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## Review of the Afrotropical *Psalis* Hübner, [1823] with descriptions of two new species and notes on Asiatic taxa (Lepidoptera, Erebidae, Lymantriinae, Orgyiini)

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Received 1 August 2024 | Accepted by V. Pešić: 13 August 2024 | Published online 15 August 2024.

### Abstract

This paper is intended to present the results of morpho-taxonomic investigations carried out on the palaeotropical tussock moth genus *Psalis* Hübner, [1823] with the aim of clarifying and diagnosing its species content as well as revising the Afrotropical taxa. Examinations of Asian and African *Psalis* material confirmed the distinctness of the externally alike *P. pennatula* (Fabricius, 1793), *P. securis* Hübner, [1823] **stat. rev.** and *P. africana* Kiriakoff, 1956. Although the marked morphological differences between the configuration of the tympanal organ of *P. pennatula* and *P. africana* as reported by Kiriakoff (1956a) could not be confirmed, the two former taxa are retained as distinct species, as well as *P. securis* which is reinstated from synonymy with *P. pennatula* based on constant differences in the female genitalia structures. Morphological examinations of collection material and samples collected during recent fieldwork in Africa resulted in the discovery of two new species: *Psalis smithi* **sp. n.** and *Psalis bashfordae* **sp. n.** Adults and their genitalia, as well as tympanal organs of all valid Asian and African *Psalis* taxa are illustrated.

**Key words** Counter tympanum, genital morphology, Republic of Congo, revised status, taxonomy, tympanum, Zambia.

### Introduction

The characteristic tussock moth genus *Psalis* Hübner, [1823] was erected to include *P. securis* Hübner, [1823] as the type species described from Java, a species later regarded as a synonym of *Psalis pennatula* (Fabricius, 1793) by Bryk (1934).

*Bombyx pennatula* Fabricius, 1793, described from 'India orientali', is a species that was noted by Aurivillius (1897) as being close to *P. securis* (Aurivillius 1897) but it was not until 1926 that *pennatula* was moved to *Psalis* by Hering (1926). Following this, Collenette (1932) listed *P. pennatula* under *Dasychira* Hübner, [1809], however the nomenclatural change made by Hering (1926) is what

has been referred to in the literature from the late 20<sup>th</sup> into the 21<sup>st</sup> century (e.g., Dall'Asta 1977, Das *et al.* 2021).

Subsequent to Hübner ([1823]), Francis Walker introduced four species that, in time, were placed under *Psalis*: *P. antica* (Walker, 1855) described from Java which is clearly a synonym of *P. securis*; *P. approximata* (Walker, 1865) without indication of the type locality, although the “N. I.” abbreviation on the label of the holotype specimen probably refers to North India (Kiriakoff 1956a), and thus most likely identical to *P. pennatula*. The third species, *P. falcata* (Walker, 1865) was described based on two syntypes from Sri Lanka and Java (in fact the same Javan specimen as the holotype of the aforementioned *P. antica* (Walker, 1855), see remark below) is also considered to be a synonym of *P. pennatula*; and finally, *P. tacta* (Walker, 1865) with its holotype from Australia which was synonymised with *P. pennatula* by Bryk (1934). An additional phenotypically distinct *Psalis* species, *P. punctuligera* (Mabille, 1880), originally placed in *Anchirithra* Butler, 1878 is known from and endemic to Madagascar. Most recently, Wileman & South (1917) described a further *Psalis* species from the island of Taiwan (*P. kanshireiensis* Wileman & South, 1917), the validity of which has not been revised by subsequent authors.

