Ecologica Montenegrina
ISSN 2336-9744 (online) | ISSN 2337-0173 (print)

Ecologica Montenegrina 72: 117-127 (2024)
This journal is available online at: www.biotaxa.org/em
https://dx.doi.org/10.37828/em.2024.72.10

Article

https://zoobank.org/urn:lsid:zoobank.org:pub:1E9373DC-683C-4BE1-AEAF-F8711A96FC4F

Revisional notes on *Grammodora* Aurivillius, 1927 with the descriptions of two new species from Angola and Tanzania (Lepidoptera: Lasiocampidae: Lasiocampinae: Selenepherini)

HITOSHI TAKANO

African Natural History Research Trust, Street Court, Leominster, HR6 9QA, UK.
E-mail: hitoshi.takano@anhrt.org.uk; *https://orcid.org/0000-0002-2627-4881*

Received 27 March 2024 | Accepted by *V. Pešić*: 5 April 2024 | Published online 8 April 2024.

Abstract
Investigations into the lappet moth genus *Grammodora* Aurivillius, 1927, hitherto considered monotypic, have resulted in the description of two new species from Angola and Tanzania: *G. angolana* **sp. n.** and *G. smithi* **sp. n.** Despite variability in the COI-5P locus of mtDNA, stability in the habitus and genital morphology have enabled the accurate delimitations of the species, and biogeographic interpretations are presented based on locality data mined from numerous museum and private collections. It appears the former is an isolated western vicariant of *G. nigrolineata* (Aurivillius, 1895) whilst the latter, previously believed to be a pale form of *G. nigrolineata*, is allopatrically (or potentially parapatrically) distributed with it in Tanzania.

Key words Afrotropics, allopatry, parapatry, vicariance, Kalahari sands, Tanzanian Craton.

Introduction

One of Africa's most beautiful and recognisable moths, the Black Lined Eggar, *Grammodora nigrolineata* (Aurivillius, 1895) was described based on at least two female specimens from Mozambique and Tanzania in Otto Staudinger's collection. Aurivillius (1895) was uncertain of the generic placement of the species and stated that it probably deserved a genus of its own but without access to comparative material, he tentatively assigned it to the genus *Lenodora* Moore, 1883 due to similarities in habitus and wing shape with a caveat that the venation was slightly different from Hampson's (1892) redescription of the genus. In the Afrotropical Lasiocampidae section of Seitz's *Die Gross-Schmetterlinge der Erde*, Aurivillius (1927) eventually described a new genus for the species and *Grammodora* Aurivillius, 1927 has been considered monotypic ever since. Although the tribal classification has not been fully resolved for the Afrotropical taxa, *Grammodora* is currently placed in the tribe Selenepherini of the Lasiocampinae (Zolotuhin *et al.* 2012; Basquin 2023). This species is known to be widely distributed throughout southern and eastern Africa (e.g., Pinhey 1975) but upon closer scrutiny of specimens in institutional and private collections, two new species were discovered, the descriptions of which follow herein.

Material and methods

Preparation of genitalia followed Lafontaine & Mikkola (1987) and the dissected genitalia were mounted on microscope slides or stored in glycerol. Genitalia were photographed using a Canon EOS 700D camera mounted on a Leitz Diaplan compound microscope. Adults were photographed using a Canon EOS 80D with a Canon 100mm Macro lens. All images were edited in Adobe Photoshop. DNA barcodes were obtained by removing tarsal segments from adult specimens before being submitted to the Canadian Centre for DNA Barcoding (CCDB, Biodiversity Institute of Ontario, University of Guelph). Sequences were obtained using Single Molecule Real-Time sequencing through the Sequel II (PacBio) pipeline at CCDB (Hebert *et al*. 2018). The resulting sequences were aligned using MUSCLE in MEGA version X (Kumar *et al*. 2018) and genetic distances were calculated using Kimura's two-parameter model (Kimura 1980). Primary label data have been transcribed verbatim with "//" denoting a different label and "/" denoting a line break. Aside from the data extracted from examined specimens, photographic records from iNaturalist (www.inaturalist.org) have been included in the distribution map.

Abbreviations used in the text:

ANHRT	African Natural History Research Trust, Leominster, UK
BIN	Barcode Index Number
NHMUK	Natural History Museum, London, UK
MfN	Museum für Naturkunde, Berlin, Germany
OUMNH	Oxford University Museum of Natural History, Oxford, UK
PWD	Pairwise distance
RCPB	Research Collection of Patrick Basquin, Yvetot-Bocage, France
RMCA	Royal Museum for Central Africa, Tervuren, Belgium

Results

***Grammodora* Aurivillius, 1927**
Grammodora Aurivillius, 1927, *in* Seitz, A. (Ed.) *Die Gross-Schmetterlinge der Erde*, 14: 259.
Type species: *Lenodora nigrolineata* Aurivillius, 1895 (by original monotypy)

