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New information on *Trichophiala devylderi* Aurivillius, 1879. Full description of both sexes, genetic study and lectotype designation (Lepidoptera, Eupterotidae)

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Abstract: Described from Namibia, *Trichophiala devylderi* Aurivillius, 1879 is a species for which, apart from the original description of female "types", little is known. Building upon recent observations in the field, investigations in various museums that preserve specimens, and a review of the literature, we describe for the first time the habitat, the known distribution, the morphology of both sexes including the presence of two phenotypes, and the genitalia of both male and female. We also provide genetic information from several specimens that reveal little variation in the standard animal DNA barcode. Finally, we designate a lectotype among the three specimens preserved at the Naturhistoriska Riksmuseet, Stockholm, Sweden.

Keywords: *Trichophiala devylderi* - Eupterotidae - Striphnopterygidae - moths - Namibia - Africa - Aurivillius - lectotype.

INTRODUCTION

Trichophiala devylderi Aurivillius, 1879 was described from Namibia as type species of the monotypic genus *Trichophiala* (Aurivillius, 1879). In a subsequent publication on the then family Striphnopterygidae, Aurivillius (1901) briefly re-described the species in English after having used Latin in the original 1879 report. The species belongs to the family Eupterotidae Swinhoe, 1892, and was included in the subfamily Striphnopterigynae Wallengren 1858 in the recent checklist of the Bombycoidea (Insecta: Lepidoptera) by Kitching *et al*. (2018). Although described over 140 years ago, *Trichophiala devylderi* is poorly known.

Building on field observations in Namibia in 2017, subsequent literature searches and investigations in museums, we review the available information, present a distribution map based on all known records, provide a complete description of the male of this species, describe the genitalia of both sexes for the first time, note the presence of two morphologically distinct phenotypes, and report limited genetic variation among individuals from the analysis of the standard animal DNA barcode (Hebert *et al.*, 2003). In addition, we demonstrate the need for a lectotype to be designated and proceed with its designation among three available syntypes. Finally, we propose a list of research objectives that would enhance the overall knowledge of the species.

METHODS

In August 2017 one of us (MR) spent time in Namibia and on two occasions (8 August and 21 August) stayed overnight at a lodge some 5 km east of the capital, Windhoek. During both evenings, starting at around 8 p.m. dozens of individuals of a light brownish moth appeared around the lamps of the lodge. The following mornings, a few individuals were still observed on the walls near the lamps but disappeared almost completely around 09h00. Seven specimens (six males and one female) were collected and later prepared for analysis. They were eventually identified by one of us (VZ) as *Trichophiala devylderi* Aurivillius, 1879 (Eupterotidae).

Given the scarcity of information on this species, a thorough literature search was undertaken exploring articles,

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books and internet sites related to African moths and the family Eupterotidae using the following keywords or combinations: *Trichophiala devylderi,* Eupterotidae, African moths, Namibian moths, South African moths, Aurivillius, De Vylder.

The site Biodiversity Heritage Library (biodiversity-library.org) was extensively consulted for older publications.

Several large natural history museums and moth experts were contacted to gather information on the species and on additional specimens available. Besides the Muséum d'histoire naturelle (MHNG) of Geneva, the Swedish Museum of Natural History (NHRS or Naturhistoriska Riksmuseet, Stockholm), and the Muséum national d'Histoire naturelle (MNHN) of Paris, these included: Dr Wolfram Mey of the Museum für Naturkunde (MNB), Berlin, Germany; Dr Ole Karsholt of the Natural History Museum of Denmark in Copenhagen, Denmark; Dr Alessandro Giusti of the Natural History Museum, London, U.K; and Dr László Ronkay, Budapest, Hungary.

The following natural history museums were also contacted to enquire about the possible presence of specimens: Zoologische Staatsammlung Munich, Germany (ZSM); Museum Thomas Witt, Munich, Germany (MWM); and Senckenberg Museum, Frankfurt, Germany (SMF). Additionally, natural history museums of the African sub-region where *T. devylderi* is found were also contacted. They included the Museums Association of Namibia, Windhoek, Namibia, the Iziko Museums in Cape Town, South Africa, and the Ditsong National Museum of Natural History in Pretoria (DNMNHP), South Africa.

The platform iNaturalist was consulted. Finally, prompted by Mr Jeremy Dobson, in January 2018 the Lepidopterists' Society of Africa issued a call to its members for information on the species through the African Butterflies News, January/February 2018 (Dobson, 2018).

The morphological description is based on the analysis of several specimens preserved at MWM, ZSM (4 males and one female) and three specimens of both sexes preserved at MHNG that were studied using techniques including dissection of the genitalia of eight specimens. The wing pattern is described based on specimens available in MHNG, MNB, and NHRS.

Genetic analyses were carried out in the molecular biology laboratory SSM ("Service de Systématique Moléculaire", UMS2700) at MNHN, Paris. We sampled a single leg from each of 12 recently collected specimens [between 2008 and 2017; vouchers deposited in MWM (6), MHNG (3) and MNB (3)] representing light and dark forms (see below) originating from five different sites in Namibia. Each leg went through DNA extraction using a Macherey-Nagel NucleoSpin® 96 tissue kit, and following the manufacturer's protocol, applying a semi-automated procedure implemented on an Eppendorf Liquid Handling Workstation epMotion® 7075 VAC. PCR amplification and sequencing followed the high-throughput protocol described in Sire *et al*. (2019), except for the use of primer pairs LCO1490/MLepR1 and MLepF1/HCO2198 (Folmer *et al*., 1994; Hajibabaei *et al.,* 2006). This approach uses a dual-indexing multiplexing strategy for library construction and sequencing on the Illumina MiSeq platform. We used Geneious R10 (https:/www.geneious.com) for filtering, cleansing, assembling and aligning the paired-end reads produced with this approach. We also processed at SSM one of the original syntypes of *T. devylderi* preserved at NHRS; because this specimen was collected in the second half of the 19th century, we used a dedicated laboratory protocol targeting shorter DNA fragments as in Hausmann *et al*. (2009). DNA was extracted using DNeasy extraction kits (Qiagen) for blood and animal tissues and then amplified using six different primer pairs as described in Lees *et al*. (2010). PCR products were deposited on 2% agarose gel, checked under UV light and only successfully amplified DNA templates were sent for Sanger sequencing on ABI 3730XL sequencer at Eurofins MWG Operon sequencing facilities (Ebersberg, Germany). We used Geneious R10 for contig assembly, editing and alignment. All consensus sequences obtained were uploaded into BOLD (www.boldsystems.org) along with other specimen information (taxonomy, voucher depository, sex, and collecting data) and images. Complete records and GenBank accession numbers are publicly available from dataset DS-TRICHO21 (DOI: dx.doi.org/10.5883/DS-TRICHO21), along with those of four additional DNA barcoded records kindly made available to us by Thierry Bouyer. Genetic distances were computed using analytical tools implemented in BOLD (Ratnasingham & Hebert, 2007), using uncorrected p-distances.

