museo civico di storia naturale Giacomo Doria*, 59: 383. Type locality: DRC, between Coquilhatville [Mbandaka] and Stanleyville [Kisangani].

Type material examined. Holotype (photograph examined): Male, “HOLOTYPUS ♂ / *Chrysopoloma flavoantennata* / E. Berio, 1937” // “Museo Civico / di Genova” // handwritten “*Chrysopoloma flavoantennata* / Berio” / “DET. BERIO” // “TYPUS” // “Nel tratto del Congo / da Coquilhatville / a Stanleyville / ott: 1930” // Gen. slide No.: MCSN-Genova, Zolotuhin pr. GU 2010-02 (image examined) (MCG).

Additional material examined: DRC. 1 male, Upper Lowa Valley, near Masisi, W. Kivu, 5000–6000 ft, forest & long grass, ii.1924, Barns, T.A., unique QR code: NHMUK 014201444, gen. slide No.: NHMUK 010317725 (NHMUK); 1 male, Kabunga, Masisi Territory, Nord-Kivu, 600–700 m, 13.ix.1945, gen. slide No.: TT 132 (ANHRT); 1 male, Maniema, Territory Kindu, viii.1959, Hecq, J. leg., gen. slide No.: CHRY-11-80 (Kurshakov pr.); 1 male, Equateur, Moutombe [=Mondombe], 25.ii.1930, Oostermans, F. leg., gen. slide No.: TT 198; 2 males, Equateur, Flandria, 11.ii.1930–viii.1931, Hulstaert, G. leg., gen. slide Nos.: TT 199, TT 200 (RMCA).

The male genitalia are described here for the first time.

Description

Male. Forewing length: 26.5–27.5 mm. Head, collar, tegula, and thorax tawny brown. Antenna bipectinate; antennae and palps ochreous yellow. Legs beige laterally with sparse dark scale spots, ochreous yellow medially. Abdomen uniformly brown-beige, sometimes with a few, irregular black scale spots. Forewing. Broad, rounded; ground colour greyish-beige to tawny-brown, speckled sparsely with dark scales that are mostly concentrated along costal margin and near thorax; wing colour slightly paler from post-medial line to distal edge. Post-medial line grey-brown, with scaling extending on the veins distally; post-medial line kinked at vein m1 near outer margin; wing colour slightly paler from post medial line to distal edge. Postmedial area with a diffuse grey-brown triangular patch between veins R3 and M1; discal spot light beige, rounded, with diffuse margin. Fringe long, slightly darker than ground colour, cilia sometimes black in distal half. Hindwing. Rounded, with undulate margin at the tornus. Ground-colour same as forewing or slightly paler; medial line dark grey-brown, wider than that of forewing. Sparse dark scales concentrated in the distal half. Outer margin with a diffuse, pale grey-brown triangular patch between veins M1 and M2. Fringe long, slightly darker than ground colour, cilia black in distal half. Underside of wing uniformly pale beige with some irregular grey scales concentrated mostly along the costal margin of the fore- and hindwing. Underside of wing uniformly pale beige with some irregular clusters of grey scales concentrated mostly along the costal margin of fore- and hindwing. Forewing discal spot traceable. Outer margin with diffuse

pale grey-brown triangular patch between veins R3 and M1 on forewing and between veins M1 and M2 on hindwing. Fringe darker than ground colour; cilia sometimes black in distal half.

Female. Unknown.

Male genitalia. Uncus elongate, triangular, flat and strongly sclerotised apically. Tegumen narrow. Transtilla comprised of two long slender, apically pointed posterior processes, and two slightly narrower, short, triangular, apically rounded anterior processes strongly connected medially via a membrane. Juxta with large, bilobate base, with small, strongly sclerotised, rectangular process antero-medially, and with two moderately long, narrow, triangular, distally pointed lobes accompanying phallus laterally. Vinculum broad, rounded. Valve wide at base, triangular, with rounded point distally on dorso-apical edge. Phallus medially curved, relatively thin, long, proximally surrounded with heavily sclerotised manica fused ventrally to caudal lobes of juxta, weakly sclerotised distally with apical split. Vesica extremely short, membranous.