***Grammodora nigrolineata* (Aurivillius, 1895)**
(Figs 1–5, 14, 17, 20–21)

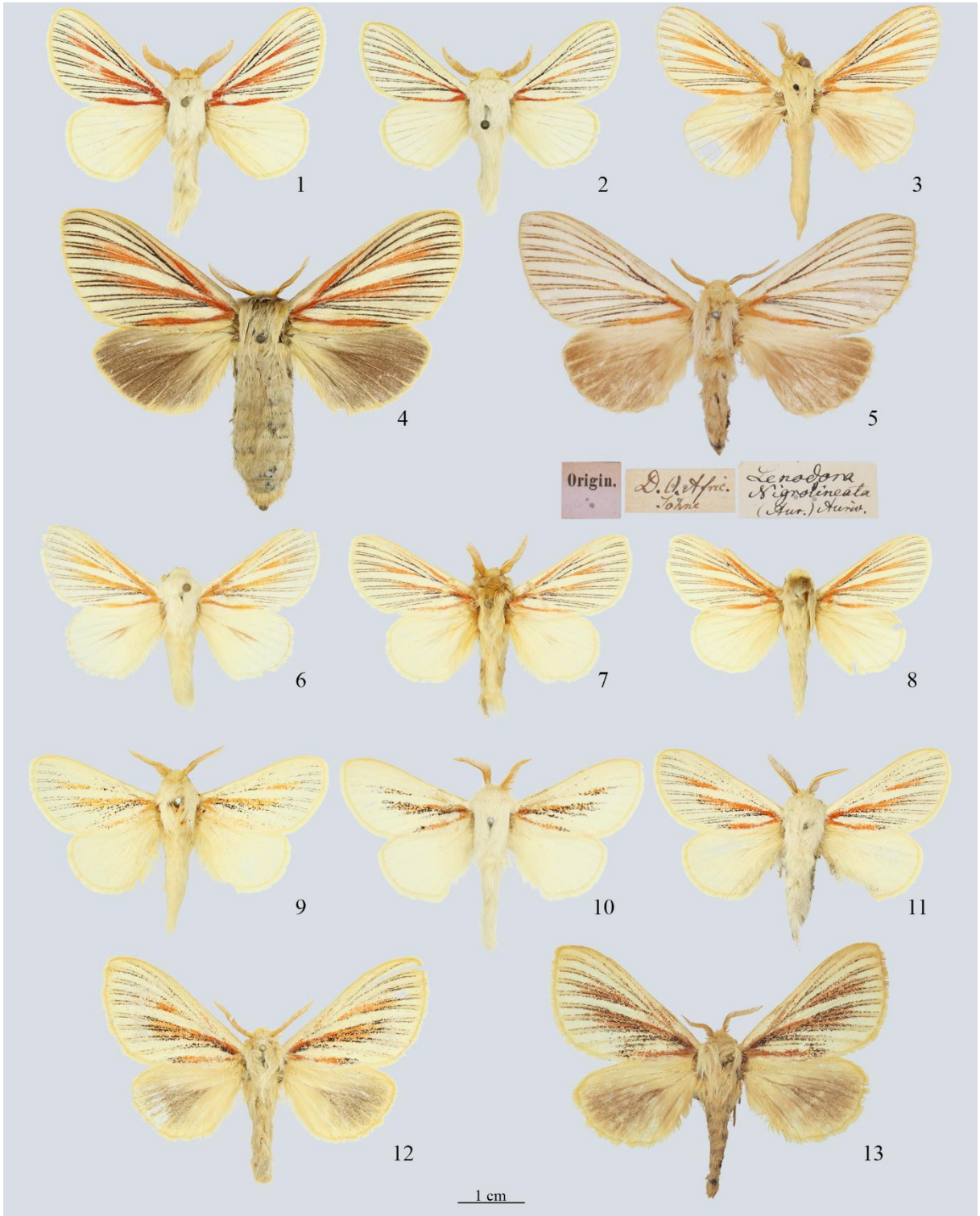
Type locality: "Delagoa Bay [Mozambique] und Deutsch Ost-Afrika [=Tanzania]"

Type material examined:
Syntype ♀ (MfN):
"Origin. [violet paper] // D.O. Afric. / Johne [handwritten] // Lenodora / Nigrolineata / (Aur.) Auriv. [handwritten]"
Note: there is a female specimen collected by Henri Junod at Delagoa Bay from the Staudinger collection in MfN but it is a much smaller moth than the wingspan measurements provided in the original description by Aurivillius (1895) and although it could be syntypic, there is some doubt over its status.

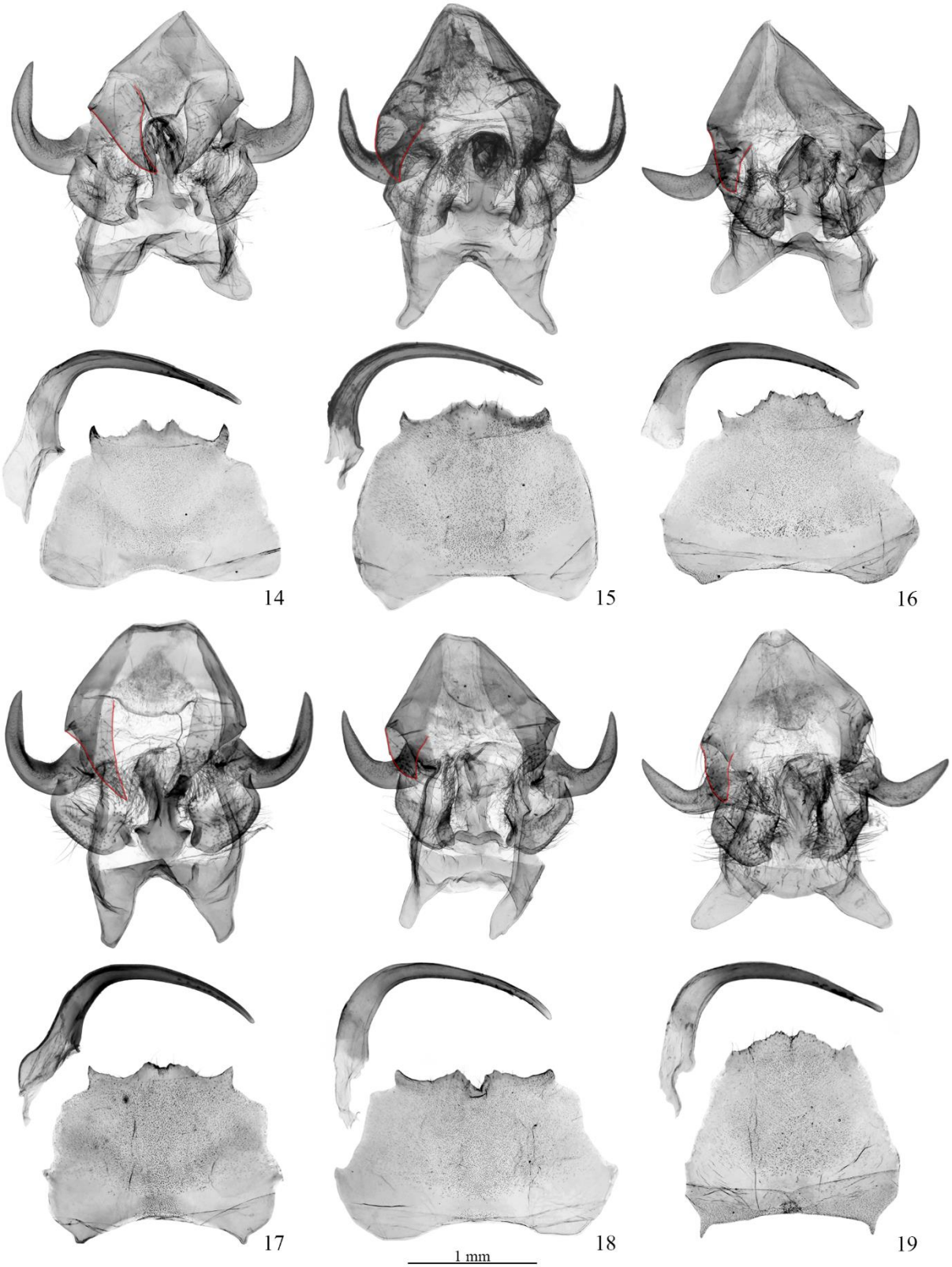
Other material examined (98♂♂ 41♀♀):
D.R. CONGO: Elisabethville [=Lubumbashi], iii.1926, leg. C. Seydel (1♂ NHMUK); Kafakumba, ii.1933, leg. F.G. Overlaet (1♂ RMCA); Kansenia, leg. W. Dedoncker (1♀ NHMUK); Kolwezi, x.1952, leg. V. Allard (1♂ RMCA); Lubumbashi, 22.iv.1979, leg. J. Thiry (1♂ RMCA); Plateau du Biano, Chute Mulamba, 1600m, 22.ix.1989, leg. T. Bouyer (1♂ RMCA); Route Tenke-Kansenia, R. Gule, 1500m, 19.ix.1989, leg. T. Bouyer (1♂ RMCA); Sakania, x.1926, leg. C. Seydel (1♂ RMCA); Sandoa, 27.vii.1932, leg. F.G. Overlaet (1♂ RMCA); **KENYA**: Kibwezi, 28.iii.1917, leg. W. Feather (1♂ NHMUK); Neugia [=Ngiini], 22.xii.1898, leg. R. Crawshay (1♀ NHMUK); **MALAWI**: Blantyre, 20.xi.99, leg. C.H. Ambruster (1♂ NHMUK); Chinteche, 30.v.1978, leg. R. Jocqué (1♂ RMCA);