RESULTS

History of the description of *Trichophiala devylderi*

Trichophiala devylderi was described by the Swedish entomologist Per Olof Christopher Aurivillius in 1879 (Aurivillius, 1879). The original publication in Latin first described the main features of the family Phialidae (today known as Eupterotidae) (Nässig & Oberprieler, 2007) and of the new genus *Trichophiala* established to accommodate the new species (pp. 53-54), signalling its connection to the genus *Phiala* Wallengren, 1860, but distinguishable on the basis of antennae, tibiae, and a few other details. This was followed by a short description of the female types of the new species (Fig. 1). Later, Aurivillius (1901) re-described the species (p. 14 and pl. 3) as part of a review of the family that had become known as Striphnopterygidae presenting an image of the female (Fig. 1).

Aurivillius described the new species based on female specimens collected in Namibia by the Swedish naturalist

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32. *Trichophiala Devylderi* n. sp. griseo-flava, tarsibus nigro-annulatis; alis omnibus utrinque sqvamis fusco-nigris sat dense irroratis, anticis fasciis duobus transversis — una in disco, altera pone medium — posticis fascia una sqvamis acervatis nigro-fuscis formata. ♀ Long. al. exp. 48–55 m.m.

Habitat in Damara mense Maji. G. DE VYLDER.

Descr. Caput cum thorace longissime, abdomen brevius flavo-griseo-hirsutum. Articuli tres ultimi abdominis abrupte attenuati et verticaliter penduli. Tarsi plus minus evidenter nigro-annulati. Antennæ breviter pectinatæ; radii plus minus clavati, summo apice setis 1—2 instructi. Color fundamentarius alarum pallide griseo-flavus, subpellucidus. Alæ omnes autem sunt utrinque sqvamis nigro-fuscis plus minus dense irroratæ. Hæ sqvamæ ad basin, in margine exteriore et in margine anteriore alarum anticarum sæpissime sunt densius acervatæ et fasciam non bene determinatam pone medium formant. Alæ posticæ etiam talem etsi multo obsoletiorem præbent fasciam. Fasciæ infra plus minus evanescentes. Ciliæ omnes longæ unicolores griseo-flavæ.

4.

← a b

Fig. 1. (a) Original 1879 description of *Trichophiala devylderi* Aurivillius, 1879; (b) first image of the new species published by Aurivillius in 1901.

Gustaf De Vylder (1827-1908) either in 1873 or 1874. Three of them are preserved at NHRS and one at MNB (see Table 1). One of these specimens is labelled "Type" by Aurivillius.

De Vylder spent three years in southern Africa, financed by the Swedish Government on the condition of collecting natural history specimens for Swedish museums. After leaving Sweden in the summer of 1871, De Vylder reached Cape Town in November of that year, following a long journey through Madeira, the Azores, St. Vincent and Rio de Janeiro. In March 1873, he finally reached Port Nolloth and, from there, the territory of today's Namibia. During the years 1873-1874, he collected a large number of entomological specimens, including in the region at the time called Damaraland (Damara being synonymous with Herero, one of the ethnic groups of Namibia), and Damaraland being the territory in the north-central part of what later became Namibia, comprised between the Swakop River and the Windhoek area in the south, the Ugab River and the Ovamboland in the north, the Namib Desert in the west, and the northern part of the Kalahari Desert in the east. His diary (Rudner & Rudner, 1998) describes in detail his long journey and his work methods, but does not refer directly to the observation and collecting of the moths described by Aurivillius. Upon De Vylder's return to Sweden in 1874, the moths were made available to the NHRS and Aurivillius.

Literature review

Several articles were identified that mentioned the species. Besides the 1879 and 1901 descriptions by Aurivillius, the consultation of the site Biodiversity Heritage Library (biodiversitylibrary.org) yielded several citations of the species in general lists of moths, especially during the period 1880-1917, with no description. These include a 1910 mention of three females and one undefined specimen collected at three different locations of today's Namibia (Grünberg, 1910). In 1930, in the book by A. Seitz "Die Gross-Schmetterlinge der Erde", M. Gaede provided a morphological description of the species (Gaede, 1930). He wrote the following (translated from German):

"Palps short. Antennae of male as in *Lichenopteryx,* in female with only short pectination. Fore tibiae with 2 spurs. Veins on forewings rather straight. Vein 5 close under upper corner, veins 6 + 7 + 8 + 9 + 10 stalked. In hindwings vein 5 far forward, veins 6 + 7 pedunculate, vein 8 only in male anastomosing with the cell groove, in the female connected with it by a bar. Adhesive bristle present in male, absent in female. Thorax dark brownish grey. Wings greyish yellow, brown sprinckled and with four bands on forewings: 2 broader ones parallel, 2 weaker ones in between. Margin darkly sprinckled, especially on the upper surface very broad and rather sharply defined. Abdomen orange-brown. 50-55 mm. South-West Africa*"*.

