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Taxonomic review of the Afrotropical genus *Gracililema* Krüger with descriptions of three new species (Lepidoptera: Erebidae: Arctiinae: Lithosiini)

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Abstract

The footman moth genus *Gracililema* Krüger, 2015 is reviewed and three new species are described: *Gracililema bettoni* **sp. n.** (Kenya and Ethiopia), *G. lydiae* **sp. n.** (northern Mozambique, Zimbabwe, Zambia, Tanzania, Kenya and Ethiopia) and *G. smithi* **sp. n.** (southern Mozambique and eastern South Africa). Adults, except the unknown male of *G. proleucodes* (Kiriakoff, 1958), together with male and female genitalia of all *Gracililema* species are illustrated.

Key words: Ethiopia, Kenya, Lithosiina, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe

Introduction

The Afrotropical genus *Gracililema* Krüger, 2015 belongs to the subtribe Lithosiina of the tribe Lithosiini and was relatively recently erected by Krüger (2015) to include two valid species. Due to the lack of material available to Krüger at the time, the taxonomic knowledge of the genus remains largely incomplete. In the course of the examination of the Lithosiini collections of the African Natural History Research Trust (Leominster, UK), the Natural History Museum (London, UK) and the Bavarian State Collection of Zoology (Munich, Germany), three unidentified species of *Gracililema* from different countries have been found. The comparison of the genitalia structures of these species with those of the two known taxa in the genus has confirmed their specific discreteness and they are described below as species new to science.

Material and methods

Abbreviations of the depositories used: AKW = private collection of Anthony J. Kingston, Wolverhampton, UK; ANHRT = African Natural History Research Trust, Leominster, UK; NHMUK (formerly BMNH) = Natural History Museum, London, UK; ZSM = the Bavarian State Collection of Zoology (Zoologische Staatssammlung München), Munich, Germany. Other abbreviations used: AV = genitalia slide prepared by Anton V. Volynkin; HT = holotype; PT = paratype; SL =sequence length.

The genitalia were dissected and mounted in Euparal on microscope slides. The photos of adults were taken using a Nikon D3100/AF-S camera equipped with a Nikkor, 18–55 mm lens while the photos of genitalia were taken using the same camera attached to a microscope with an LM-scope adapter. All pictures were processed using the Adobe Photoshop CC 2018 software.

DNA Barcoding Analysis. Leg tissue from 59 individuals belonging to three *Gracililema* taxa (10 specimens of *G. proleuca* (Hampson, 1914), 35 specimens of *G. lydiae* **sp. n.** and 14 specimens of *G. smithi* **sp. n.**) and one individual of *Muxta xanthopa* Holland (Table 1) were submitted to the Canadian Centre for DNA Barcoding (CCDB), Guelph, Canada for DNA extraction, amplification and sequencing of cytochrome oxidase subunit I (COI-5P). *Muxta xanthopa*, belonging to the same subtribe Lithosiina as *Gracililema*, was selected as the outgroup taxon

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due to fundamental differences in the male genitalia. Sequences were aligned using MUSCLE in MEGA version 10.2.5 (Kumar *et al.* 2018) and Maximum Likelihood analyses were performed in MEGA, the model parameters optimised for the dataset using the Bayesian Information Criterion (T92+G). Pairwise distances were calculated using Kimura's two-parameter model (Kimura 1980). The COI-5P sequences are available from the BOLD Systems website (www.boldsystems.org).

TABLE 1. Specimen, barcode and collecting locality data for the 59 specimens of *Gracililema* and a specimen of *Muxta xanthopa* sampled for the present study.

Species	Locality	Sample ID	Process ID	SL	Sex
G. proleuca	Ivory Coast, Mt. Tonkoui Peak	ANHRTUK-00099166	ANLMN1789-21	654	♀
G. proleuca	Ivory Coast, Mt. Tonkoui Peak	ANHRTUK-00132852	ANLMN1788-21	655	♀
G. proleuca	Ivory Coast, Mt. Tonkoui Peak	ANHRTUK-00201043	ANLMN1786-21	655	♂
G. proleuca	Ivory Coast, Mt. Tonkoui Peak	ANHRTUK-00201044	ANLMN1787-21	655	♀
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00019238	ANLMN1790-21	655	♂
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00029961	ANLMN1791-21	655	♂
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00026097	ANLMN1795-21	655	♀
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00148135	ANLMN1793-21	655	♀
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00148134	ANLMN1792-21	654	♀
G. proleuca	Liberia, Nimba Mts	ANHRTUK-00030034	ANLMN1794-21	654	♂
G. lydiae **sp. n.**, PT	NW Zambia, Lukwakwa	ANHRTUK-00061638	ANLMN1815-21	653	♂
G. lydiae **sp. n.**, PT	NW Zambia, Jiwundu Swamp	ANHRTUK-00056933	ANLMN1803-21	655	♀
G. lydiae **sp. n.**, HT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00191483	ANLMN1796-21	655	♂
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00094970	ANLMN1802-21	654	♀
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00094755	ANLMN1801-21	654	♀
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00139622	ANLMN1799-21	653	♂
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00100945	ANLMN1798-21	654	♂
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00192181	ANLMN1797-21	642	♂
G. lydiae **sp. n.**, PT	E Zambia, Mutinondo Wilderness Area	ANHRTUK-00111089	ANLMN1800-21	655	♂
G. lydiae **sp. n.**, PT	NE Zambia, Danger Hill	ANHRTUK-00083509	ANLMN1805-21	654	♂
G. lydiae **sp. n.**, PT	NE Zambia, Danger Hill	ANHRTUK-00083492	ANLMN1804-21	654	♂
G. lydiae **sp. n.**, PT	NE Zambia, Lumangwe Falls	ANHRTUK-00076553	ANLMN1813-21	655	♀
G. lydiae **sp. n.**, PT	NE Zambia, Chilambwe Falls	ANHRTUK-00072401	ANLMN1814-21	654	♀
G. lydiae **sp. n.**, PT	NE Zambia, Lunzua Falls	ANHRTUK-00083167	ANLMN1812-21	654	♀
G. lydiae **sp. n.**, PT	NE Zambia, Lunzua Falls	ANHRTUK-00083164	ANLMN1811-21	654	♀
G. lydiae **sp. n.**, PT	NE Zambia, Kalungu	ANHRTUK-00136107	ANLMN1810-21	653	♂
G. lydiae **sp. n.**, PT	NE Zambia, Kalungu	ANHRTUK-00094656	ANLMN1809-21	654	♂
G. lydiae **sp. n.**, PT	NE Zambia, Senka Hill	ANHRTUK-00082345	ANLMN1808-21	646	♂
G. lydiae **sp. n.**, PT	NE Zambia, Senka Hill	ANHRTUK-00083658	ANLMN1807-21	654	♂
G. lydiae **sp. n.**, PT	NE Zambia, Senka Hill	ANHRTUK-00082352	ANLMN1806-21	653	♂
G. lydiae **sp. n.**, PT	Tanzania, Giting, Mt. Hanag	ANHRTUK-00201045	ANLMN1816-21	654	♂
G. lydiae **sp. n.**, PT	Tanzania, Maskati, Nguru Mts	ANHRTUK-00201046	ANLMN1817-21	655	♂
G. lydiae **sp. n.**, PT	Mozambique, Chimanimani NR	ANHRTUK-00049152	ANLMN1839-21	654	♀
G. lydiae **sp. n.**, PT	Mozambique, Mt. Namuli	ANHRTUK-00049450	ANLMN1836-21	655	♂
G. lydiae **sp. n.**, PT	Mozambique, Mt. Namuli	ANHRTUK-00049402	ANLMN1837-21	655	♂
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075708	ANLMN1835-21	653	♀
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075882	ANLMN1827-21	654	♂

.....continued on the next page

TABLE 1. (Continued)