Chintechi, i–v.1924, leg. T.H. Lloyd (1♀ NHMUK); Dowa, xii.1901–i.1902, leg. H.A. Byatt (1♀ OUMNH); Kasangazi, near Bandawe, 3000ft, leg. G. Prentice (1♂ 1♀ NHMUK); Lilongwe, 27.xii.1909, leg. F. Andrews (1♂ NHMUK); Magunda estate, Luchenza, leg. F. Nisbet (1♀ NHMUK); Maiwale, 3280ft, 06.xii.1929, leg. W.A. Lamborn (1♂ OUMNH); Mt. Mlanje, 28.x.1913, leg. S.A. Neave (1♂ NHMUK); Mt. Mlanje, Luchenya River, 04.xi.1913, leg. S.A. Neave (1♂ NHMUK); Mzeze, 1560ft, iii.1922, leg. W.A. Lamborn (1♂ OUMNH); Nkhata Bay, Kolwe Forest Reserve, 540m, 11°36’39”S, 34°14’06”E, 19.iv.2011, leg. R. Yakovlev (1♂ ANHRT); Zomba, xi.1913, leg. H.S. Stannus (1♂ NHMUK); same data but iv.1920, leg. H. Barlow (1♀ NHMUK); **MOZAMBIQUE**: E of Mt. Chiperone, 2200ft, 19.xi.1913, leg. S.A. Neave (1♀ NHMUK); Ibo (1♂ 3♀♀ NHMUK); Kola Valley, 05.iv.1913, leg. S.A. Neave (1♀ NHMUK); Maputo Special Reserve, West Gate (Sand Thicket), 22m, 26°30’14.2”S, 32°42’59.6”E, 10–17.ii.2018, leg. G. László, J. Mulvaney & L. Smith (4♂♂ 2♀♀ ANHRT); same data 09–17.ii.2018 (2♂♂ ANHRT); same data but (Sand Forest), 13–15.ii.2018 (5♂♂ 2♀♀ ANHRT); same data 21–22.ii.2018 (2♂♂ ANHRT); **SOUTH AFRICA**: Barberton, i.1894, leg. P. Rendall (1♀ NHMUK); Lydenburg [=Mashishing], leg. W.L. Distant (1♂ NHMUK); Shilouvane, leg. H. Junod (2♂♂ NHMUK); Soutpansberg, White River, xi.1909, leg. A.T. Cooke (2♀♀ MfN); **TANZANIA**: Amani Malaria Institute, iii.1962, leg. G. Pringel (1♂ NHMUK); Campus de Faculté d’Agriculture, Morogoro, 600m, v–viii.1971, leg. L. Berger, N. Leleup & J. Debecker (1♂ RMCA); Dar es Salaam, vii.1917, leg. A. Reuss (1♀ MfN); Minaki, 03.x.1965 (1♀ NHMUK); foot of Uluguru Mts., 2000ft, 14.vii.1917, leg. A. Loveridge (1♂ NHMUK); Hondo Hondo, Udzungwa, 300m, 07°50’02”S, 36°53’34”E, 07–08.iv.2011, leg. R. Smith & H. Takano (1♂ ANHRT); Kigonsera, xi–xii.1906 (1♀ NHMUK); Kilosa, 19.xii.1925, leg. N.C.E. Miller (1♀ NHMUK); near Kilossa, 1500–2500ft, 26.xii.1910, leg. S.A. Neave (1♂ NHMUK); Kilwa (1♂ NHMUK); Kota Kota (2♂♂ NHMUK); Lindi, leg. L. Marwitz (3♀♀ MfN); Magila, Usambara, 28.v.1898, leg. C.V. Legros (1♂ NHMUK); Mahenge (1♂ MfN); Masasi, ix–xii.1904 (1♂ NHMUK); Massoko, Mbaka River, 1924, leg. N.C.E. Miller (1♂ 1♀ NHMUK); Mbeya, 28.xi.1950, leg. H.B.D. Kettlewell (1♂ NHMUK); Mikindani, i–v.1897, leg. S. Reimer (4♂♂ 1♀ NHMUK); Mohorro, v.1901, leg. W. Langheld (1♀ MfN); Morogoro, 15.xii.1920, leg. N.C.E. Miller (1♂ NHMUK); same data but leg. A. Reuss (1♂ 1♀ MfN); same data but 01.ix.1917, leg. A. Loveridge (1♂ OUMNH); Nachingwea, iv.1961, leg. W. Bigger (1♂ NHMUK); Neu-Helgoland [=Pugulo Island], xii.1899, leg. F. Fülleborn (1♀ MfN); Nguelo, Usambara, leg. A. Kummer (1♀ NHMUK); Nguru, vii.1885, leg. A. Le Roy (1♂ NHMUK); Old Shinyanga, 06.iv.1956, leg. E. Burtt (1♀ NHMUK); Tanga (1♀ NHMUK); Ukami, 03.vi.1898, leg. Moritz (1♂ MfN); Uhehe-Iringa, i–iv.1899, leg. W. Goetze (1♂ MfN); Umuamba-Umalila, 23.x.1899, leg. W. Goetze (1♀ MfN); Zanzibar, leg. J. Hildebrandt (1♀ MfN); **ZAMBIA**: Chilambwe Falls, 1420m, 09°50’13”S, 30°43’35”E, 08–09.xi.2014, leg. R. Smith, H. Takano & D. Oram (1♂ ANHRT); same data but 08–12.ii.2019, leg. V. Dérozier, L. Mulvaney, R. Smith & H. Takano (2♂♂ ANHRT); Fibwe Mushitu, Kasanka National Park, 1191m, 12°35’15”S, 30°14’52”E, 02–04.xii.2012, leg. R. Smith & H. Takano (5♂♂ ANHRT); Fort Jameson [=Chipata], 14.iv.1906, leg. A.A. Longshaw (1♂ NHMUK); same data but 3800ft, 24.ii.1904, leg. S.A. Neave (1♂ OUMNH); Greystone, Kitwe, 1179m, 12°55’50”S, 28°14’29”E, 06–07.v.2015, leg. R. Smith, H. Takano & M. Aristophanous (1♂ ANHRT); Jiwundu Swamp, 1340m, 11°51’54”S, 25°33’20”E, 21–24.xi.2014, leg. R. Smith & H. Takano (1♀ ANHRT); Kabwe, Kasanka National Park, 1187m, 12°32’28”S, 30°12’42”E, 30.xi–01.xii.2012, leg. R. Smith & H. Takano (2♂♂ ANHRT); Kalungu, 1280m, 09°40’52”S, 32°42’50”E, 22–24.xi.2016, leg. R. Smith, H. Takano & D. Oram (1♀ ANHRT); same data but 05–08.iii.2017, leg. D. Oram, W. Miles & L. Smith (1♂ ANHRT); Kasanka River Pontoon, Kasanka National Park, 1191m, 12°34’23”S, 30°14’05”E, 02–04.xii.2012, leg. R. Smith & H. Takano (6♂♂ ANHRT); Kayambi, 1908, leg. M. Guillemé (1♂ NHMUK); Lake Kashiba, 1160m, 13°26’55”S, 27°56’40”E, 25–26.x.2014, leg. R. Smith, H. Takano & D. Oram (1♂ ANHRT); same data but 04–05.v.2015, leg. R. Smith, H. Takano & M. Aristophanous (1♂ ANHRT); Lusaka, 03.ii.1956. leg. R.C. Dening (1♂ NHMUK); Mayukuyuku, Kafue National Park, 1080m, 14°54’55”S, 26°03’47”E, 21–26.xi.2013, leg. R. Smith, H. Takano & D. Oram (4♂♂ 1♀ ANHRT); Mpika, 4000ft, iii–iv.1921 (1♂ NHMUK); Mumbwa, 15.xi.1913, leg. H.C. Dollman (1♂ NHMUK); Mwengwa, 02.xi.1914, leg. H.C. Dollman (1♂ NHMUK); Ndole Bay, 777m, 08°28’42”S, 30°26’59”E, 30.iv–05.v.2013, leg. R. Smith, H. Takano & D. Oram (1♂ ANHRT); N’kana, leg. L. Ellison (1♀ NHMUK); Senka Hill, Mukulizi Forest Reserve, 1566m, 09°05’43”S, 32°05’06”E, 01–06.v.2019, leg. V. Dérozier, G. László & W. Miles (1♂ ANHRT); Solwezi, 15.ix.1917, leg. H.C. Dollman (1♂ NHMUK); **ZIMBABWE**: Mountain Inn, Melsetter, xi.1950, leg. H.B.D. Kettlewell (1♂ NHMUK); near Gwailo River, x.1873, leg. F. Oates