For the first time Gaede mentioned three features of the male. They seem to be similar, if not identical, to those of several Eupterotidae, in particular some species of the genus *Lichenopteryx* and, to some extent, *Phiala, Poloma,* and *Phillalia.* The three features described are quite similar to what was already reported in Aurivillius (1901) for Striphnopterygidae. Seitz's book also presents

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Table 1. List of specimens of *T. devylderi* preserved in different collections or reported in published materials. n.a. = not available; (DMNG) = from Grünberg (1910) in Denkschriften der Medicinisch-Naturwissenschaftlichen Gesellschaft zu Jena; RCTB = Research Collection of Thierry Bouyer, Chênée, Belgium; N = convenience numbers for further reference. Note: Most specimens belong to the sandy-gray form; specimens 11, 12, 18, 33, 34, 72, 78, 79 belong to the darker pinkish-brown form – see below.

N	Site	Country	Sex	Date	Leg.	Collection
1-3	Damara	Namibia	3♀	6/5/?1873	De Vylder	NHRS
4	Damara	Namibia	1♀	6/5/?1873	De Vylder	MNB
5	Damaraland	Namibia	n.a.	n.a.	n.a.	(DMNG)
6-7	Windhoek	Namibia	2♀	n.a.	Lindt	(DMNG)
8	Windhoek	Namibia	1♂	n.a.	Zobrys	MNB
9-10	Windhoek	Namibia	2♀	n.a.	Lindt	MNB
11-14	Windhoek	Namibia	3♂ 1♀	VI, VIII	n.a.	DNMNHP
15-18	Windhoek	Namibia	4♂	1/7/1998	G. Betti	RCTB
19-25	Windhoek Auas Berge	Namibia	7♂	26/4/2000	Burmeister	ZSM
26-32	Korlia vicinity	Namibia	6♂ 1♀	8-21/8/2017	Raviglione	MHNG
33-45	Okahandja	Namibia	8♂ 5♀	I, V	n.a.	DNMNHP
46	Okahandja	Namibia	1♂	17/5/1955	n.a.	SMF
47	Grootfontein	Namibia	1♂	IX	n.a.	DNMNHP
48-51	Abachaus	Namibia	3♂ 1♀	v,vi,vii	n.a.	DNMNHP
52	Portsmut	Namibia	1♂	VI	n.a.	DNMNHP
53-61	Farm Valencia 42	Namibia	9♂	IV, VI	n.a.	DNMNHP
62	Omuweroumue	Namibia	1♀	n.a.	Seewald	MNB
63	Khomas, Farm Vaalgras	Namibia	1♂	21/9/2008	F. Koch	MNB
64-71	Otjiwarongo	Namibia	8♂	25-27/7/2012	W. Mey	MNB
72	Otjiwarongo	Namibia	1♂	4/8/2010	N. Pürzer & C. Ganslmeier	MWM
73	Waterberg	Namibia	1♀	22/5/1909	Seewald	(DMNG)
74-79	Outjo Umg. Karanjab	Namibia	6♂	15/7/2010	W. Struijlaart & K. Lisbrand van der Meer	MWM
80-87	Bushcamp Umg. Khomas	Namibia	7♂ 1♀	31/8/2010	W. Cave & T. A. Newtown-Chance	MWM
88	Livingstone (8 ml N)	Zambia	1♂	25-28 V 1954	A.J.T. Janse	DNMNHP
89-90	Victoria Falls Camp	Zimbabwe	2♂	3-4- V 1954	A.J.T. Janse	DNMNHP

an image of the female of *T. devylderi* (Fig. 2). However, twenty-five years after Seitz's publication, Forbes still refers to the male of *T. devylderi* as unknown (Forbes, 1955). No description of the genitalia of either sex is available from the literature. The book by Pinhey on Southern African moths does not record the species (Pinhey, 1975), nor does the monograph on the Lepidoptera of the Brandberg Massif in Namibia (Mey, 2004, 2007).

One photograph of one of the type specimens was found on two websites. The photograph is of a specimen hosted by the NHRS, where three of the type specimens are preserved (Naturhistoriska Riksmuseet, 2021). Besides the NHRS website, the same image is shown on AfroMoths, a website providing an extensive online database on Afrotropical moth species (De Prins & De Prins, 2011-2021); however, this website also shows males erroneously identified as *T. devylderi* that belong to other Eupterotidae species, presumably of the genus *Phiala.* The website "Lepidoptera and some other life forms" (Savela, 1990-2021) lists the species, but provides no additional information. The platform iNaturalist has no observation of *T. devylderi* (iNaturalist, 2011-2021) as of the month of January 2022. Finally, the Barcode of Life Datasystems (BOLD; www.boldsystems.org; Ratnasingham & Hebert, 2007) hosts four records of that species sampled from the research collection of Thierry Bouyer (Chênée, Belgium).

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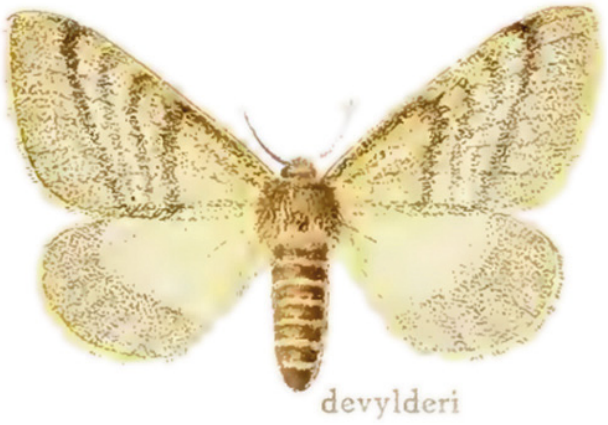


Fig. 2. Image of the female of *Trichophiala devylderi* Aurivillius, 1879 published in: Seitz A.: Die Gross-Schmetterlinge der Erde. 14 Band. Alfred Kernen, Verlag, Stuttgart, 1930.

Existing *Trichophiala devylderi* types

The number of specimens collected as part of the initial De Vylder's series is unknown. As mentioned, at the NHRS there are currently three female syntypes of *T. devylderi* (Fig. 3). One additional original female syntype is preserved at the MNB (see below). Among the three specimens in the NHRS, there is one designated as "Typus". It is catalogued with the number NHRS-SRAH000001507 and corresponds to the specimen illustrated on the NHRS website, the only available internet image of the species: *Trichophiala devylderi Aur. Typus – Damara 6/5 - G. de Vylder*.