Species	Locality	Sample ID	Process ID	SL	Sex
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075900	ANLMN1828-21	654	♂
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075671	ANLMN1829-21	655	♂
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00046477	ANLMN1830-21	652	♀
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075630	ANLMN1831-21	652	♀
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00074327	ANLMN1833-21	654	♀
G. lydiae **sp. n.**, PT	Mozambique, Gorongosa NP	ANHRTUK-00075874	ANLMN1834-21	652	♀
G. lydiae **sp. n.**, PT	Zimbabwe, Bvumbe	ANHRTUK-00138016	ANLMN1841-21	641	♂
G. lydiae **sp. n.**, PT	Zimbabwe, Vukutu	ANHRTUK-00143194	ANLMN1842-21	655	♀
G. smithi **sp. n.**, HT	Mozambique, Maputo Special Reserve	ANHRTUK-00001848	ANLMN1824-21	654	♂
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00019330	ANLMN1818-21	653	♂
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00201047	ANLMN1826-21	653	♀
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00019331	ANLMN1819-21	651	♂
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00019332	ANLMN1820-21	654	♂
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00027709	ANLMN1822-21	654	♀
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00007122	ANLMN1823-21	654	♂
G. smithi **sp. n.**, PT	Mozambique, Maputo Special Reserve	ANHRTUK-00001850	ANLMN1825-21	654	♀
G. smithi **sp. n.**, PT	South Africa, KwaZulu Natal, Vernon Crookes NR	ANHRTUK-00111817	ANLMN1845-21	654	♀
G. smithi **sp. n.**, PT	South Africa, KwaZulu Natal, Vernon Crookes NR	ANHRTUK-00111790	ANLMN1844-21	654	♂
G. smithi **sp. n.**, PT	South Africa, KwaZulu Natal, Belvedere Game Ranch	ANHRTUK-00104311	ANLMN1846-21	654	♀
G. smithi **sp. n.**, PT	South Africa, Eastern Cape, Tsitsikamma	ANHRTUK-00135214	ANLMN1848-21	654	♂
G. smithi **sp. n.**, PT	South Africa, Eastern Cape, Tsitsikamma	ANHRTUK-00135256	ANLMN1847-21	655	♂
G. smithi **sp. n.**, PT	South Africa, Eastern Cape, Tsitsikamma	ANHRTUK-00135237	ANLMN1849-21	654	♀
M. xanthopa	Gabon, Crystal Mts	ANHRTUK-00192482	ANLMN1721-21	657	♂

The male and female genitalia terminology follows Krüger (2015), Goater *et al.* (2003) and Fibiger (1997). The distribution map was constructed using the online resource SimpleMappr (www.simplemappr.net).

Genus *Gracililema* Krüger, 2015

Gracililema Krüger, 2015, *Generic classification of Afrotropical footman moths sensu stricto (Lepidoptera: Erebidae: Arctiinae: Lithosiini (partim)*: 72.
Type species: *Ilema proleuca* Hampson, 1914, by original designation.

Remark. A detailed description and diagnosis of the genus was provided by Krüger (2015) based on two described species. However, in the description of the female genitalia, Krüger characterised the corpus bursae wall as membranous while it is in fact gelatinous in all species. This error was likely due to the old genital preparations of the females of *G. proleuca* and *G. proleucodes* (deposited in NHMUK) being over-macerated resulting in the thinning of the corpus bursae walls. The configuration of the vesica was not discussed by Krüger and is described below.

Diagnosis. Adults of *Gracililema* are externally reminiscent of members of the genus *Mimelilema* Krüger, 2015 (illustrated by Krüger (2015)), but are slightly smaller with a somewhat narrower forewing and paler colouration. In the male genital capsule of *Gracililema*, the valvae are symmetrical (asymmetrical in *Mimelilema*) and the distal saccular process is narrow having a spine-like tip (a feature characteristic for the genus) whereas the saccular process in other similar genera is densely covered with spinules (*Mimelilema* Krüger, 2015, *Mkalama* Krüger, 2015, *Birketsmithiola* Krüger, 2015 and *Lomilema* Krüger, 2015) or evenly tapered distally (*Pseudotigrioides* Krüger,

2015) (illustrated by Krüger (2015)). Among Afrotropical Lithosiina, the spine-like tip of the distal saccular process is also known in the genera *Stenilema* Hampson, 1909 and *Zadadrina* Kiriakoff, 1954 which are dissimilar to *Gracililema* both externally as well as in the structures of the genitalia of both sexes (illustrated by Krüger (2015)). In the female genitalia, the gelatinous corpus bursae with a broad posterior diverticulum are characteristic for the genus.

Re-description. **Adults** (Figs 1–16). Forewing length 10.0–15.5 mm in males and 11.0–16.0 mm in females. Species vary in size within the same population. Antenna ciliate with somewhat longer cilia in male. Head pale yellow. Thorax grey, collar pale yellow. Forewing ground colour from pale to deep grey, costal stripe and cilia from pale to deep yellow. Hindwing pale yellow. Abdomen ochreous. **Male genitalia** (Figs 17–24). Uncus elongate, slender, dorso-ventrally flattened, evenly curved and apically pointed. Tuba analis membranous with thin and weakly sclerotised scaphium. Tegumen ca. 3 times shorter than valva, with moderately broad arms fused in posterior half. Vinculum approximately equal in length to tegumen, its arms anteriorly connected by membrane forming medial depression. Intravincular area with one short corema medially. Valva with almost parallel margins medially, tapered distally and apically rounded. Costa with extensive, moderately sclerotised plate subapically. Sacculus moderately wide and sclerotised, basally connected by a thick membranous commissure. Distal saccular process heavily sclerotised, cylindrical and curved inwards, bearing a robust apical spine. Juxta shield-like with elongate and narrow anterio-medial protrusion. Phallus elongate and narrow, with relatively long coecum, somewhat curved at ostium ducti ejaculatorii. Vesica curved dorsally or laterally, with short lateral diverticula and elongate distal diverticulum bearing granulation or spinulose scobination and one spine-like apical cornutus. Vesica ejaculatorius originating subbasally. **Female genitalia** (Figs 25–29). Papilla analis rectangular with rounded corners, weakly setose. Apophyses thin, apophyses anteriores somewhat longer than posterior ones. Ductus bursae shorter than corpus bursae, with short, membranous medial and sclerotised, dorso-ventrally flattened anterior section; antrum (posterior section of ductus bursae) more or less caliciform, weakly sclerotised. Corpus bursae more or less pyriform or teardrop-shaped with thin gelatinous walls and broad, thickly gelatinous posterior diverticulum. Appendix bursae conical, very short but broad, membranous, positioned postero-dorsally or postero-laterally between diverticulum and base of ductus bursae.

Molecular data. The intraspecific divergence of COI-5P sequences of three *Gracililema* species sampled ranges between 0.00 and 1.08%. The uncorrected pairwise distance between *Gracililema* species ranges between 3.30 and 6.44% (Table 2; Fig. 30). Molecular data for *G. proleucodes* and *G. bettoni* **sp. n.** are currently unavailable.

TABLE 2. The uncorrected pairwise distances between of COI-5P sequences of *Gracililema* species with intra- and interspecific divergences.

Species	*G. proleuca*	*G. lydiae* **sp. n.**	*G. smithi* **sp. n.**
G. proleuca	0.00–0.93%		
G. lydiae **sp. n.**	3.30–3.95%	0.00–1.08%	
G. smithi **sp. n.**	5.75–6.44%	5.10–5.78%	0.00–0.46%

***Gracililema* species content**

- *G. proleuca* (Hampson, 1914)
- *G. proleucodes* (Kiriakoff, 1958)
- *G. bettoni* **sp. n.**
- *G. lydiae* **sp. n.**
- *G. smithi* **sp. n.**

***Gracililema proleuca* (Hampson, 1914)**

(Figs 1–3, 17, 18, 25)

Ilema proleuca Hampson, 1914, *Catalogue of the Lepidoptera Phalaenae in the British Museum.* Supplement Volume 1: 499, pl. 27: fig. 15 (Type locality: [Ghana] "Gold Coast, Aburi").

Type material examined. **Holotype** (Figs 1, 17): male, "Gold Coast. Aburi. 3.III.1911 L.Armstrong. 1913-14." / "*Ilema proleuca* type ♂. Hmpsn." / red ring "Type H. T." label / "Arctiidae genitalia slide No. 25" / QR-code label with unique number "NHMUK 010889644" (NHMUK).

Additional material examined (16 males and 12 females). **GUINEA**: 2 males, 1 female, 540–600m, 619km ESE of Conakry, Nzerekore Region, Prefecture de Lola, Ziela env., x.2017, 7˚42'N, 8˚221'W, local collectors leg. (ANHRT); **LIBERIA**: 3 males, 2 females, 1165m, Nimba county, ENNR, Nimba Mts camp, 7˚31'45''N, 8˚31'37''W, 3–13.xii.2017, MV (125w) & blended bulb (250w) light traps, Aristophanous, M., Sáfián, Sz., Simonics, G. & Smith, L. leg., gen. prep. No.: AV5301; 1 male, 1 female, 1000–1100m, Nimba Mts, ENNR, Nimba county (Cellcom road), 7˚32'45.88''N, 8˚31'21.04''W, 02–14.xii.2017, Cold Cathode Light Bucket, Aristophanous, M., Sáfián, Sz., Simonics, G. & Smith, L. leg.; 1 female, 1000–1100m, ENNR, Nimba Mts, Cellcom Rd., 7˚32'45.9''N, 8˚31'21''W, 27.iii.–04.iv.2017, light trap (250w blended bulb) & cold cathode UV light bucket trap (8w), Sáfián, Sz., Simonics, G. leg.; 1 male, 865m, Lofa County, Wologizi Mts, Ridge camp, 8˚07'10''N, 9˚57'11''W, 24–29.xi.2017, Light Trap (blended bulb 250w), Aristophanous, M., Sáfián, Sz., Simonics, G. & Smith, L. leg. (ANHRT); 1 male, 883m, Lofa County, Wologizi Mts, Ridge camp 2, 8˚7'20.79''N, 9˚56'50.75''W, 22–31.xi.2018, Cold Cathode UV Light Trap (8w), Sáfián, Sz., Simonics, G. leg., gen. prep. No.: AV5303; 1 male, 1002m, Lofa County, Wologizi Mts, Elephant Ridge, 8˚7'1.46''N, 9˚55'24.18''W, 23–26.xi.2018, Cold Cathode UV Light Trap (8w), Sáfián, Sz., Simonics, G. leg., gen. prep. No.: AV5302; **IVORY COAST**: 6 males, 5 females, 1171m, Mt. Tonkoui Peak, 07˚27'15.2''N, 07˚38'12.5''W, 1–8.xi.2015, light trap, Aristophanous, M., Moretto, P., Ruzzier, E. leg., gen. prep. No.: AV4549 (male); 1 male, 1 female, same locality and collectors as previous, 12–18.vii.2015, gen. prep. No.: AV4559 (female); 1 female, same locality as previous, 19–27.xi.2019, MV light trap, Aristophanous, M., Dérozier, V., Moretto, P., Ouattara, S. leg.; 1 female, same locality as previous, 20–27.v.2018, MV light trap, Aristophanous, M., Miles, W., Moretto, P., Ouattara, S. leg. (ANHRT).