Taxonomic note. In the original description of *C. flavoantennata*, Berio (1937) suggests that his species may be the male of *Strigivenifera albidiscalis* (Hampson, 1910) which was described based on a female holotype from DRC. However, on examination of external morphology of the *C. flavoantennata* holotype, it was confirmed that this species is congeneric with *A. theorini* due to the typical dark speckles across both fore- and hindwings as well as the lack of defined brown wing venation characteristic of *Strigivenifera*. Furthermore, the general male genital structure of the *C. flavoantennata* holotype showed marked similarities to that of *A. theorini*, such as the two elongate posterior processes of the transtilla and the long, thin, distally weakly sclerotised phallus (albeit with diagnostic differences which are discussed below), whilst lacking the typical generic features found in *Strigivenifera* taxa. This species is thus transferred to *Achrocerides*: *Achrocerides flavoantennata* (Berio, 1937) **comb. n.**

Diagnosis. This species is considerably larger in size than both *A. theorini* and *A. smithi* **sp. n.** and specimens are generally slightly darker and more greyish in colour. When comparing the male genitalia with *A. theorini*, the clasping apparatus is overall larger in size, the two anterior transtilla processes are shorter and slightly broader, and fused medially with a more heavily sclerotised membrane. In addition, the juxta processes of *A. flavoantennata* are noticeably wider and shorter, and the valva is much more triangular and less truncate, with a much longer and more pointed dorso-apical edge compared to the related species.

Distribution (Fig. 20). Found only in DRC, this species exists in sympatry with *A. theorini* although it appears to be much rarer. It is distributed within the rainforests of the Congo Basin extending its range to the mountainous Nord-Kivu region in the east. The holotype was collected by Lidio Cipriani, an anthropologist and zoologist who visited DRC in 1930. It has rather vague locality data, given as “In the stretch of the Congo between Coquilhatville [Mbandaka] and Stanleyville [Kisangani]”, but since Cipriani travelled via boat along the Congo River during his expedition (Cipriani 1932), the type locality of *A. flavoantennata* in Fig. 20 is given as approximately halfway along the river between the two cities.

Achrocerides smithi **sp. n.** (Figs. 9–10, 18–19)

<https://zoobank.org/urn:lsid:zoobank.org:act:65FA0A34-3C66-435B-8702-9203D95BF41B>

Holotype: Male, “LA MABOKE / REP. CENTRAFRIC. / V-1965 / Michel BOULARD” // “Coll.Mus.Tervuren” // “dét.G.Poncin / achrocerides / theorini auriv.” // “Chysopolomidae [sic] / P.Kurshakov pr. / CHRY-11-84” (RMCA).

Paratypes: **Central African Republic.** 4 males, La Maboke, 24.xi.1964–9.v.1966, Pujol, R. leg., gen. slide No.: TT 201 (RMCA).

Description

Male. Forewing length 22 mm. Head, collar, tegula, and thorax tawny brown. Antenna bipectinate; antennae and palps ochreous yellow. Legs beige laterally with sparse dark scale spots, ochreous yellow medially. Abdomen uniformly brown-beige, sometimes with a few, irregular dark scales. Forewing. Broad, rounded; ground colour beige to tawny-brown, although slightly paler from post-medial line to outer margin; wing speckled sparsely with dark scales that are mostly concentrated along costal margin and near thorax. Post-medial line grey-brown, with scaling extending on the veins distally; post-medial line kinked at vein M1 near outer margin. Postmedial area with a diffuse grey-brown triangular patch between veins R3 and M1; discal spot light beige, rounded, with diffuse margin. Fringe long, slightly darker than ground colour, cilia sometimes black in distal half. Hindwing. Rounded, with undulate margin at the tornus. Ground-colour same as forewing or slightly paler beige; medial line dark grey-brown, wider than that of forewing. Sparse dark

scales concentrated in distal half. Outer margin with a diffuse, pale grey-brown triangular patch between veins M1 and M2. Fringe long, slightly darker than ground colour, cilia black in distal half. Underside of wing uniformly pale beige with some irregular clusters of grey scales concentrated mostly along the costal margin of the fore- and hindwing. Forewing discal spot visible traceable. Outer margin with diffuse pale grey-brown triangular patch between veins R3 and M1 on forewing and between veins M1 and M2 on hindwing. Fringe darker than ground colour; cilia sometimes black in distal half.

Female. Unknown.

Male genitalia. Uncus elongate, triangular, strongly sclerotised apically. Tegumen narrow. Transtilla comprised of two long, narrow, apically pointed posterior processes, and two thin, short, apically pointed anterior processes. Juxta with bilobate base, with small, strongly sclerotised, rectangular process antero-medially, and with two moderately long, narrow, tapered, distally pointed lobes accompanying phallus laterally. Vinculum broad, rounded. Valve wide at base, triangular, narrowing distally with rounded point on dorso-apical edge. Phallus medially slightly curved, relatively thin, long, proximally surrounded with heavily sclerotised manica fused ventrally to caudal lobes of juxta, weakly sclerotised at the distal end with apical split. Vesica extremely short, membranous.