The other two specimens are also females and with the same collection information as the one with the "Typus" label. They are catalogued with numbers NHRS-SRAH000001508 and 1509. There was no holotype formally designated by Aurivillius. However, as the wing length is given as a range in the original publication (48-55 mm), there was evidently more than one type according to Aurivillius. This would explain why the specimen in Berlin also carries the "type" label (see below). All



Fig. 3. The three syntypes of *T. devylderi* from the collection of the Stockholm Naturhistoriska Riksmuseet, (a) specimen NHRS-SRAH000001507 and (b) its original labels by De Vylder and the label "Typus", (c) specimen NHRS-SRAH000001508, (d) specimen NHRS-SRAH000001509.

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three specimens at the NHRS should be considered as belonging to the type series (syntypes); they share the data "Damara", "6/5", "De Vylder". The additional syntype in the MNB (Wolfram Mey, pers. comm.), also a female, is registered with the following information: Type: 1 ♀, [Namibia], "Damara" [printed], "De Vylder" [printed], "32502" [printed], "6.5.", "*Trichophiala/devylderi* Typ." [handwritten with black ink on white paper].

Other specimens in museum collections

Among the consulted museums, only the Ditsong Museum in Pretoria, the MNB, ZSM, MWM, and SMF preserve specimens of *T. devylderi*. The specimens kept in those collections are presented in Table 1. In addition, there is information on some specimens cited by Grünberg in Denkschriften der Medicinisch-Naturwissenschaftlichen Gesellschaft zu Jena (1910). These specimens are from Damaraland (one), Windhoek (2 females) and Waterberg, South Africa (one female, Seewald, 22 May 1909). Finally, the call for information through the Lepidopterists' Society of Africa did not yield any results.

Trichophiala devylderi distribution

The distribution of *T. devylderi* is only partially known (Fig. 4). There is no information on the website AfroMoths (De Prins & De Prins, 2011-2021) while the Funet website (Savela, 1990-2021) reports generically "Namibia". Based on the data available from the specimens in the various collections (see Table 1), the distribution map of the species shows that it is present in several localities of Namibia, and, as far as other countries are concerned, it has been observed in May 1954 near Victoria Falls on both the Zambian and Zimbabwean sites.



Fig. 4. Distribution map of known sites of observation of *Trichophiala devylderi* (red dots: recent observations after 2000; blue dots: previous observations mostly from the late XIXth and early XXth century).

Habitat, flight period and life history

Little is known of the biology of *T. devylderi*. The original description only indicates the site where the specimens were collected. It then adds "month of May", which may correspond to the "6/5" (presumably 6th of May) on one of the original labels at the NHRS. Based on observations by one of us (MR) in the month of August 2017, the species lives in a habitat that is part of the highland shrubland of Namibia, at an altitude of approximately 1750 m, some 10 km east of Windhoek near Korlia (Fig. 5). The vegetation in the arid hilly area consists mainly of sparse shrubs and various *Acacia* species, with kudu bush (*Combretum apiculatum* Sond.) (Combretaceae) and buffalo thorn (*Ziziphus mucronata* Willd.) (Rhamnaceae).



Fig. 5. Habitat of *T. devylderi* near Korlia, east of Windhoek, altitude 1750 m.

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The flight period of the species has not been elucidated thus far. However, the available specimens in the various collections have been caught with maximum frequency around the austral cold and dry season in Namibia (from April to September, with a single isolated record each for the months of November and January). Therefore, one could conclude that the moth flies mainly during the austral winter.

The life history is largely unknown. The only available mentions of the larval stages are from few published articles, two of which focused on topics other than Lepidoptera. Gaerdes (1962) reported that in the past the "hairy caterpillars" of "a grey moth (*Trichophiala devylderi*)… when the acacias had been stripped bare, caused a lot of damage to garden trees". Jensen & Clinning (1974) mentioned that the "hairy caterpillars… were still abundant on the acacias" in early March 1974. Finally, another article only mentioned, in a broad comparison of genus *Trichophiala* with another species, the presence of "free larval procoxae like in Lasiocampoidea" (Oberprieler & Duke, 1994). There is however no full description of the morphology of the immature stages of *Trichophiala*. The adult is highly phototropic as observed during the month of August 2017 when hundreds of individuals were coming to the lights of a lodge starting at sunset at around 8 p.m. and probably throughout the night (Fig. 6a-b). A few individuals were still present on the walls near the lights in the early morning (Fig. 6c), but the vast majority was gone after dawn.

Redescription of imago with revision of the female and first complete description of the male

Due to the limited original description available for this species, the female is re-described and a full description of the male is provided for the first time.

Trichophiala devylderi Aurivillius, 1879, Öfversigt af Kongl. Vetenskaps-Akademiens Forhandlingar 36 (7): 54. Type locality: "in Damara," Namibia.

Male (Fig. 7). Head small, with short labial palpus and large eye. Antenna bipectinate, as long as ca 2/5 of costal margin of forewing, pale creamy yellow; pectination longest at middle of flagellum, as long as about 8x width of corresponding flagellomeres. Head and thorax with mostly uniform yellowish sandy hair-like cover dorsally and ventrally, also with dark brown hair-like scales around labial palpi and below head, between forelegs. Coxa and femur of all legs with long, sandy, hair-like scales, particularly prominent on hindleg; tibia dorsolaterally with long, hair-like scaling, slightly darker than on femur, earth yellow, with few dark brown scales; tarsomeres with simply pointed or apically bifid thin and slightly elongate scales, earth yellow to orange with dark brown at their bases. Wingspan 41-47 mm, forewing length 22-26 mm. Forewing with weakly pointed apex, with widely rounded outer margin, of sandy ground colour, with admixture of brown to rusty-brown cover scales which can be grouped in certain fields, in which case they form darker zones, most typical among them a submarginal field and shadow-like fasciae medially; pattern consisting of two medial fasciae rather distinct in all