(1♂ OUMNH); Salisbury [=Harare], xii.1899, leg. G.A.K. Marshall (1♂ NHMUK); same data but 1902 (1♀ OUMNH); Umtali [=Mutare], ix–x.1953, leg. P.A. Sheppard (1♂ NHMUK).



Figures 1–13. *Grammodora* species. 1. *G. nigrolineata* (Aurivillius, 1895), ♂, Zambia, Chilambwe Falls [ANHRTUK 00233148]. 2. *Id*., ♂, Mozambique, Maputo Special Reserve [ANHRTUK 00035109]. 3. *Id*., ♂, Tanzania, Mikindani [NHMUK 014200407]. 4. *Id*., ♀, Zambia, Kafue NP [ANHRTUK 00016436]. 5. *Id*., syntype ♀ of *Lenodora nigrolineata* Aurivillius, 1895 (MfN). 6. *G. angolana* **sp. n.**, holotype ♂. 7. *Id*., paratype ♂ [NHMUK 014200401]. 8. *Id*., paratype ♂ [NHMUK 010292303]. 9. *G. smithi* **sp. n.**, holotype ♂. 10. *Id*., paratype ♂ [NHMUK 014200403]. 11. *Id*., paratype ♂ [NHMUK 014200404]. 12. *Id*., paratype ♀ [ANHRTUK 00276158]. 13. *Id*., paratype ♀ (RCPB).