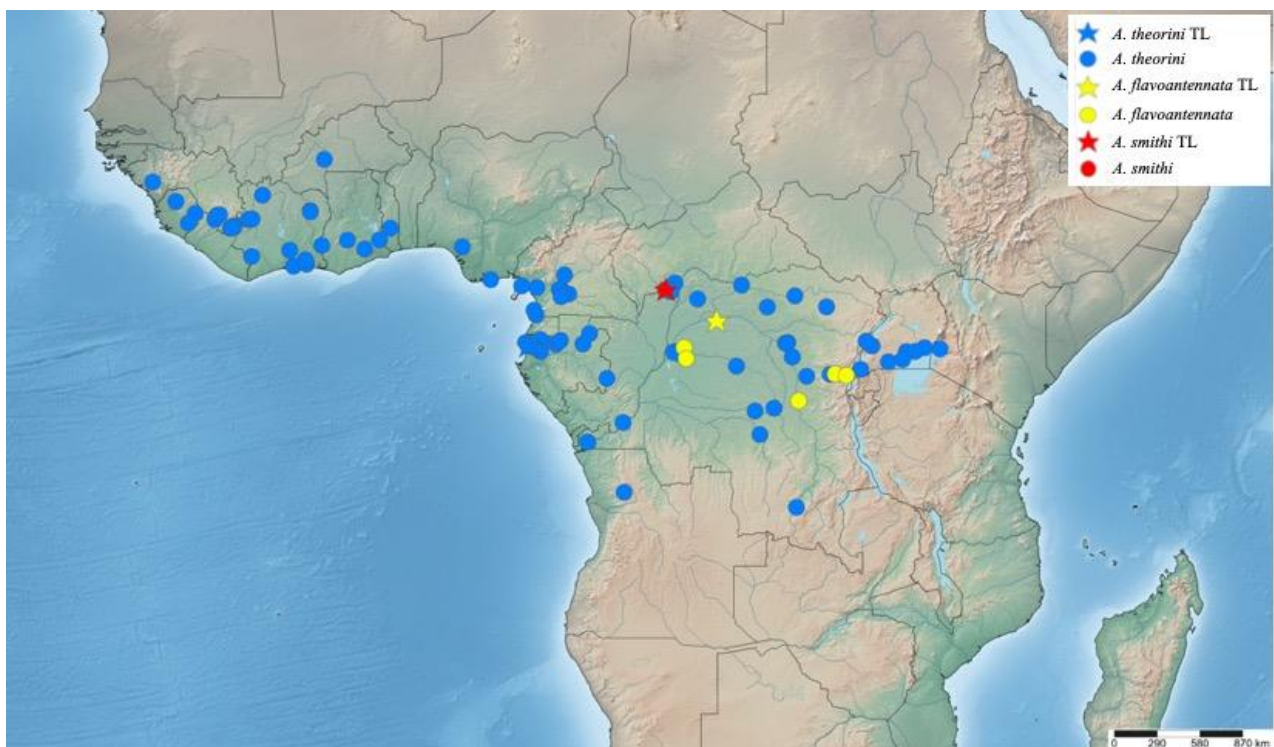


Figure 20. Distribution of *Achrocerides* species (TL = Type locality).

Diagnosis. Externally, the new species is similar in size to *A. theorini* whilst also displaying the typical slight variability in wing colouration and so the two cannot be readily distinguished. However, in the male genitalia, the diagnostic characters are clear. In *A. smithi*, the valva is triangular in shape whilst in *A. theorini* the valva is distally truncate, almost rectangular in some specimens. In addition, the lobes of the juxta are markedly shorter and slightly wider in the new species than in *A. theorini*, which has longer and narrower juxta processes. When comparing the new species with *A. flavoantennata*, the taxa can be readily distinguished externally by the much smaller size of the new species. In addition, the two species do not occur sympatrically and the Ubangi and Sangha Rivers may be acting as a barrier for dispersal of the new species. In the male genitalia, the new species is close to *A. flavoantennata* in terms of the juxta processes, which are broader and shorter in both species relative to those of *A. theorini*. The distal portion of the valve is also much more elongate in these two species compared to the truncate valve of *A. theorini*, although in *A. smithi* the costal edge is slightly narrower and more rounded distally compared to the more triangular, pointed valve of *A. flavoantennata*. Finally, the membrane connecting the anterior transtilla processes of the new species is less sclerotised compared to that of its closely allied species.