Diagnosis. The forewing length is 11.5–13.0 mm in males and 12.0–14.5 mm in females. The species is characterized by the relatively narrow forewing with a thin pale yellow costal stripe (Figs 1–3). The male genitalia of the species (Figs 17, 18) are most similar to those of *G. bettoni* **sp. n.** (Figs 19, 20), the distinctive features between the two taxa are discussed in the diagnosis of the latter species. Compared to *G. lydiae* **sp. n.** (Figs 21, 22) and *G. smithi* **sp. n.** (Figs 23, 24), the male genital capsule of *G. proleuca* has a basally wider valva. In the vesica, the lateral diverticulum is very short and the cornutus is markedly more robust than in *G. lydiae* **sp. n.** and *G. smithi* **sp. n.** The female genitalia of *G. proleuca* (Fig. 25) are similar to those of *G. proleucodes* (Fig. 26) and *G. bettoni* **sp. n.** (Fig. 27), the comparisons are provided below under the diagnoses of the species.

Distribution. Known from Ghana (Hampson 1914), Ivory Coast, Liberia and Guinea (new records) (Fig. 31).

Gracililema proleucodes (Kiriakoff, 1958)

(Figs 4, 26)

Eilema proleucodes Kiriakoff, 1958, *British Museum (Natural History) Ruwenzori Expedition 1952. Arctiidae (except Nolinae), Thyretidae and Notodontidae*, 1 (2): 10 (Type locality: "Uganda: Bundibugyo, 3440 ft").

Type material examined. **Holotype** (Figs 4, 26): female, "Uganda: Ruwenzori Range. Bundibugyo. 3,440 ft. 22.viii–3.ix.1952. D.S.Fletcher." / "Ruwenzori Exped. B.M.1952-566." / "S. G. Kiriakoff det., 1954 *Eilema proleucodes* sp.n." / red ring "Type" label / "Arctiidae genitalia slide No. 23" / "Neg. No. 14084" / QR-code label with unique number "NHMUK 010889648" (NHMUK).

Diagnosis. The forewing length is 12.5 mm in the holotype female. *Gracililema proleucodes* (Fig. 4) is externally similar to *G. proleuca* (Figs 1–3) but has a somewhat wider forewing. In the female genitalia of *G. proleucodes* (Fig. 26), the posterior diverticulum of the corpus bursae is markedly shorter and narrower than in *G. proleuca* (Fig. 25), and the apophyses anteriores are longer (in proportion to the length of the ovipositor). Additionally, the ductus bursae is anteriorly dilated in *G. proleucodes* whereas it is tapered in *G. proleuca*.

Male is unknown.

Distribution. Known only from its type locality in the eastern foothills of the Ruwenzori Range in western Uganda (Fig. 31).

***Gracililema bettoni* sp. n.**
(Figs 5–7, 19, 20, 27)

Type material. **Holotype** (Figs 5, 19): male, [Kenya] "E Quaso. Masai. B.E.Africa. 23.x.1900. C.S.Betton. 1901-136." / QR-code label with unique number: "NHMUK 014173087" / "Slide NHMUK 010317201" (NHMUK).

Paratypes (5 males and 2 females): **KENYA**: 1 male, Gwelil. [= Goelil, 0˚30'S, 36˚05'E] B. E. Africa. C.S. Betton. 20.IX.1900. 1901–27,. gen. prep. No.: BMNH Arctiidae 587, unique number: NHMUK 010889645 (NHMUK); 1 female, [Eburru] Eb Urru, B. E. Africa, 30.V.1900, C.S. Betton, 1900–221, gen. prep. No.: BMNH Arctiidae 588, unique number: NHMUK 010889646 (NHMUK); 1 male, Eastern Province, Meru District, Lewa Conservancy, 2080m, N0˚08.235', E37˚27.282', 28–30.xi.2008, A.J. Kingston [leg.], gen. prep. No.: AV6534 (AKW); 1 male, Africa or., Mt. Kenya, Nanyuki, 8.XII.[19]60, H. Löffler leg., gen. prep. No.: ZSM Arct. 2021-177 (prepared by Volynkin) (ZSM); 1 male, Kabete, 29.X.1972, H. Politzar leg., gen. prep. No.: ZSM Arct. 2021-178 (prepared by Volynkin) (ZSM); 1 female, Kakamega, 1.X.1973, H. Politzar leg., gen. prep. No.: ZSM Arct. 2021-179 (prepared by Volynkin) (ZSM); **ETHIOPIA**: 1 male, 07°17'00''N, 36°07'58''E, 11.2 km W Bonga, 01.xi.2010, 2050m, Li [at light], J. De Freina, H. Hacker, H. Peks, H.-P. Schreier leg., gen. prep. No.: ZSM Arct. 2020-221 (prepared by Volynkin) (ZSM).

Remark. The type locality of "E Quaso. Masai." almost certainly refers to the Guaso Masai stream (0˚13'S, 35˚47'E) in the area between modern day Molo and Elburgon just to the north of the Mombasa-Victoria railway line (H. Takano 2021, pers. comm.).

Diagnosis. The forewing length is 15.0–15.5 mm in males and 16.0 mm in the female paratype. *Gracililema bettoni* **sp. n.** (Figs 5–7) is distinguished from its congeners (Figs 1–4, 8–16) by its larger size. The wide yellow costal stripe is similar to that of *G. lydiae* **sp. n.** (Figs 8–11) but in the male of` *G. bettoni* **sp. n.**, it is dilated subapically. Additionally, the forewing of *G. bettoni* **sp. n.** has a somewhat more acutely angled apex in the male, and a more rounded tornus in the female. The male genitalia of *G. bettoni* **sp. n.** (Figs 19, 20) are most similar to those of *G. proleuca* (Figs 17, 18) but differ in the slightly thinner distal saccular process, the markedly broader vesica and the longer and thicker cornutus. Additionally, the uncus of *G. bettoni* **sp. n.** is somewhat more elongate than in *G. proleuca* (ca. 1.15 times longer than the tegumen while the uncus and the tegumen of *G. proleuca* are equal in length). Compared to that of *G. lydiae* **sp. n.** (Figs 21, 22), the male genital capsule of the new species has a shorter uncus and distal saccular process. The vesica of the new species is markedly longer (equal to the length of the phallus tube in *G. bettoni* **sp. n.** as opposed to half the length in *G. lydiae* **sp. n.**) and broader than in *G. lydiae* **sp. n.**, curved dorsally (it is curved laterally in the congener), and the cornutus is longer and thicker. The female genitalia of *G. bettoni* **sp. n.** (Fig. 27) are most similar to those of *G. lydiae* **sp. n.** (Fig. 28) but differ in the broader anterior sclerotised section of the ductus bursae and the somewhat broader postero-lateral diverticulum of the corpus bursae. Compared to *G. proleuca* (Fig. 25), the female genitalia of *G. bettoni* **sp. n.** have an anteriorly more dilated ductus bursae and a markedly shorter and narrower diverticulum of the corpus bursae.

Distribution. The species is known from Kenya and southern Ethiopia (Fig. 31).

Etymology. The species is named after Charles Steuart Betton, an engineer on the Uganda Railway who collected not only most of the type specimens of this new species but numerous other Invertebrata and small Vertebrata in East Africa.

***Gracililema lydiae* sp. n.**
(Figs 8–11, 21, 22, 28)

Type material. **Holotype** (Figs 8, 21): male, "Zambia 1460m Mutinondo Wilderness Area, Mpika, Northern Prov. 12˚27'06''S, 31˚17'30''E 14–17.ii.2019 MV Light Trap Dérozier, V., Mulvaney, L., Takano, H. Leg. ANHRT:2019.4", unique number: ANHRTUK 00191483, gen. prep. No.: AV6417 (ANHRT).