African records of *Psalis pennatula* were first reported from the Democratic Republic of the Congo by Aurivillius (1900) and later noted by Sevastopulo (1957) from Uganda; whilst *P. securis* was reported earlier from Kenya (Butler 1894), Mozambique (Pagenstecher 1893), South Africa (Distant 1897) and Zimbabwe (Hampson 1905). It was not until 1956 that Kiriakoff attempted to clarify the identity of the African *Psalis* which undoubtedly look identical to the Asian taxa and being pests of cereal crops (Kiriakoff 1956a), could have been introduced to the continent by shipments of agricultural products. Kiriakoff (1956a), with the help of W. H. T. Tams and C. L. Collenette, then curators of the British Museum of Natural History, reported a marked difference in the ratio of the tympanum/counter tympanum between the African and the Asian specimens and although he could not observe any difference in the configuration of the male genitalia, he found that the female genitalia of the Asian and African specimens displayed distinct differences, thus leading to the description of *P. africana* Kiriakoff, 1956 for the latter population.

The primary goal of our study was to test Kiriakoff's concept, by examining the same characters in several specimens of both African and Asian origin and attempt to clarify the validity of *P. africana* and the distribution of the Asian *P. securis*/*P. pennatula* species-pair which have continued to be treated as species occurring on the African continent (de Prins & de Prins 2023). Having examined the configuration of the tympanal organs of six African and seven Asian specimens we could not confirm the existence of the marked difference declared by Kiriakoff (Figs 49–55) while the male genitalia do not show any constant diagnostic characters between the African and the Asian taxa, agreeing with Kiriakoff's (1956a) observations. In the female genitalia, however, the configuration of the ostium bursae and the signum bursae displays a good differential character between the African and Asian species in agreement with Kiriakoff (1956a). Furthermore, minor but constant differences were observed between topotypical East African and Zambian *P. africana* females suggesting that two taxa may be involved; further studies involving genetic markers are required to establish the taxonomic value of this seemingly geographical variation.

It is important to note that the Javan specimens referring to *P. securis* and the Indian specimens referring to *P. pennatula* are also readily distinguishable based on the configuration of the ostium bursae, confirming the validity of *P. securis* (Figs 40–42).

In the course of re-curating the *P. africana* material housed in the collections of the African Natural History Research Trust (ANHRT), a series of considerably smaller, more uniformly greyish specimens, collected during previous ANHRT expeditions conducted in Zambia, was found. The genitalia dissections revealed marked differences between these and typical *P. africana* individuals and the peculiar Zambian specimens are described below as a species new to science: *P. smithi* sp. n.

During recent fieldwork conducted by an ANHRT team in Odzala-Kokoua National Park (OKNP), Republic of Congo, a series of conspicuously small and uniformly ochreous brown specimens undoubtedly belonging to *Psalis* was collected in a wet savannah/marshland habitat. Sporadic old records of *Psalis* were known from West and Central Africa (Kiriakoff 1956a), however, these new records from northern Congo confirm that the genus is still extant in central Africa with a seemingly thriving population in OKNP. Based on their unique external habitus and certain diagnostic characters

in genital morphology, it is deemed that this *Psalis* population is not conspecific with the southeastern or southern-central African *P. africana* and is described herein as a new species: *P. bashfordae* **sp. n.**

## Material and methods

The material collected during ANHRT expeditions in Zambia and Republic of Congo was sampled using a light tent illuminated with a 125 W mercury vapour light bulb or automatic actinic and LepiLED light bucket traps.

Genital apparatuses were extracted and stained with Eosin red or Chlorazol black and embedded in Euparal on microscope slides, applying standard methods of preparation (Lafontaine & Mikkola 1987, Robinson 1976). Images of adults were captured using a Nikon D90 SLR camera equipped with a Nikkor AF Micro 60 mm lens. Genitalia were imaged using a Canon EOS 700D camera mounted on a Leitz Diaplan compound microscope (ANHRT) or by a Canon EOS 5DSR camera and MP-E 65 mm lens attached to a Kaiser RS 1 Repro stand equipped with a Stackshot system operated by Helicon Remote software (version 3.8.4 W) (NHMUK). Observation of tympanal organs was done by careful detachment of the abdomen following Speidel *et al.* (1996). Images of tympanal organs were taken by a Canon EOS 700 D camera mounted on a Nikon C-DS stereomicroscope.