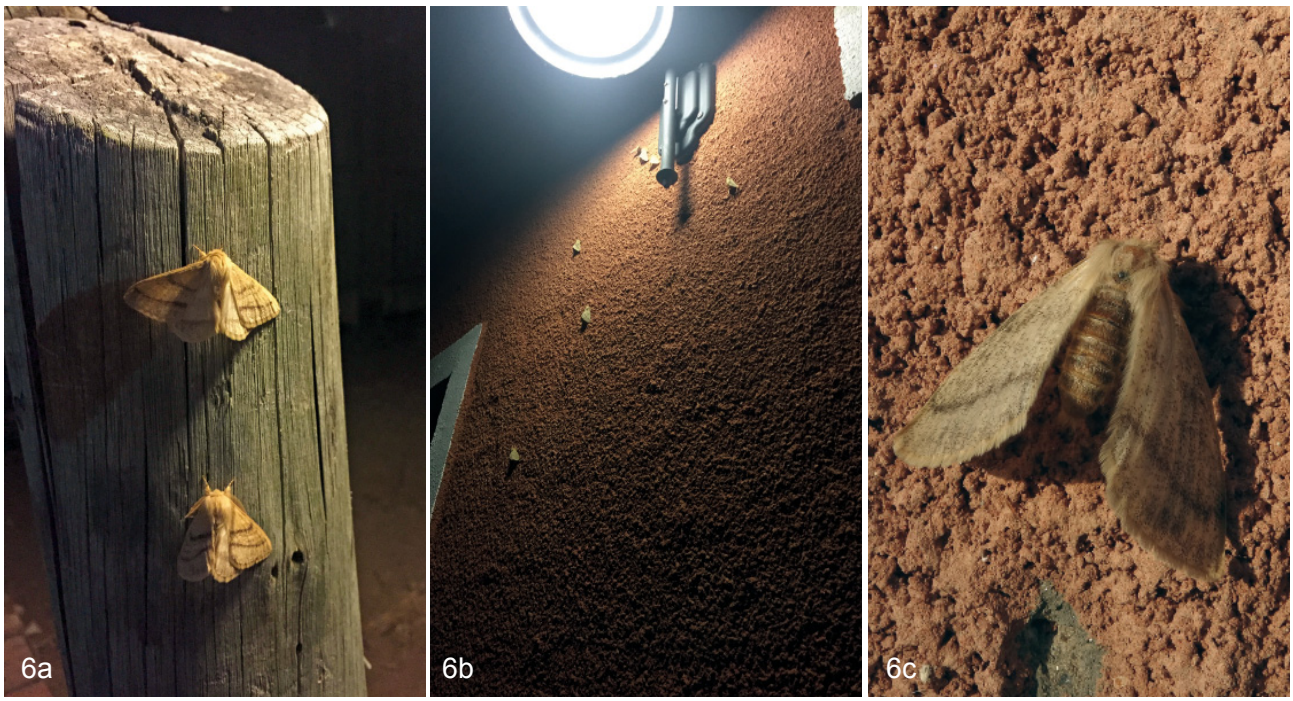


Fig. 6. (a-b) Individuals of *T. devylderi* flying to the light during the evening, (c) female still resting on the wall near a light in the early morning hour. Vicinity of Korlia, Namibia, August 2017.

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Fig. 7. A male of *T. devylderi* (a) dorsal view, (b) ventral view. Vicinity of Korlia, Namibia, August 2017.

specimens as diffuse but obvious transversal post-medial and antemarginal bands; antemarginal fascia 7-shaped and antemarginal slightly curved, S-shaped; without basal band and discal dot/spot; fringe often paler and visible in contrast with darker submarginal field, sandy coloured, with narrow darker strokes on tips of veins. Hindwing with rounded outer margin, of same ground colour as forewing, with both fasciae very faint; submarginal field often darkened with greyish or reddish-brown scales; fringe uniformly sandy yellow.

In addition to typically coloured forms, darker individuals can be found (Fig. 8); they are rust brown, with very narrow elements of forewing pattern, contrasting dark fringe on both wings, but with reduced dark suffusion on hindwing.

Abdomen long and slender, with long hair-like, sandy yellow cover scales apically forming a tuft around last segment and shorter, darker, undercover spine-like pointed scales more strongly fixed on integument of tergites 1-8.

Male genitalia (Figs 9-10). Small and highly modified. Tergites without setae; tergum 10 membranous except for pair of medially separated plates enlarged medially and laterally, and smaller median triangular plate at base; tergum 9 (tegumen) reduced to narrow weakly sclerotized band medially widened and slightly projecting as triangle anteriorly. Vinculum very narrow, medially projected posteriorly as triangle with more thickly sclerotized margins; with very long saccus, as long as length of genital capsule, very slender basally, 3-5 times broader distally. Valva with swollen basal section and 'bird-head-like' distal valvula; basal section medially most thickly sclerotized, corrugated, and with thick cover of short setae, elsewhere with very sparse short setae, apparently fused with vinculum along basal margin; valvula with setae of variable lengths, mostly laterally and ventrally, with some quite long at apex. Juxta sheath-like, quadrangular in lateral view, with ventral edge and lateral margins slightly more strongly sclerotized. Phallus rather short, slightly longer in darker phenotype; without coecum; shaft slightly down-curved, wider at base and apex, slenderer in darker phenotype, opening directly caudad, ventrally before apex with short, rounded projection; vesica small, without cornuti or scobination.

Female (Fig. 11). Head with antennae bipectinate, with pectination very short, as long as ca. 1/3 of costal margin of fore wing, pale creamy yellow. Head and thoracic colouration as in male. Wing pattern and coloration generally corresponding to those of sandy coloured males, but more diffuse and rougher; no darker females are known. Cilia more yellowish than in males. Individual variation is visible in development of grey-brownish suffusion on wings and prominence of wing pattern elements. Wingspan 49-54 mm, forewing length 27-30 mm. Foreleg and midleg as in male, with more dark brown hair-like scales on foretibia in available specimen; hindleg unavailable for description. Abdomen rather robust; tergites with long, hair-like and short, trifid whitish sandy cover scales and with short and thin, spine-like pointed ochre undercover scales on most of surface more strongly affixed to integument, as in male, also with tuft of longer pale ochre hair-like scales apically; ventrally more uniformly coloured with pale ochre to whitish mostly narrow scales of medium length.