Paratypes (46 males and 34 females): **ZAMBIA**: 7 males, 2 females, same data as in holotype, MV and Actinic light traps, unique numbers: ANHRTUK 00094755, 00094970, 00100945, 00100948, 00111089, 00111090, 00139622, 00191479, 00192181, gen. prep. No.: AV6444 (female); 2 females, 1340m, Jiwundu Swamp (Miombo / riverine forest mosaic), 11˚51'54''S, 25˚33'20''E, 29.x.–4.xi.2018, Actinic and LepiLED light traps, Aristophanous, M., Dérozier, V., László, G., Oram, D. leg., unique numbers: ANHRTUK 00056933, 00058226; 1 female, same

locality, 21–24.xi.2014, Smith, R. & Takano, H. leg., unique number: ANHRTUK 00201083; 1 male, 2 females, 1147m, Lukwakwa, West Lunga NP, 12˚39'40''S, 24˚26'13''E, 23–26.viii.2013, Smith, R. & Takano, H. leg., unique numbers: ANHRTUK 00201084–00201086, gen. prep Nos.: AV4560 (male), AV4561 (female); 1 male, 1147m, Lukwakwa, West Lunga NP. (Cryptosepalum forest / Dambo), 12˚39'40''S, 24˚26'13''E, 9–15.xi.2018, LepiLED light trap, Aristophanous, M., Dérozier, V., László, G., Oram, D. leg., unique number: ANHRTUK 00061638; 2 males, 1684m, Danger Hill, 30 km North of Mpika, Muchinga Province, 11˚37'38''S, 31˚33'56''E, 27–30.iv.2019, MV and LepiLED light traps, Dérozier, V., László, G., Miles, W. leg., unique numbers: ANHRTUK 00083509, 00083492; 3 males, 1566m, Senka Hill, Mukulizi Forest Reserve, Muchinga Province, 09˚05'43''S, 32˚05'06''E, 1–6.v.2019, MV and LepiLED light traps, Dérozier, V., László, G., Miles, W. leg., unique numbers: ANHRTUK 00082345, 00082352, 00083658; 2 males, 1280m, Kalungu, North of Isoka, Muchinga Province, 09˚40'52''S, 32˚42'50''E, 30.iv.–1.v.2019, LepiLED and Actinic light traps, Dérozier, V., László, G., Miles, W. leg., unique numbers: ANHRTUK 00094656, 00136107; 2 females, 1416m, Lunzua Falls, 20 km South of Mpulungu, Northern Province, 08˚55'38''S, 31˚09'31''E, 11–16.v.2019, MV light trap, Dérozier, V., László, G., Miles, W. leg., unique numbers: ANHRTUK 00083164, 00083167; 1 female, 1187m, Lumangwe Falls, Kalungwishi River, 09˚32'33''S, 29˚23'17''E, 4–7.ii.2019, MV light trap, Dérozier, V., Mulvaney, L., Smith, R., Takano, H. leg., unique number: ANHRTUK 00076553; 1 female, 1420m, Chilambwe Falls, Kafubu River, 09˚50'13''S, 30˚43'35''E, 8–12.ii.2019, MV light trap, Dérozier, V., Mulvaney, L., Smith, R., Takano, H. leg., unique number: ANHRTUK 00072401; 1 male, 1316m, Nkwaji, Mwinilunga, 11˚36'22''S, 24˚33'17''E, 29.x.–3.xi.2013, light trap, Smith, R., Takano, H., Chmurova, L. & Smith, L., unique number: ANHRTUK 00201087, gen. prep. No.: AV4565; 1 male, the same locality but 27.viii.2013, Smith, R., Takano, H. leg., unique number: ANHRTUK 00201088 (ANHRT); **TANZANIA**: 1 male, 1759m, Maskati, Nguru Mountains, 06˚03'29.3''S, 37˚29'08.4''E, 4–7.vii.2010, light trap, Smith, R. & Takano, H. leg., unique number: ANHRTUK 00201046, gen. prep. No.: AV4548; 1 male, 1964m, Giting, Mt. Hanang, 04˚24'14''S, 35˚24'56''E, 31.vii.–4.viii.2012, light trap, Smith, Takano & Garner leg., unique number: ANHRTUK 00201045, gen. prep. No.: AV4562 (ANHRT); **KENYA**: 1 male, Nairobi, 5.iv.1919, Dr. van Someren leg., Rothschild Bequest B.M. 1939-1, unique number: NHMUK 010916142, gen. prep. No.: BMNH Arctiidae 5630 (NHMUK); 1 female, Central Province, Thika District, 8 km SW Thika, Karamaini Estate, 1500m, S01˚02'764'', E36˚59'472'', 24.ix.2011, A.J. Kingston [leg.], gen. prep. No.: AV6535 (AKW); **ETHIOPIA**: 6 males, 1 female, 05˚18'47''N, 36˚44'07''E, 12 km W of Jinka, border of Mago National Park, 6.v.2008, 930m, at light, H. Hacker & Schreier H.-P. leg., gen. prep. Nos.: ZSM Arct. 2020-217, 2020-218, 2020-219 (males), ZSM Arct. 2020-220 (female) (prepared by Volynkin) (ZSM); **ZIMBABWE**: 5 females, 1900m, Manicaland Province, Vukutu, 18˚21'52''S, 32˚36'29''E, 25–26.iv.2011, R. Yakovlev leg., unique numbers: ANHRTUK 00143189, 00143194, 00143202, 00143222, 00143235; 1 male, 1580m, Manicaland Province, Bvumbe, Seldomseen Holiday Cottages, 19˚06'14''S, 32˚45'17''E, 12–14.iv.2011, R. Yakovlev leg., unique numbers: ANHRTUK 00138016 (ANHRT); **MOZAMBIQUE**: 12 males, 11 females, 937m, Sofala Province, Gorongosa NP, Mt. Gorongosa SE slope (Riverine Forest / Grassland), 18˚28'58.9''S, 34˚02'40.6''E, 8–9.viii.2018, Actinic light trap, László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00046474–00046478, 00074325–00074328, 00075628–00075630, 00075668–00075672, 00075708, 00075715, 00075874, 00075882, 00075900, 00078990, gen. prep. Nos.: AV5296 (male), AV5297 (female); 2 males, 1 female, 1245m, Zambezia Province, Mt. Namuli SW slopes near Mucunha village (forest remnant), 15˚22'33''S, 37˚05'05.7''E, 15–16.viii.2018, MV and Actinic light traps, László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00049402, 00049449, 00049450; 3 males, 1 female, Zambezia Province, Mt. Namuli SW slopes near Mucunha village (secondary vegetation / farmland), 15˚21'27''S, 37˚05'18''E, 14–15.viii.2018, MV light trap, László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00050579, 00050583, 00050584, 00050589, gen. prep. No.: AV5298 (male); 1 male, 4 females, 630m, Manica Province, Chimanimani National Reserve, Moribane Forest, Ndzou Camp (Moist Forest), 19˚44'01.4''S, 33˚20'15.1''E, 3–5.viii.2018, MV light trap, László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00047082, 00047821, 00049150, 00049152, gen. prep. No.: AV5299 (male); 3 females, 708m, Manica Province, Chimanimani National Reserve, Nyabawa village (Eastern Miombo Woodland), 19˚42'09.4''S, 33˚01'53.1''E, 5–6.viii.2018, LepiLED light trap, László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00046392–00046394 (ANHRT).

Diagnosis. The forewing length is 11.0–14.0 mm in males and 12.0–15.0 mm in females. The new species (Figs 8–11) is distinguished externally from *G. bettoni* **sp. n.** (Figs 5–7) by the smaller size and the less acute forewing apex. Compared to other congeners (Figs 1–4, 12–16), *G. lydiae* **sp. n.** has a wider and deeper yellow costal stripe which is pale yellow in other species. The genitalia of both sexes of *G. lydiae* **sp. n.** (Figs 21, 22, 28) resemble those

of *G. bettoni* **sp. n.** (Figs 19, 20, 27), the distinctive features between the two taxa are discussed in the diagnosis of the latter species. The male genital capsule of the new species (Figs 21, 22) is also reminiscent of *G. proleuca* (Figs 17, 18), but is distinguished by the narrower valva with a narrower distal lobe and a somewhat longer distal saccular process. The phallus of the new species is shorter than in *G. proleuca* (in proportion to the length of the tegumen-vinculum complex) and more curved ventrally. The main chamber of the vesica of *G. lydiae* **sp. n.** is shorter and narrower than in *G. proleuca*, the lateral diverticulum is more elongate and the cornutus is markedly thinner. The female genitalia of the new species (Fig. 28) differ from those of *G. proleuca* (Fig. 25) in the narrower antrum, the narrower anterior sclerotised section of the ductus bursae, and the considerably shorter posterior diverticulum of the corpus bursae. Female genitalia differences with *G. bettoni* **sp. n.** (Fig. 27), another similar species, are given previously under this species.

Distribution. Known from northern Mozambique, Zimbabwe, Zambia, Tanzania, Kenya and Ethiopia (Fig. 31).