Terminology of genital structures follows Volynkin (2024), and terminology of tympanal organ follows Kiriakoff (1956b) and Speidel *et al.* (1996).

Holotype label data are quoted exactly as they appear. A division slash (/) denotes the commencement of a new line, two division slashes (//) data on a further label.

Collection acronyms used in the text:

ANHRT – African Natural History Research Trust, Leominster, U.K.

NHMUK – The Natural History Museum, London, U.K.

OUMNH – Oxford University Museum of Natural History, Oxford, U.K.

Other abbreviations:

BP – genitalia slide prepared by Bethany Powell

DRC – Democratic Republic of Congo

HT – holotype

LG – genitalia slide prepared by Gyula M. László

MSR – Maputo Special Reserve, Mozambique

OKNP – Odzala-Kokoua National Park, Republic of Congo

PT – paratype

## Taxonomic section

### Genus *Psalis* Hübner, [1823]

*Psalis* Hübner, [1823], *Zuträge zur Sammlung exotischer Schmettlinge, bestehend in Bekundigung einzelner Fliegmuster neuer oder rarer nichteuropäischer Gattungen* 2: 19, figs 291, 292. Type species: *Psalis securis* Hübner, [1823] by monotypy.

### Characterisation of the genus.

*Psalis* is an old-world genus widely distributed in the tropical-subtropical regions of Asia, Australia and Africa with highly similar species throughout its range. The species of the genus have a largely characteristic external habitus expressed by the well-developed feathery antennae possessing long rami in males and shorter ones in females, the narrow, elongate forewing with fawn to dark brown ground colour patterned by a dark longitudinal area running medially along the whole length of the forewing and the broad, rounded, pale hindwing lacking any markings. The sexual dimorphism is moderately prominent, the females are ca. 20% larger than the males with more elongate, apically produced, pointed forewings. The male genitalia are characterised by the short, stout bifid uncus, the short, rounded, ear-like socii, the relatively short triangular tegumen, the deeply cleft valva with a narrow digitiform,

strongly sclerotized dorsal (costal) process and a wider, elongate-triangular membranous and slightly setose valvula and the weakly sclerotized sacculus possessing a short, oblique crest. The juxta is unmodified, ring-like, consisting of a pair of narrow, curved, distally pointed plates; the vinculum is short and rounded. The phallus is very short, moderately thick, medially curved without carinal process; the vesica is short, largely inflated, possessing a very small cornuti field consisting of ca. 4–6 tiny triangular cornuti. The female genitalia are characterised by the short, wide, rounded papillae anales, the well-developed, rounded pseudopapillae, the short and broad ovipositor, the conspicuously long posterior apophyses and the very short, weakly sclerotized ribbon-like 8<sup>th</sup> tergite. The ostium bursae is characteristically wide with heavily sclerotized margin, the shape of which is an important specific character, the distal end of the ductus bursae forms a short but broad, heavily sclerotized, goblet-shaped antrum, the proximal section of the ductus bursae is relatively thick and membranous, the cervix bursae is unmodified, the corpus bursae is large ovoid bearing heavily sclerotized, variably dilated dash-like transverse signum bursae.

## Overview of Asian taxa

### *Psalis securis* Hübner, [1823] stat. rev.

(Figs 1, 18, 27, 40, 55)

*Psalis securis* Hübner, [1823], *Zuträge zur Sammlung exotischer Schmettlinge, bestehend in Bekundigung einzelner Fliegmuster neuer oder rarer nichteuropäischer Gattungen* 2: 19, figs 291, 292. Syntype, female, depository unknown, types probably lost. Type locality: [Indonesia] “Ostindien von Java”.

*Arestha antica* Walker, 1855, *List of the specimens of Lepidopterous Insects in the Collection of the British Museum* 4: 805. Holotype, male in coll. NHMUK. Type locality: [Indonesia] Java.