Figures 14–19. Male genitalia of *Grammodora* species: *G. nigrolineata* (Aurivillius, 1895), Mozambique [HT 020] (Fig. 14) and Tanzania [HT 018] (Fig. 17); *G. angolana* **sp. n.**, holotype (Fig. 15) and paratype (Fig. 18); *G. smithi* **sp. n.**, holotype (Fig. 16) and paratype (Fig. 19). The outline of the left socius has been highlighted in red.

Re-description.
Forewing length: males: 18–22 mm; females: 24–31 mm.

Male. Upperside. Ground colour of head golden brown, thorax, wings and abdomen cream. Antenna bipectinate, golden brown. Forewing apex rounded, outer margin arcuate. Costa and fringe beige. Black scaling along all veins except Sc and R1 forming lines that diverge and become bilineate distally; the lines diverge submarginally between veins R3 to M1, and for veins M2 to 1A+2A at their base. Red scaling is present from the base along vein R1, cubitus, and 1A+2A, and replaces the black along the bases of veins R5 and M1, and M2, M3 and CuA1; the extent of the red scaling is variable. Length of black scaling along vein CuP variable. Hindwing rounded, fringe beige. Veins lack scales thus contrasting against the ground colour. Some brown scaling present at the base of and between veins M3 and CuA1 forming a chevron pointed proximad, its extent highly variable. Underside. Ground colour of head and legs golden brown, thorax, wings and abdomen cream. Wings slightly darker than upperside; veins with beige scaling. Forewing black scaling from the upperside weakly showing through. Some individuals with heavy golden-brown scaling along costal margin.

Male genitalia. Socius elongate-triangular, almost as long as valve. Tegumen ribbon-shaped, with broad posteromedial projection. Valve short and narrow, evenly and strongly curved dorsad medially, tapering to a pointed apex. Sacculus ovoid, with almost straight outer margin. Juxta as long as valve, anteriorly dilated and posteromedially rounded. Vinculum ventrally elongate with two long, digitiform, apically tapered and rounded processes. Phallus thin, curved, tapering apically with pointed apex. Eighth sternite trapezoidal, anterolaterally produced, posteriorly emarginate with two short projections medially and lateral projections on either side.

Female. Upperside. Ground colour of head golden brown, thorax and abdomen creamy-grey. Antenna bipectinate, golden brown. Abdominal segments with paler scaling along posterior margin giving the abdomen a banded appearance. Forewing as in the male but with a darker, greyer hue marginally. Black scaling along the veins heavier. Hindwing ground colour dark brown, paler straw-coloured basally. Distal portion of veins and fringe with golden-yellow scaling. Underside. Ground colour of head and legs golden brown, thorax and abdomen dark greyish-brown. Wings dark brown, veins with yellow scaling. Forewings paler straw-coloured marginally, contrasting against the dark scaling either side of the veins following the pattern of the upperside.

Early stages. The larval and pupal stages were first described by Strand (1913) with additional information provided by Aurivillius (1927) and Pinhey (1960, 1975). Larval foodplants include *Albizia* (Pinhey 1960), *Brachystegia*, *Cassia* (Pinhey 1975), *Combretum*, *Ekebergia*, and *Senna* (Kroon 1999).

Diagnosis. See under *G. angolana* sp. n. and *G. smithi* sp. n. below.

DNA divergences. *Grammodora nigrolineata* was recovered in two separate BINs, BOLD:AFF5894 and BOLD:AAL9647. Intraspecific PWDs ranged from 0.0–3.0% (n=8) and diverged from *G. smithi* by 2.5–4.3%. A specimen from Tanzania assigned to the former BIN displayed identical genital configurations to all other males in the latter BIN. Thus *G. nigrolineata* is perceived as being a single variable taxon both in its external phenotype and the COI-5P locus.

Distribution. Widely distributed throughout woodland and forest mosaic environments in southern and eastern Africa (Fig. 21).

***Grammodora angolana* sp. n.**
https://zoobank.org/urn:lsid:zoobank.org:act:806C0E36-8C12-4CCA-B5DD-75CEDD27BA39
(Figs 6–8, 15, 18, 21)

Holotype ♂ (NHMUK):
"ANGOLA (A5) / Sa da Bandeira / 22–24.ii.1972 // Southern / African Exp. / B.M. 1972-1 // NHMUK 014200400 [QR Code]"

Paratypes (2♂♂):
ANGOLA: Tundavala, 27–29.iii.1972, Southern African Expedition (2♂♂ NHMUK).

Description and diagnosis.
Forewing length: holotype male: 20 mm; paratypes: 19–21 mm.

Phenotypically indistinguishable from *G. nigrolineata* although the new species is generally a smaller insect and the forewing is slightly less elongate. In the male genitalia of *G. angolana*, the socii are almost half as long and hence more equilateral-triangular in shape, the valves are narrower and noticeably shorter, the posterolateral processes of the vinculum are narrower, and the phallus is distinctly serrate apicoventrally. As these two species are distributed allopatrically, there is unlikely to be any confusion in specimens with good provenance.

Female unknown.

DNA divergences. Unavailable.

Derivatio nominis. A patronymic in reference to the type locality.

Vernacular name. Angolan Black Lined Eggar.

Distribution. The new species is known only from the Lubango area (Fig. 21) and is likely restricted to the south-western escarpment in Angola, a striking landscape of sheer cliffs with deep ravines and gorges at the southernmost extent of the Angolan montane forest-grassland mosaic ecoregion known to harbour numerous endemic flora and fauna (summarised in Baptista & Mills 2018). Although Angola has in recent times been poorly sampled, this species was never encountered by Pogge and Falkenstein (MfN), Ansorge (ANHRT, NHMUK), Barns, Jordan, Monteiro or Pemberton (NHMUK) nor has it been recorded in the literature from Angola (e.g., Tams 1936) or northern Namibia (e.g., Kopij 2014; Kopij & Paxton 2019). Moreover, despite over 700 observations of moths from Angola on iNaturalist (accessed March 2024), there are no records of this conspicuous insect suggesting that the distribution is not continuous across central and eastern Angola. The nearest known records of *G. nigrolineata* are over 1000 km away in the vicinity of the Congo-Zambezi watershed and is seemingly absent along the sandy Zambezi floodplain in western Zambia (despite repeated sampling by ANHRT) as well as the Angolan Dry Miombo Woodlands on deep Kalahari sands in eastern Angola (Huntley 2023). Similar to other fauna restricted to the Precambrian rocks of western Angola (Bates *et al.* 2023), the aridification of the Kalahari in the mid- to late-Miocene may provide one explanation for the isolation of *G. angolana*.