Female genitalia (Figs 9, 12). Papillae anales short, ovoid, weakly sclerotized, covered with setae longer dorso-apically. Apophyses posteriores and anteriores very slender; posteriores about 1/5 shorter than anteriores, connected to narrow sclerotized band around base of segment except ventrally; anteriores connected to slightly wider narrow sclerotized band enlarging laterodorsally but not connected dorsally, moderately setose except ventrally where it forms an arc with the posterior margin blunt medially, also with small unsclerotized oval window in sclerotized band at level of base of each apophysis anterioris. Ostium bursae medially situated, behind sclerotized band of sternite VIII. Antrum short, wide, wrinkled and not sclerotized. Ductus bursae short and narrow, unsclerotized, about as long as segments

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Fig. 8. Specimens of *Trichophiala devylderi* preserved at MWM. The three male specimens on top left column show a pattern (darker rusty-pinkish-brown colour) that differs from that of the majority of the other, sandy ground-coloured, males..

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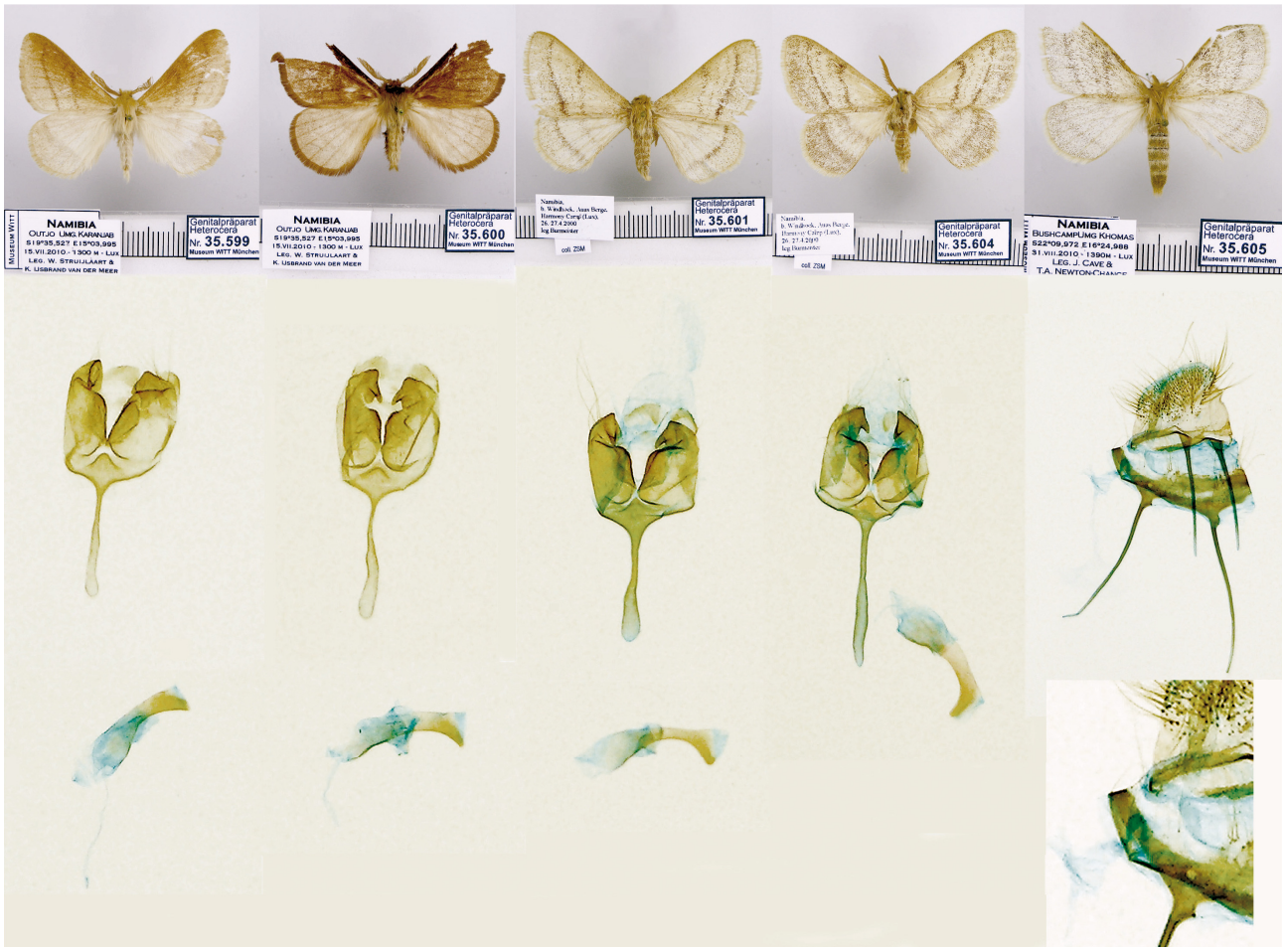


Fig. 9. Male genitalia (first 4 on left) and female genitalia (far right) of *Trichophiala devylderi* shown with the image of the corresponding individual (on top). The first two males on left show the darker phenotype (specimens from MWM).

8-10, forming right angle for short distance before connecting with oviduct, with short tube before right angle connected to small (about as long as ductus seminalis) pear-shaped corpus bursae devoid of sclerotization. Paired glandulae sebaceae very long, connected by short tube to oviduct.

DNA barcode analysis: genetic variation in *Trichophiala devylderi*

Pairwise comparisons of the 16 full-length (658bp) DNA barcode sequences obtained from the recently collected specimens revealed nearly no genetic variation for this marker within this species (mean p-distance = 0.13%; maximum p-distance = 0.32%). Dark individuals share identical DNA barcodes with the lighter ones; this supports the interpretation of these variations in habitus as being mere individual forms of a single species. The short DNA sequence of 126bp recovered from the syntype of *T. devylderi* proved strictly identical, over its length to 11 of the 16 sequences obtained from the recent specimens. DNA barcodes of *T. devylderi* cluster as BIN BOLD:AAP1066 (as of January 19th, 2022) in BOLD's automated DNA-based registry (Ratnasingham & Hebert, 2013). Its nearest neighbour is *Teratojana flavina* Hering, 1937 of the Striphnopteryginae subfamily, with a minimum p-distance between the two species of 5.13%.