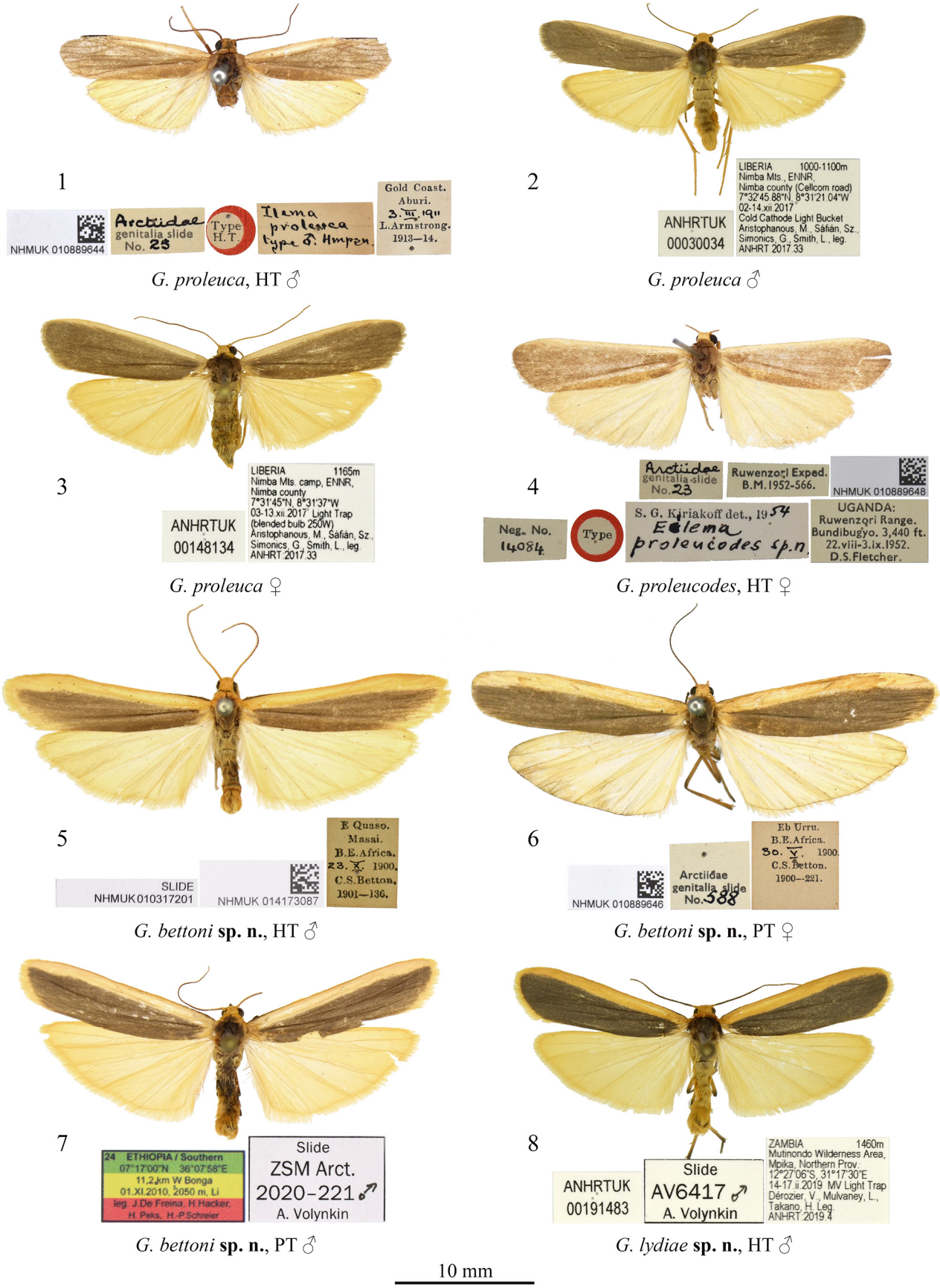
Etymology. The new species is named after Mrs Lydia Mulvaney, curator and researcher at the African Natural History Research Trust, and collector of the holotype and a part of the paratype series.

***Gracililema smithi* sp. n.**
(Figs 12–16, 23, 24, 29)

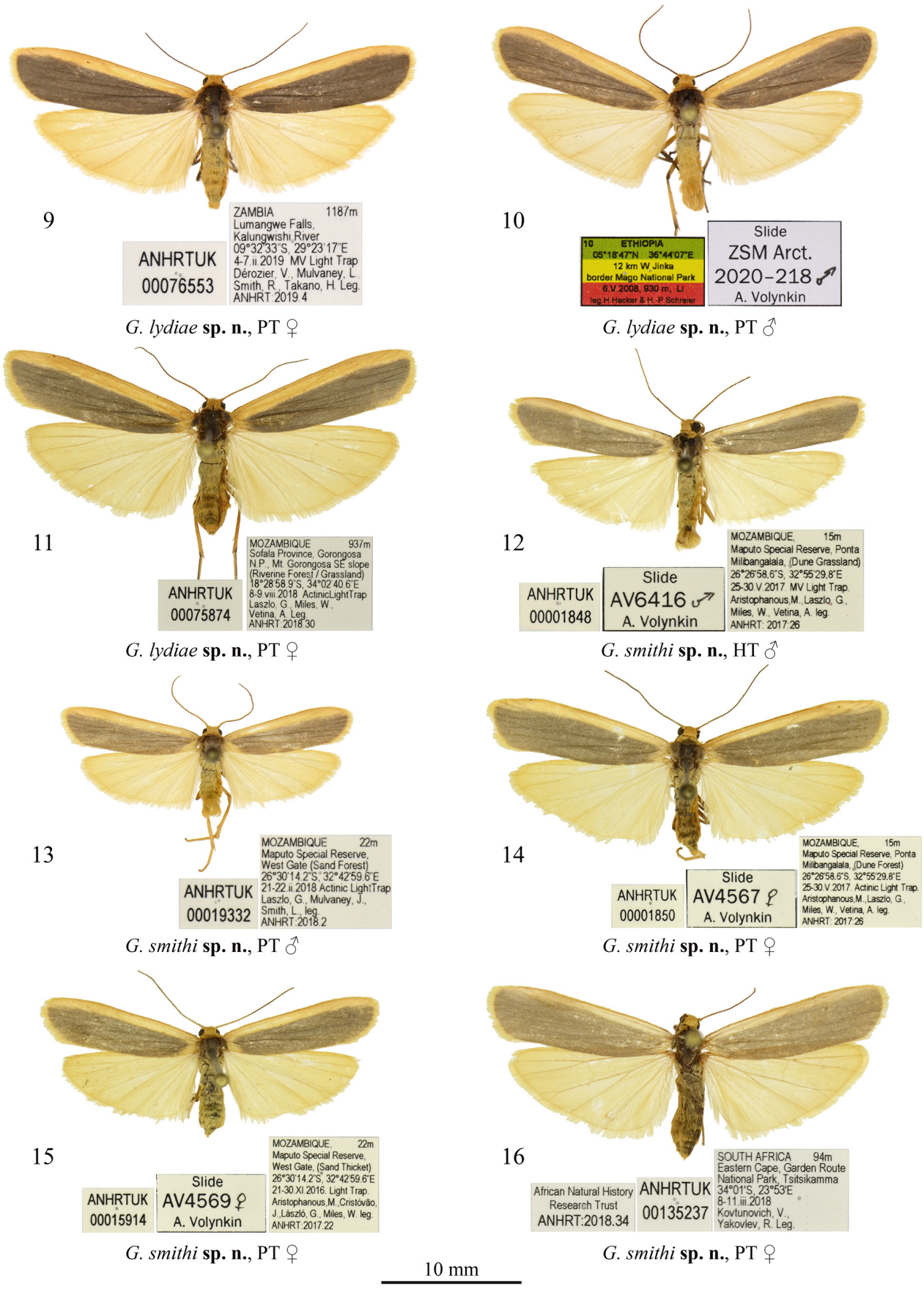
Type material. **Holotype** (Figs 12, 23): male, "Mozambique, 15m Maputo Special Reserve, Ponta Milibangalala, (Dune Grassland) 26˚26'58.6''S, 32˚55'29.8''E 25–30.V.2017. MV Light Trap. Aristophanous, M., Laszlo, G., Miles, W., Vetina, A. leg. ANHRT: 2017:26", unique number: ANHRTUK 00001848, gen. prep. No.: AV6416 (ANHRT).