***Grammodora smithi* sp. n.**

https://zoobank.org/urn:lsid:zoobank.org:act:28B7128C-CD58-42DD-A24D-C40730A5C95A

(Figs 9–13, 16, 19–21)

Holotype ♂ (OUMNH):

"Apr. 21 1917. / E. AFRICA, / Kongwa, nr. Ry. / c.210 m. W. of / Dar es Salaam. / K. St. A. Rogers. // ♂ Lenodora / nigroline- / ata, Auriv. / reduced mk'gs. / Lasiocampid. / t in B M / Dec 21 1921. / E.B. Poulton, / W.H.T. Tams. [partially handwritten] // 1917 / 2358 [partially handwritten]"

Paratypes (20♂♂ 4♀♀):

TANZANIA: same data as holotype (1♂ OUMNH); Chunya, 2650ft, 25.i.1947, leg. G. Swynnerton (1♂ NHMUK); Idetero, 1797m, 08°31.848'S, 35°01.250'E, 23.i.2010, leg. P. Darge (2♂♂ RCPB); Irangi, 3800ft, iii.1921, leg. T.A. Barns (1♂ NHMUK); Iyayi, 1409m, 08°51.397'S, 34°31.370'E, 07.ii.2014, leg. P. Darge (1♀ RCPB); Km 31, Road Singida/Babati, 1695m, 04°44.909'S, 34°58.008'E, 04.iv.2010. leg. P. Darge (8♂♂ RCPB); Kongwa, 23.iv.1917, leg. A. Loveridge (1♂ NHMUK); Madibira, 1905 (1♂ NHMUK); Mkalama, 1905, leg. L. Marwitz (1♂ MfN); Mlangali, Livingstone Mountains, 1761m, 09°46'52"S, 34°31'22"E, xii.2012, leg. R. Smith & H. Takano (1♀ ANHRT); Mpapua [=Mpwapwa], leg. E. Baxter (3♂♂ 1♀ NHMUK); Mpwapwa (1♂ NHMUK); Usagara (1♀ ANHRT).

Description.

Forewing length: holotype male: 20 mm; paratype males: 20–22 mm; paratype females: 24–27 mm.

Male. Upperside. Ground colour of head golden brown, thorax, wings and abdomen cream. Forewing apex rounded, outer margin arcuate. Costa and fringe beige. Red scaling is present at the base of R5 and M1, along the cubital from base of wing to base of M2, M3 and CuA1 and along vein 1A+2A. All veins speckled with black scales, most heavily around the bases of the veins, but continuing in some specimens to the termen, especially along veins R3 to M1. Black scaling limited or absent along veins

R1 to R3 (except towards the termen in some specimens) and vein CuP. Hindwing rounded, fringe beige. Underside. Ground colour of head and legs golden brown, thorax, wings and abdomen cream. Wings slightly darker than upperside; veins with beige scaling. Brown scaling medio-dorsally in some individuals.

Male genitalia. Socius elongate-triangular, half as long as valve, slightly rounded at apex. Tegumen ribbon-shaped, with weak posteromedial projection. Valve short and narrow, strongly curved dorsad medially, tapering to a pointed apex. Sacculus ovoid, with almost straight outer margin. Juxta longer than valve, anteriorly dilated and posteromedially rounded. Vinculum ventrally elongate with two long, digitiform, apically tapered and rounded processes. Phallus thin, curved, tapering apically with pointed apex. Eighth sternite trapezoidal, anterolaterally produced, posteriorly emarginate with two short dentate projections medially and lateral projections on either side.

Female. Upperside. Ground colour of head golden brown, thorax and abdomen cream. Antenna bipectinate, golden brown. Abdominal segments darker with paler scaling along posterior margin giving the abdomen a banded appearance. Forewing apex pointed, outer margin gently arcuate; ground colour cream. All veins with bilineate black lines, indistinct in some specimens. CuP with limited black scaling. Red scaling along veins as in males. Hindwing ground colour dark cream with heavy irroration of long dark brown scales most concentrated postmedially. Distal portion of veins and fringe with golden-yellow scaling. Underside. Ground colour of head and legs golden brown, thorax and abdomen dark beige. Wings dark cream, with heavy irroration of long dark brown scaling except for the outer margin; veins with yellow scaling.

Diagnosis. Considered to be a pale form of *G. nigrolineata* by E.B. Poulton and W.H.T. Tams (ca. 1920s, based on labels attached to specimens in OUMNH and NHMUK), both sexes of *G. smithi* can easily be identified by the shape of the black and red scales on the forewing upperside which are acicular in the former and oblanceolate in the latter (Fig. 20). In the males, *G. nigrolineata* displays fine and well-defined bilineate black lines along all veins to the outer margin of the forewing and the black line along CuP is always present. In the male genitalia of *G. nigrolineata*, the socii are twice as long and apically pointed, the valves are strongly curved (the basal and apical sections almost at right-angles to each other) and ca. twice as long, and the sacculus is broader. The females of *G. nigrolineata* are generally larger, the bilineate black lines of the forewing are crisp and well-defined, whilst the ground colour is darker and the hindwing, with the exception of the basal area, is brown throughout.

DNA divergence. The new species has been assigned the BIN BOLD:AFG8060. Only a single specimen has been sequenced which diverged from *G. nigrolineata* by 2.5–4.3%.

Derivatio nominis. It is with great pleasure that the new species is dedicated to Richard Smith, Chairman of the Board of Trustees, ANHRT, for his continued championing of alpha taxonomy and entomological research in Africa through the institution he founded.

Vernacular name. Smith's Black Lined Eggar.

Figures 20. Forewings of *G. nigrolineata* (left) and *G. smithi* **sp. n.** (right) illustrating the differing scale shapes.