Lectotype designation

The two phenotypical forms observed in *Trichophiala devylderi* show some degree of genital differentiation. Pending future insights into this issue, these differences warrant the designation of a lectotype from the three syntypes in the NHRS. Therefore, we designate the more elaborately labelled female held at NHRS (NHRS-SRAH000001507) as lectotype for the species (Fig. 3). The other two females held at NHRS as well as the female from the original collection by De Vylder held at MNB become therefore paralectotypes.

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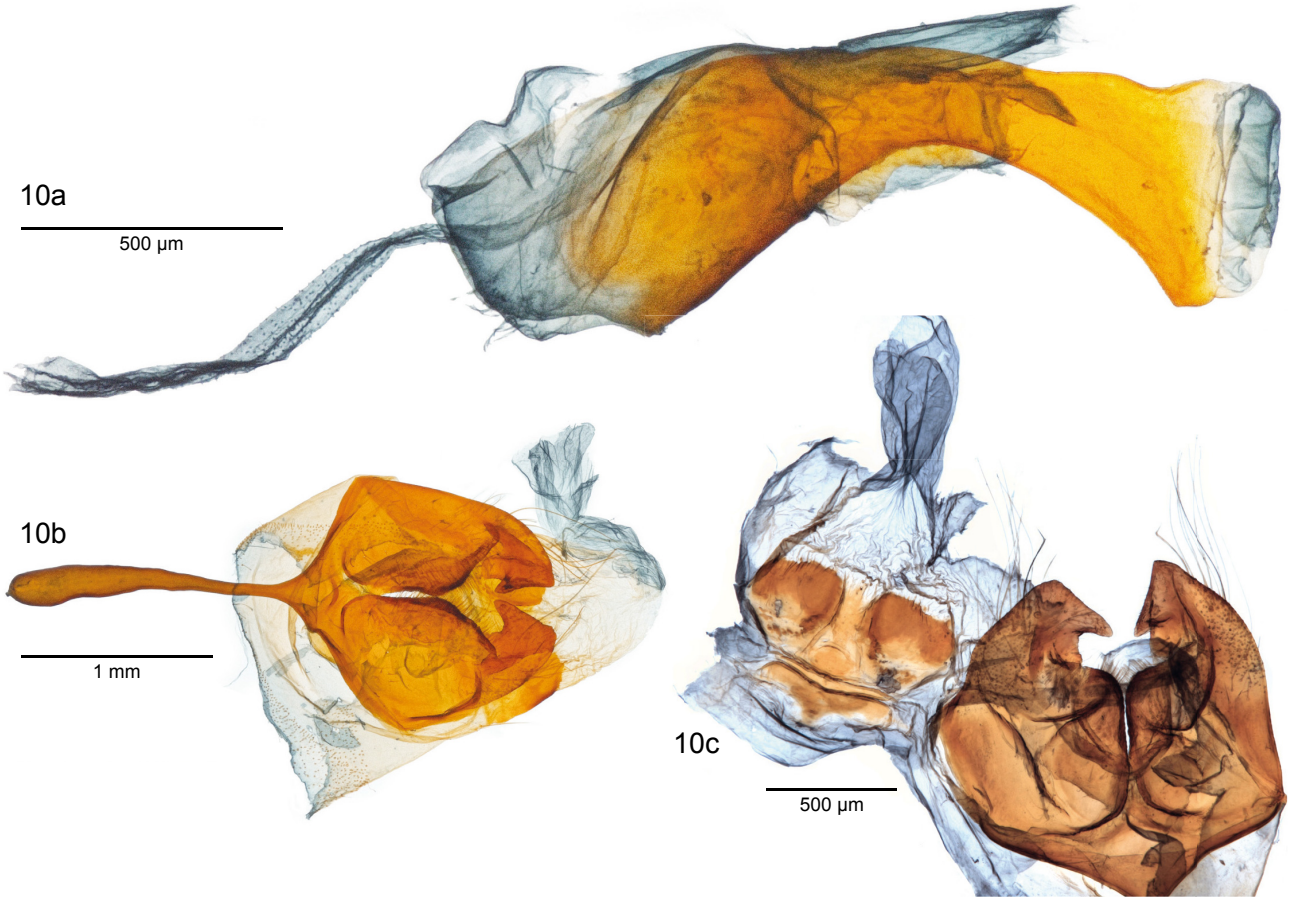


Fig. 10. Male genitalia of *Trichophiala devylderi*, (a) phallus and (b) genital capsule (specimen MHNG-ENTO-0013324), (c) part of genital capsule of specimen MHNG-ENTO-0013394 with tergites 9 and 10 spread out.

DISCUSSION

This study was prompted by the observation of numerous individuals of *Trichophiala devylderi*, both males and females, during a trip to Namibia in August 2017 and by the subsequent realization that very little was known about this species. The literature search conducted revealed in fact only the original description, dated 1879, by the Swedish entomologist Aurivillius, a second description by the same author in 1901 in a general review of the "Ethiopian genera of the family Striphnopterygidae" (synonym by Wallengren, 1858 of Eupterotidae Swinhoe, 1892 (Nässig & Oberprieler, 2007), a description by Gaede (1930), and very limited information available on websites, internet platforms and other sources. When the species is cited, a reference to the original description is usually presented with no details or new findings. As previously mentioned, only one photograph is available on two websites, that of the female type utilised by Aurivillius to describe the species, and two images of the female were found in the early literature (Figs 1 and 2). To our knowledge, no male image has ever been published. Likewise, male and female genitalia had never been fully analysed and described.

A comparative analysis of numerous adult specimens allows to conclude that two phenotypic forms of the species exist: a commoner form that has a sandy ground colour with a slight greyish suffusion and a less frequent form that has a darker rusty pink-brown colour and reduced or nearly absent darker suffusion on the hindwings. This observation prompted a detailed comparison of genitalia between the two forms. A slight difference in phallus was observed and this feature is a character of good taxonomic weight in this group of Eupterotidae. However, DNA barcode analysis revealed little genetic variation among the specimens processed and no difference between individuals of the two forms. This goes against the hypothesis of two distinct species and suggests instead that darker specimens represent mere individual variations from the more common and typical lighter phenotype. Additional molecular, morphological or ecological studies, as well as breeding experiments, might lead to a better understanding of the nature of these individual forms.