Paratypes (26 males and 14 females): **MOZAMBIQUE**: 3 males, 5 females, same data as in holotype, MV and Actinic light traps, unique numbers: ANHRTUK 00001846, 00001847, 00001849–00001851, 00001853, 00201089, 00201090, gen. prep Nos.: AV4566 (male) and AV4567 (female); 11 males, 22m, Maputo Special Reserve, West Gate (Sand Thicket), 26°30'14.2''S, 32°42'59.6''E, 30.v.–9.vi.2017, MV and Actinic light traps, Aristophanous, M., László, G., Miles, W., Vetina, A. leg., unique numbers: ANHRTUK 00001540, 00001543, 00001839, 00006949, 00007120, 00007122, 00007477, 00007478, 00007555, 00010811, 00201091, gen. prep. Nos.: AV4440, AV4570; 5 males, 4 females, same locality as previous, 21–30.xi.2016, light trap, Aristophanous, M., Cristóvão, J., László, G., Miles, W. leg., unique numbers: ANHRTUK 00002166, 00002179, 00007498, 00010715, 00014800, 00014965, 00015761, 00015861, 00015914, gen. prep. Nos.: AV4568 (male), AV4569 (female); 3 males, same locality as previous, 21–22.ii.2018, Actinic light trap, László, G., Mulvaney, J., Smith, L. leg., unique numbers: ANHRTUK 00019330–00019332; 1 male, 9m, Maputo Special Reserve, Mangrove Camp (Mangrove–Woodland Mosaic), 26°19'35.9''S, 32°42'35.7''E, 7–9.xii.2016, MV, Aristophanous, M., Cristóvão, J., László, G., Miles, W. leg., unique number: ANHRTUK 00004550; 1 female, 17m, Maputo Special Reserve, Futi Corridor (Sand Forest Woodland Mosaic), 26°32'10.1''S, 32°43'09.7''E, 23–24.ii.2018, 125W MV Light Trap, László, G., Mulvaney, J., Smith, L. leg., unique number: ANHRTUK 00027709; 1 female, 11m, Maputo Special Reserve, forest clearing campsite (Sand Forest), 26°17'24''S, 32°45'45''E, 9–12.vi.2017, MV Light Trap. Aristophanous, M., László, G., Miles, W., Vetina, A. leg., unique number: ANHRTUK 00201047 (ANHRT); **SOUTH AFRICA**: 1 male, 1 female, 410m, KwaZulu-Natal, Vernon Crookes Nature Reserve, 30˚16'29''S, 30˚36'32''E, 11–14.iii.2018, Kovtunovich, V., Yakovlev, R. leg., unique numbers: ANHRTUK 00111790, 00111817, gen. prep. No.: AV6445 (female); 1 female, 430m, KwaZulu-Natal, Pongola, Belvedere Game Ranch, 27˚31'S, 31˚45'E, 22–26.ii.2018, Kovtunovich, V., Yakovlev, R. leg., unique number: ANHRTUK 00104311; 2 males, 1 female, 94m, Eastern Cape, Garden Route National Park, Tsitsikamma, 34˚01'S, 23˚53'E, 8–11.iii.2018, Kovtunovich, V., Yakovlev, R. leg., unique numbers: ANHRTUK 00135214, 00135237, 00135256, 00140923 (ANHRT).

Diagnosis. The forewing length is 10.0–13.0 mm in males and 11.0–13.5 mm in females. The new species (Figs 12–16) is reminiscent of *G. lydiae* **sp. n.** (Figs 8–11), but can be distinguished by its narrower and paler yellow costal stripe. The male genital capsule of the new species (Figs 23, 24) differs from those of its congeners (Figs 17–22) in the wider intervincular area, the more convex costa and the thinner distal saccular process. Additionally, compared to *G. lydiae* **sp. n.** (Figs 21, 22), the valva of *G. smithi* **sp. n.** is distally narrower and the distal saccular process is shorter. The phallus of the new species is thicker than those of *G. proleuca* and *G. lydiae* **sp. n.** and has

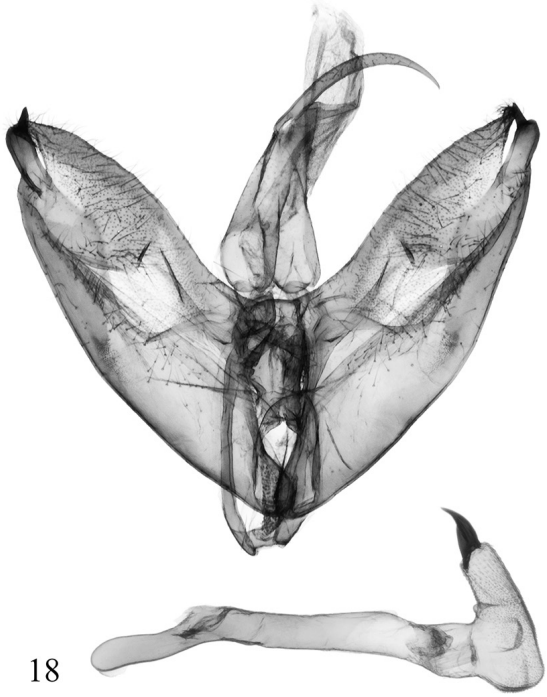


FIGURES 1–8. *Gracililema* spp.: adults. Depositories of the specimens: 1 and 4–6 in NHMUK (©The Trustees of NHMUK); 2, 3 and 8 in ANHRT; 7 in ZSM.

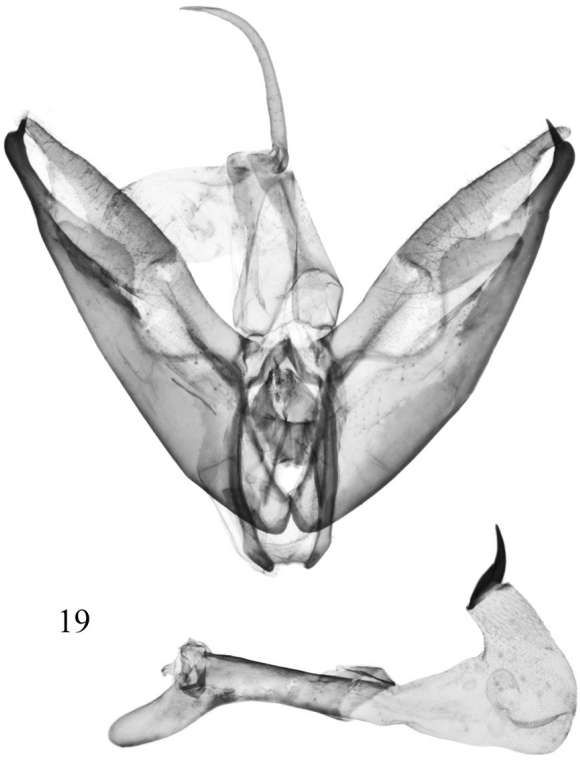


FIGURES 9–16. *Gracililema* spp.: adults. Depositories of the specimens: 9, 11–16 in ANHRT; 10 in ZSM.

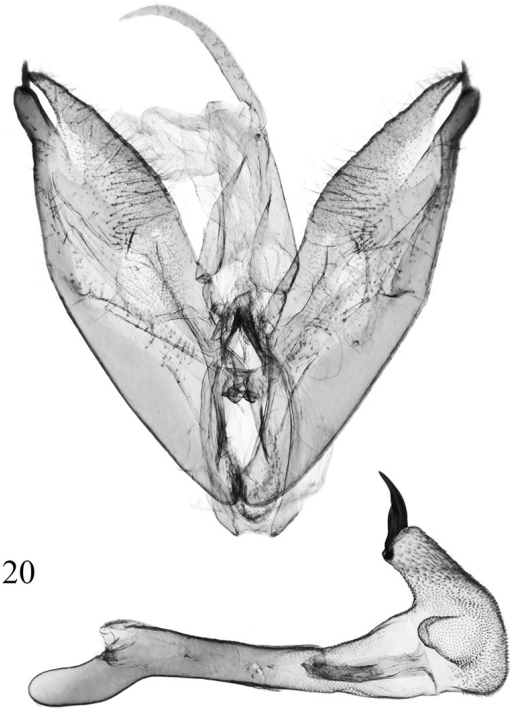
***G. proleuca*, HT**
Ghana, Aburi, slide BMNH Arctiidae 25



G. proleuca
Ivory Coast, Mt. Tonkoui Peak, slide AV4549



***G. bettoni* sp. n., HT**
Kenya, Guaso Masai stream, slide NHMUK 010317201



***G. bettoni* sp. n., PT**
SW Ethiopia, SNNPR, slide ZSM Arct. 2020-221

FIGURES 17–20. *Gracililema* spp.: male genitalia. Depositories of the specimens dissected: 17 and 19 in NHMUK (©The Trustees of NHMUK); 18 in ANHRT; 20 in ZSM.