Distribution. The new species is endemic to Tanzania where it is broadly distributed along the uplifted eastern margin of the Tanzanian Craton and the Eastern Rift Valley, in dry Southern *Acacia*-

Commiphora bushlands and thickets (Fig. 21). It appears to be allopatric with *G. nigrolineata* throughout much of its range but may be parapatric especially in the southern parts of its distribution.

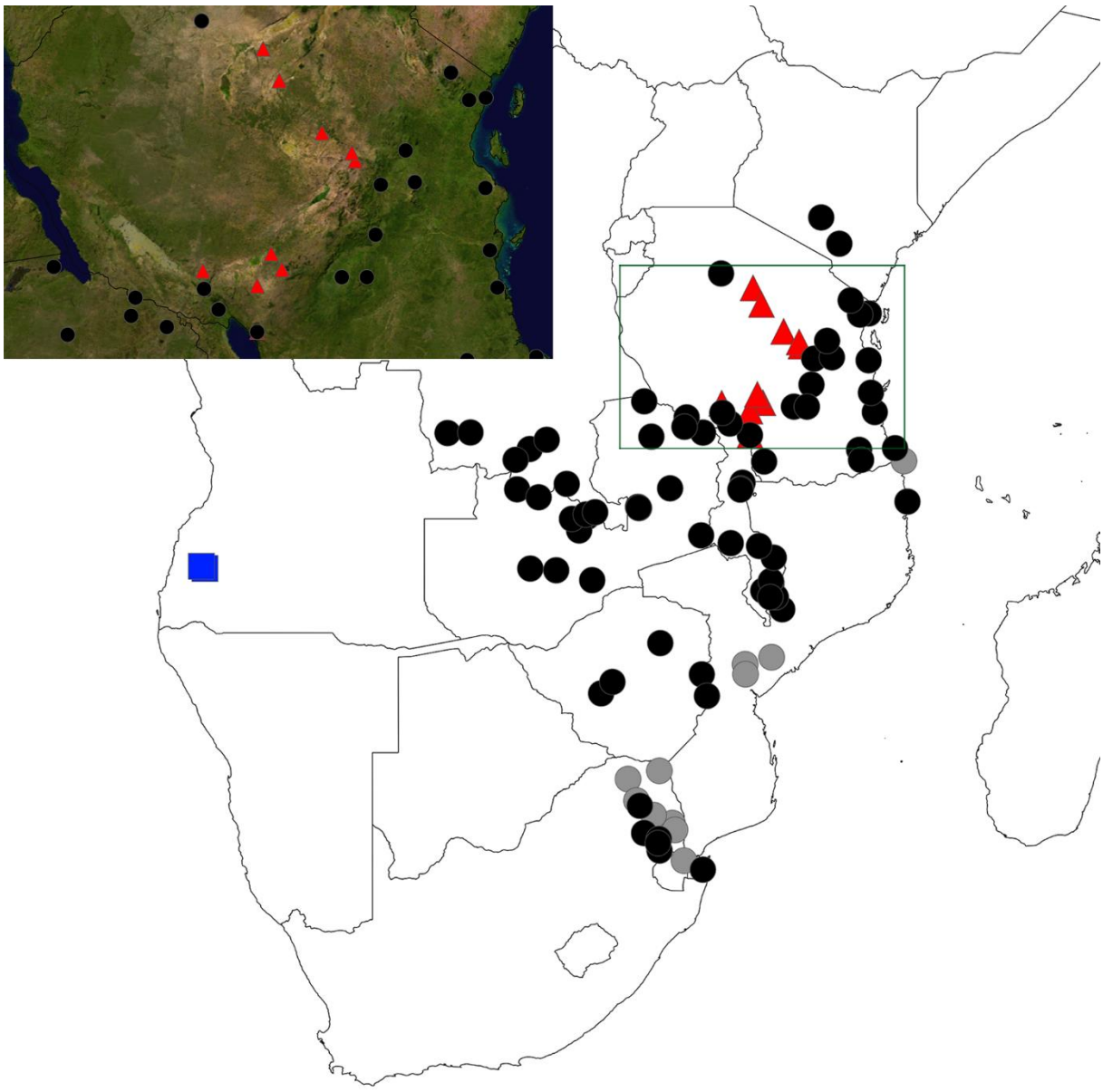


Figure 21. Distribution map of *Grammodora nigrolineata* (circles), *G. angolana* **sp. n.** (squares) and *G. smithi* **sp. n.** (triangles). Grey colouration indicates additional records from iNaturalist (accessed March 2024). Magnified inset shows distribution of *G. smithi* on a satellite layer highlighting its occurrence along the dry eastern margin of the Tanzanian Craton and Eastern Rift Valley.

Conclusions

Two new species of *Grammodora* are delimited and described based on observed differences in morphology and for *G. smithi*, divergences in the barcode region. The western vicariant *G. angolana*, separated from G. *nigrolineata* by over 1000 km of Kalahari sands, is known only from three specimens and although virtually indistinguishable in habitus, the genitalia displayed constant differences. One in ten specimens examined as part of this study belonged to *G. smithi*, an insect previously considered to be a pale variety of *G. nigrolineata*, but it has been shown herein that this phenotype and the unique scaling on the forewing of both sexes of the former constitutes a species distinct from the latter. The barcode divergences within this genus were such that sampled specimens were recovered in three BINs:

G. nigrolineata was split into two populations, one on either side of the Rift Valley along the Tanzania-Zambia border, and *G. smithi* into another. However, the genital morphology of the two *G. nigrolineata* populations were identical despite the almost 3.0% barcode divergence and based on the large number of specimens examined as part of this study, their distribution in East Africa is continuous. Such intraspecific variation in the COI-5P locus appears to be a common occurrence in the Lasiocampidae (Takano & László 2024), and initial analyses of nearly 1000 barcodes generated from ANHRT specimens resulted in phenomena such as female-only BINs for species where males and female identification was not in doubt (i.e. the specimens having been caught at the same trap on the same night). This challenges the utility of a locus that has widely been implemented to match the different sexes of dimorphic species (e.g., Cock *et al*. 2023), and adds a further layer of complexity in defining and delimiting taxa in a group such as the Lasiocampidae which are well-known to display polymorphism and extreme sexual dimorphism. Ultimately, a holistic approach synthesising all the strands of morphological, genetic and biogeographic evidence is needed in order to accurately establish generic and specific boundaries.