From a systematic perspective, *Trichophiala* is a monotypic genus. Its relationship with other members of the

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Fig. 11. A female of *Trichophiala devylderi* (a) dorsal view, (b) ventral view. Vicinity of Korlia, Namibia, August 2017.

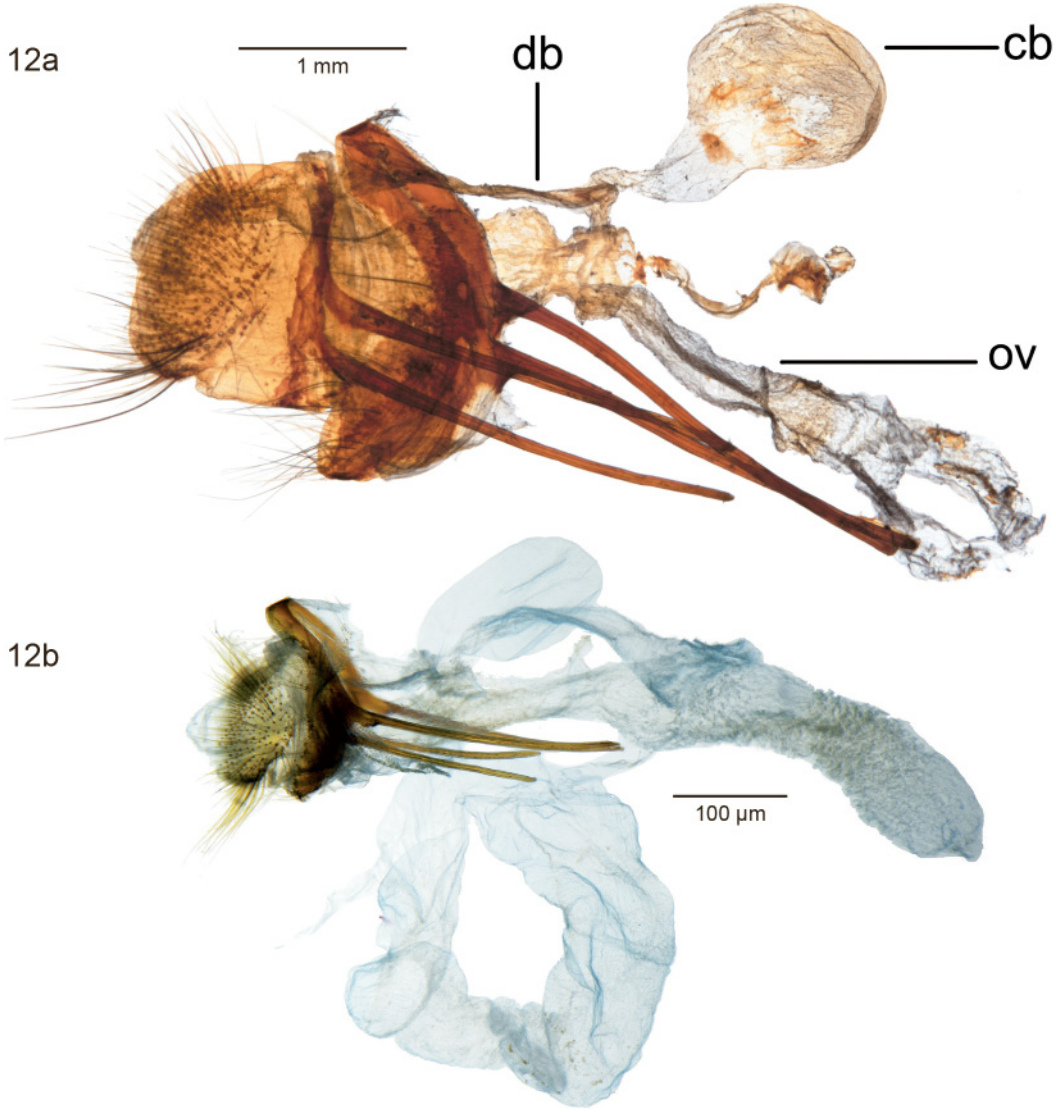


Fig. 12. Female genitalia of *Trichophiala devylderi*, (a) lateral view of specimen MHNG-ENTO-0013395 without glandulae sebaceae, (b) lateral view of lectotype (NHRS-SRAH000001507). db: ductus bursae; cb: corpus bursae; ov: oviduct.

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Striphnopteryginae subfamily remains unelucidated, although DNA barcodes place it in close proximity of *Teratojana flavina* and general morphology and genitalia suggest, as already hypothesized by others, that *Trichophiala* may be closely related to *Phiala* and *Lichenopteryx*. The male genitalia are highly modified as in other members of the Striphnopteryginae (Oberprieler *et al.*, 2003). The gnathos is absent and the uncus present only as a pair of plates, without discernible posterior projections while the tegumen is interpreted here as a distinct narrow plate. The other male genital structures conform well to the diagnosis of the subfamily provided by Oberprieler *et al.* (2003). The female genitalia were not discussed by the latter authors.

Although this work has shed light on *Trichophiala devylderi*, much remains to be studied to have a comprehensive understanding of this taxon. Needed investigations include, for example, studies on its natural history: descriptions of the eggs, larva and pupa, as well as annual cycle, and parasites and predators. At the moment, these aspects are ignored. Equally poorly known is the larval foodplant although some reports point to the species feeding on acacia trees: in general, breeding Eupterotidae is reported as extremely difficult and only very few species have been reared so far given that the foodplant is unknown for most, and that numerous African species are specialist feeders (Vanhoudt, 2020-2021). Furthermore, the phylogenetic relationships of the genus with *Phiala, Lichenopteryx, Teratojana* and other Eupterotidae genera would greatly benefit from further molecular studies.

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