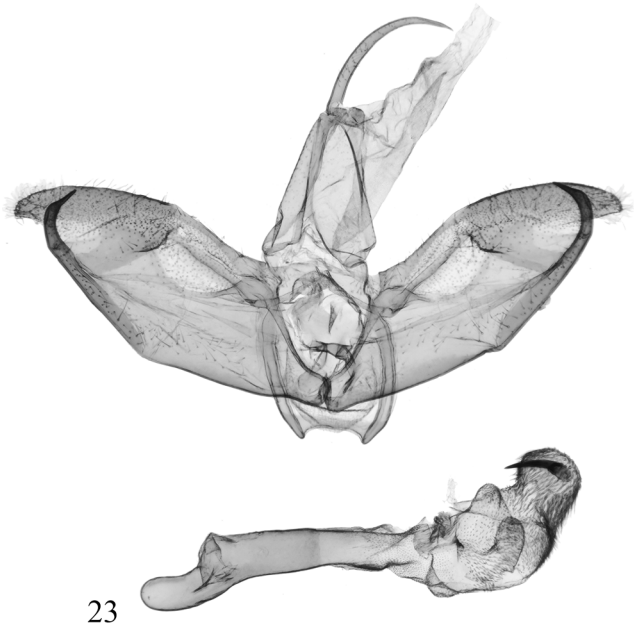
a shorter coecum. The vesica of *G. smithi* **sp. n.** is longer and markedly broader than those of its congeners with two additional lateral diverticula covered in fine spinulose scobination (whereas the vesica of *G. proleuca* and *G. lydiae* **sp. n.** is granulated). The cornutus of the new species is basally thinner than in *G. proleuca* (Figs 17, 18) and *G. bettoni* **sp. n.** (Figs 19, 20) and somewhat longer and thicker compared to that of *G. lydiae* **sp. n.** (Figs 21, 22). The female genitalia of *G. smithi* **sp. n.** (Fig. 29) are similar to those of *G. lydiae* **sp. n.** (Fig. 28) but distinguished by the somewhat broader antrum, the slightly narrower and longer anterior sclerotised section of the ductus bursae, and the shorter and narrower posterior diverticulum of the corpus bursae.

21

***G. lydiae* sp. n., HT**
Zambia, Mutinondo Wilderness Area, slide AV6417

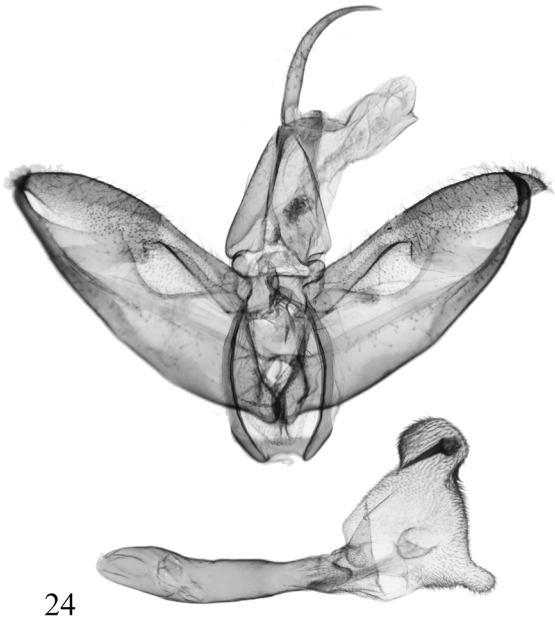
22

***G. lydiae* sp. n., PT**
SW Ethiopia, slide ZSM Arct. 2020-217 Volynkin



23

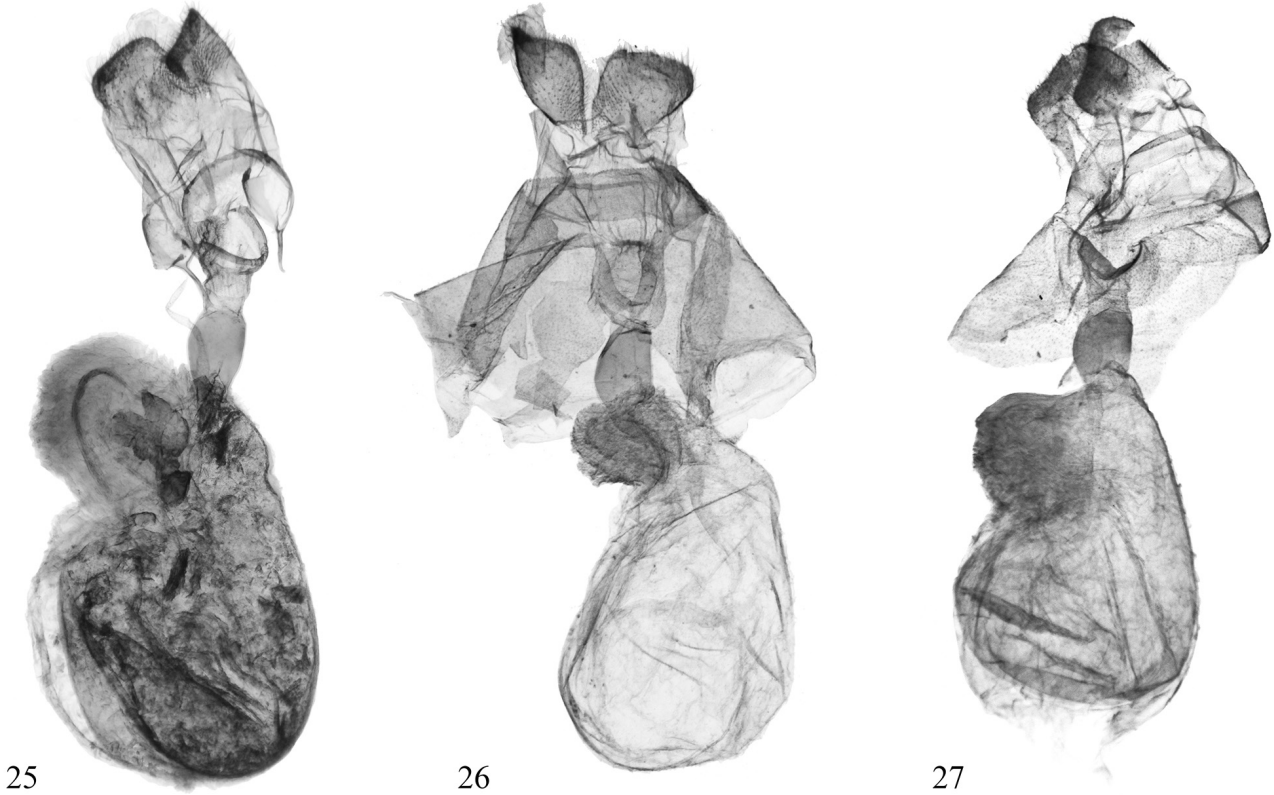
***G. smithi* sp. n., HT**
S Mozambique, Maputo Special Reserve, slide AV6416



24

***G. smithi* sp. n., PT**
S Mozambique, Maputo Special Reserve, slide AV4566

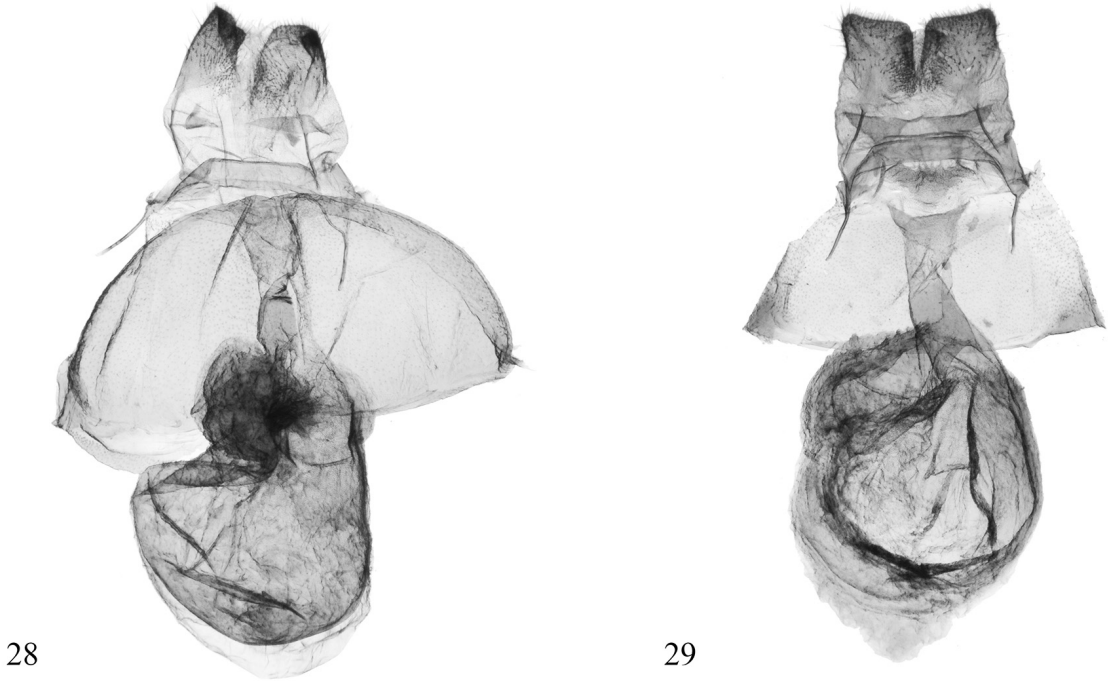
FIGURES 21–24. *Gracililema* spp.: male genitalia. Depositories of the specimens dissected: 21, 23 and 24 in ANHRT; 22 in ZSM.