This present review of *Grammodora* has demonstrated that even in the most recognisable and charismatic genera of Lasiocampidae, there are hidden cryptic species suggesting there is much more still to learn about the true diversity of the lappet moths in the Afrotropics.

Acknowledgements

I am extremely grateful to Théo Léger (MfN), Alessandro Giusti (NHMUK), James Hogan (OUMNH) and Stéphane Hanot (RMCA) for facilitating access to collections under their care. I extend my gratitude to Patrick Basquin for welcoming me to view his fine collection and sending additional photographs.

References

Aurivillius, C. (1895) Diagnosen neuer Lepidopteren aus Afrika. *Entomologisk Tidskrift*, 16, 113–120. [In German]

Aurivillius, C. (1927) Lasiocampidae. *In*: Seitz, A. (Ed.) *Die Gross-Schmetterlinge der Erde. Eine Systematische Bearbeitung der bis jetzt bekannten Gross-Schmetterlinge. Die Afrikanischen Spinner und Schwärmer*. Stuttgart: Verlag des Seitzschen Werkes, Alfred Kernen, pp. 205–281. [In German]

Baptista, N.L. & Mills, M.S.L. (2018) Angola White-headed Barbet *Lybius [leucocephalus] leucogaster* rediscovered. *Bulletin of the African Bird Club*, 25 (2), 225–229.

Bates, M.F., Lobón-Rovira, J., Stanley, E.L., Branch, W.R. & Vaz Pinto, P. (2023) A new species of green-eyed *Cordylus* Laurenti, 1768 from the west-central highlands of Angola, and the rediscovery of *Cordylus angolensis* (Bocage, 1895) (Squamata: Cordylidae). *Vertebrate Zoology*, 73, 599–646. https://doi.org/ 10.3897/vz.73.e95639

Basquin, P. (2023) Découvrons les Lasiocampides africains. *Saturnafrica*, 32, 37–47. [In French]

Cock, M.J.W., Laguerre, M., Buddie, A.G., Cafa, G., Alston-Smith, S., Morrall, J. & Gosula, V.S. (2023) Using DNA barcodes to test the association of sexes and morphs in *Calodesma* spp. (Lepidoptera, Erebidae, Arctiinae, Arctiini, Pericopina) of Trinidad, West Indies, with an overview of the genus, taxonomic changes and a new species. *Zootaxa*, 5270 (2), 231–261. https://doi.org/10.11646/zootaxa.5270.2.4

Hampson, G.F. (1892) *The fauna of British India, including Ceylon and Burma. Moths–Vol. 1*. Taylor and Francis, London, xxiii + 527 pp.

Hebert, P.D.N., Braukmann, T.W.A., Prosser, S.W.J., Ratnasingham, S., deWaard, J.R., Ivanova, N.V., Janzen, D.H., Hallwachs, W., Naik, S., Sones, J.E. & Zakharov, E.V. (2018) A Sequel to Sanger: amplicon sequencing that scales. *BMC Genomics*, 19, 219. https://doi.org/10.1186/s12864-018-4611-3

Huntley, B.J. (2023) *Ecology of Angola: Terrestrial Biomes and Ecoregions*. Springer, Cham, 459 pp.

Kimura, M. (1980) A simple method for estimating evolutionary rate of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution*, 16, 111–120. https://doi.org/10.1007/BF01731581

Kopij, G. (2014) Lepidoptera fauna of Namibia. I. Seasonal distribution of moths of the Koakoland (Mopane) Savanna in Ogongo. *Fragmenta Faunistica*, 57 (2), 117–129. https://doi.org/10.3161/00159301FF2014.57.2.117

Kopij, G. & Paxton, M. (2019) Lepidoptera fauna of Namibia II: Okavango River Valley, Kavango Region. *Acta entomologica serbica*, 24 (1), 19–40. https://doi.org/10.5281/zenodo.2671796

Kroon, D.M. (1999) *Lepidoptera of Southern Africa: Host-plants & other associations. A Catalogue*. Lepidopterists' Society of South Africa, Jukskei Park and D.M. Kroon, Sasolburg, 160 pp.

Kumar, S., Stecher, G., Li, M., Knyaz, C. & Tamura, K. (2018) MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and Evolution*, 35, 1547–1549. https://doi.org/ 10.1093/molbev/msy096

Lafontaine, J.D. & Mikkola, K. (1987) Las-och-nyckel systemen i de inre genitalierna av Noctuidae (Lepidoptera) som taksonomiska kaennetecken. [Lock-and-key systems in the inner genitalia of Noctuidae (Lepidoptera) as a taxonomic character.] *Entomologiske Meddelelser*, 55, 161–167. [In Swedish]

Pinhey, E.C.G. (1960) The larvae of some moths, reared by Mr D.K.B. Wheelerat Syringa Farm, Southern Rhodesia. Part I. *Occasional Papers of the National Museums of Southern Rhodesia*, 3 (24B), 489–508.

Pinhey, E.C.G. (1975) *Moths of Southern Africa*. Tafelberg Publishers, Cape Town, iv + 273 pp.

Strand, E. (1913) Über einige Lasiocampiden aus Deutsch Ost-Afrika. *Archiv für Naturgeschichte,* Abteilung A, 79 (1), 47–56. [In German]

Takano, H. & László, G.M. (2024) Descriptions of new *Hypotrabala* Holland, 1893 (Lepidoptera: Lasiocampidae: Lasiocampinae: Selenepherini) in the collections of the African Natural History Research Trust, with notes on allied genera and the description of a new genus. *Ecologica Montenegrina*, 72, 19–63. https://doi.org/10.37828/em.2024.72.4

Tams, W.H.T. (1936) Dr. Karl Jordan's expedition to South-West Africa and Angola: Lasiocampidae. *Novitates Zoologicae*, 40, 95–114.

Zolotuhin, V.V., Efimov, R.V., Anikin, V.V., Demin, A.G. & Knushevitskaya, M.V. (2012) Changes in the suprageneric classification of Lasiocampidae (Lepidoptera) based on the nucleotide sequence of gene EF-1α. *Entomological Review*, 92 (5), 531–547. https://doi.org/10.1134/S0013873812050065