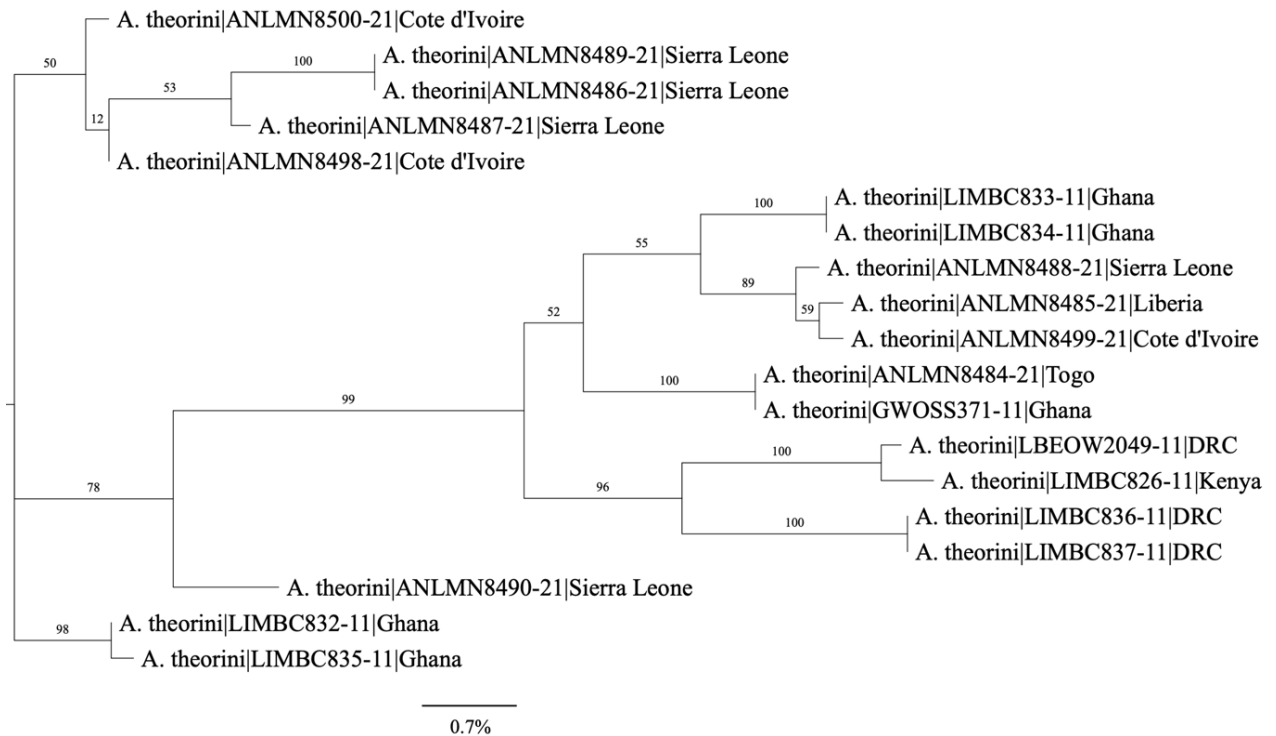


Figure 21. Unrooted phylogenetic tree (Maximum Likelihood model, generated by MEGA from complete sequences of 658 bp CO1-5P obtained in BOLD) of 19 *Achrocerides theorini* specimens.

Distribution (Fig. 20). *Achrocerides smithi* is likely confined to the south-east region of the Central African Republic with a similar distribution to another Chrysopolomid species, *Strigivenifera marina* Kurshakov & Zolotuhin, 2013. The Ubangi-Sangha interfluvial region is known to harbour many endemic species of insects (e.g. Hemp & Massa 2021) as well as birds (e.g. Marks 2010), and the new species is likely to be another unique species to this biodiverse region of Africa.

Etymology. This new species is dedicated to Richard Smith, founder and Chairman of the Board of Trustees of the African Natural History Research Trust, in recognition of his consistent support for the advance of research in the field of Lepidoptera and taxonomy.

Conclusion

This revision has provided an updated taxonomy of the Chrysopolomidae genus *Achrocerides*, resulting in the new combination of *A. flavoantennata* and the description of the new species *A. smithi*. Although intraspecific variation exists within members of *Achrocerides*, the diagnostic morphological characters between species provided here are consistent and can be used for accurate identification. Further DNA sequencing that incorporates all species of the genus would be beneficial in supporting these morphological conclusions. The majority of the other genera within Chrysopolomidae are poorly studied and in need of revision; the discovery of a new species within a hitherto monotypic genus such as *Achrocerides* suggests there are likely to be further new species that await description within this family.

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“La Specola” (Florence Museum of Natural History) for helping to locate the HT. We also thank Tobias Malm (SNHM) for providing a high-quality image of the *A. theorini* HT, which is made available under the Creative Commons License 4.0 (<https://creativecommons.org/licenses/by/4.0/>).

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