G. proleuca
Ivory Coast, Mt. Tonkoui Peak,
slide AV4559

***G. proleucodes*, HT**
Uganda, Ruwenzori Range,
slide BMNH Arctiidae 23

***G. bettoni* sp. n., PT**
Kenya, Eburru,
slide BMNH Arctiidae 588



***G. lydiae* sp. n., PT**
Zambia, Mutinondo Wilderness Area, slide AV6444

***G. smithi* sp. n., PT**
S Africa, KwaZulu-Natal Prov., slide AV6445

FIGURES 25–29. *Gracililema* spp.: female genitalia. Depositories of the specimens dissected: 25, 28 and 29 in ANHRT; 26 and 27 in NHMUK (©The Trustees of NHMUK).

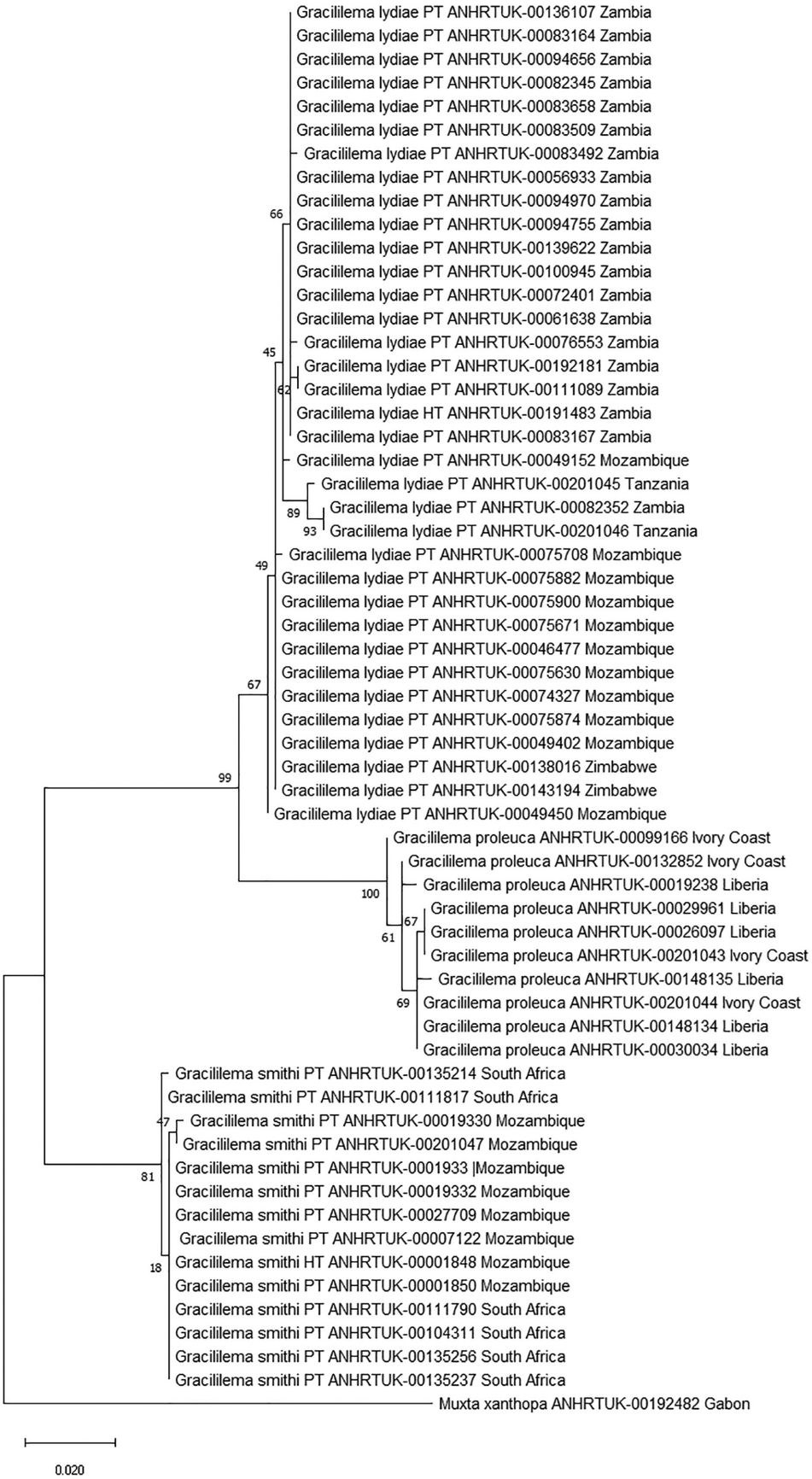


FIGURE 30. Maximum Likelihood tree of *Gracililema* based on COI-5P sequenced. Scale indicates substitution rate per site. Bootstrap support values indicated on branches.

Distribution. Known from southern Mozambique and South Africa (provinces of KwaZulu-Natal and Eastern Cape) (Fig. 31).

Etymology. The new species is dedicated to Mr Richard Smith, Chairman of the Board of Trustees, African Natural History Research Trust, who, through organising and undertaking numerous entomological expeditions to Sub-Saharan Africa has enabled the discovery of numerous species new to science.

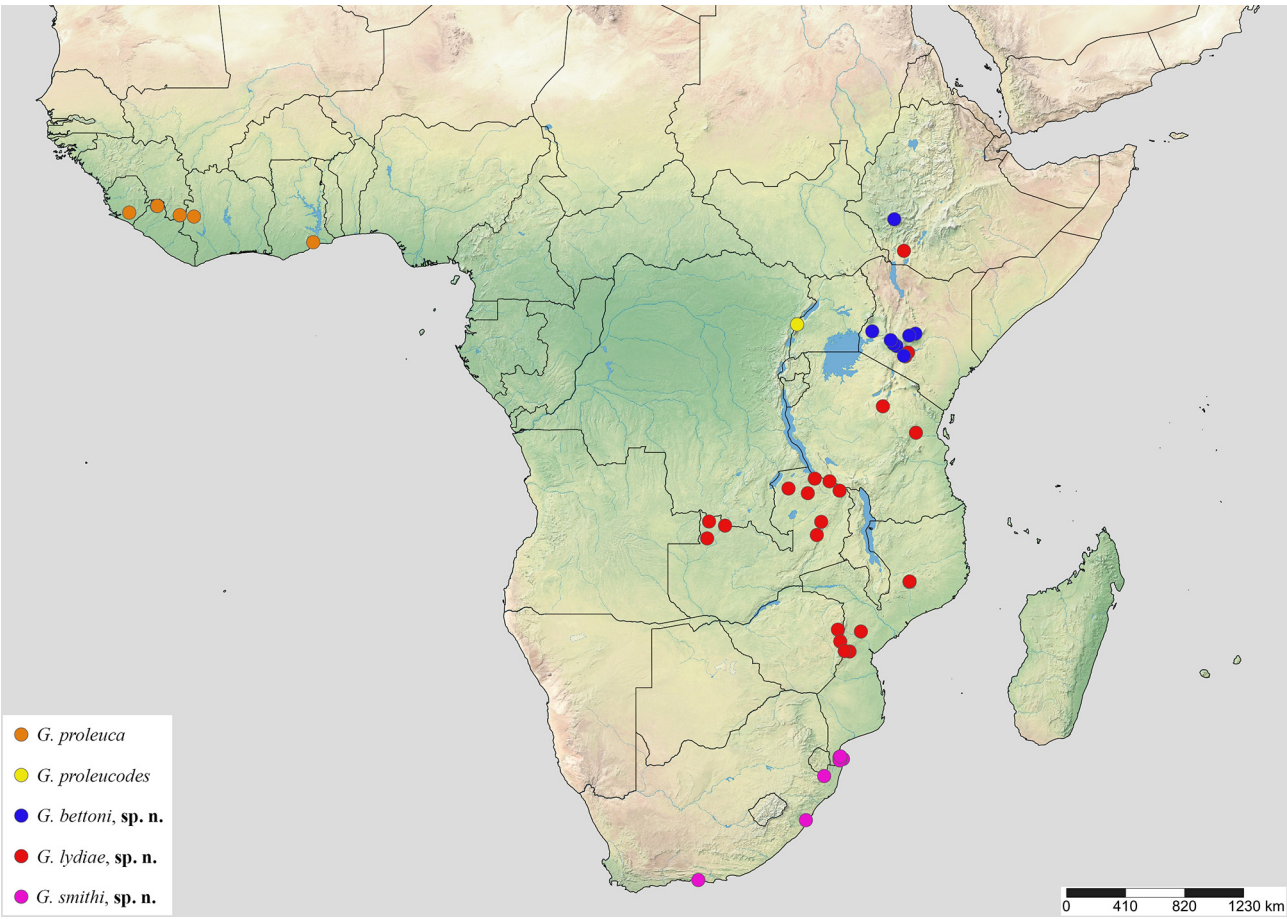


FIGURE 31. Distribution map of *Gracililema* spp.

Acknowledgements

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The author declares that to the best of his knowledge he conforms to the national regulations and meets with the conditions and requirements of International Conventions concerning collecting/export and handling of the specimens presented in this article.

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