*Rigema tacta* Walker, 1865, *List of the specimens of Lepidopterous Insects in the Collection of the British Museum* 32: 438. Holotype, male in coll. NHMUK. Type locality: Australia. **Remark.** It cannot be ruled out that *P. tacta* is a bona species, due to its distribution and genetic divergence from Asian taxa (Balaji *et al.* 2021), nevertheless we retain its synonymy with *P. securis* until comparative material from Australia is studied and phylogenetic analyses sampling both Indomalayan (*P. securis*) and Australian (*P. tacta*) specimens, are completed.

*Anchyneura praeusta* Felder, 1861, *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften* 43 (1): 33. Holotype, male in coll. NHMUK. Type locality: [Indonesia] Amboina [=Ambon Island].

### Material examined.

**Indonesia.** 1 male, 1 female, E. Java, Nongkodjadjar, 4000 ft, ii.1934, leg. A.R. Wegner, QR code labels with unique ids: NHMUK010292336 (male), NHMUK010292340 (female), gen. slide Nos: NHMUK 014332605 (male), NHMUK 014332609 (female) (prepared by G.M. László) (NHMUK); 1 male, Java, leg. Horsfield, gen. slide No.: BP 050; 1 female, Java, gen. slide No.: BP 043 (OUMNH).

**Taxonomic note.** Although the rather variable specimens of *P. pennatula* (Indian subcontinent) and *P. securis* (Java) are indistinguishable based on their habitus and the male genitalia configuration, the comparison of the female genitalia of specimens from Java and the Indian subcontinent revealed several distinctive characters between the two Asiatic species. These characters are expressed by the noticeably longer papillae anales and pseudopapillae, the medially deeply notched distal margin of the ostium bursae and the very narrow and long, thread-like signum bursae of the Javan *P. securis* in contrast to the gently arched ostial margin and the shorter and markedly broader, elliptical plate of the signum bursae in the Indian *P. pennatula* (Figs 40–42). In spite of the fact that numerous online sources list *P. securis* as a valid taxon (e.g., [www.afromoths.net](http://www.afromoths.net), [www.funet.fi](http://www.funet.fi)), we could not trace the taxonomic act reviving *P. securis* from synonymy with *P. pennatula* and consider the former to remain in synonymy with the latter following Bryk (1934). The clarification of the identity of *P. securis* is rather problematic as the primary type of *P. securis* together with many other Hübner specimens was probably destroyed in a fire during the Vienna Revolution in 1848 (Gilligan & Wright 2013). Thus, the identity of this species cannot be confirmed with full certainty, although it is highly likely that *Psalis* specimens from such a well-

defined type locality as Java, belong to *P. securis*. As it cannot be ruled out that primary type specimens of *P. securis* have survived the fire and currently reside in the immense collections of the Natural History Museum in Vienna, a neotype designation would be unsound; however, based on examinations of topotypical specimens we tentatively confirm the distinctness of *P. securis* **stat. rev.** and is treated as a valid species. Further questions that require answering include whether *P. securis* is confined to the island of Java or whether it has a more extensive range expanding into India and/or Australia, and, vice versa in the case of *P. pennatula*. In order to elucidate the accurate distributions of these Asiatic species and establish if *P. pennatula* and *P. securis* are indeed allopatric taxa, extensive morphological and genetic studies are required which are beyond the scope of this present paper.

### ***Psalis pennatula* (Fabricius, 1793)**

(Figs 2–3, 19–20, 28–29, 41–42, 49–50)

*Bombyx pennatula* Fabricius, 1793, *Entomologia systematica emendate et aucta. Secundum Classes, Ordines, Genera, Species adjectis synonymis, locis, observationibus, descriptionibus* (3) 1: 465. 2 syntypes, in coll. ZMUC (Zimsen 1964). Type locality: [East India] “India orientali”.

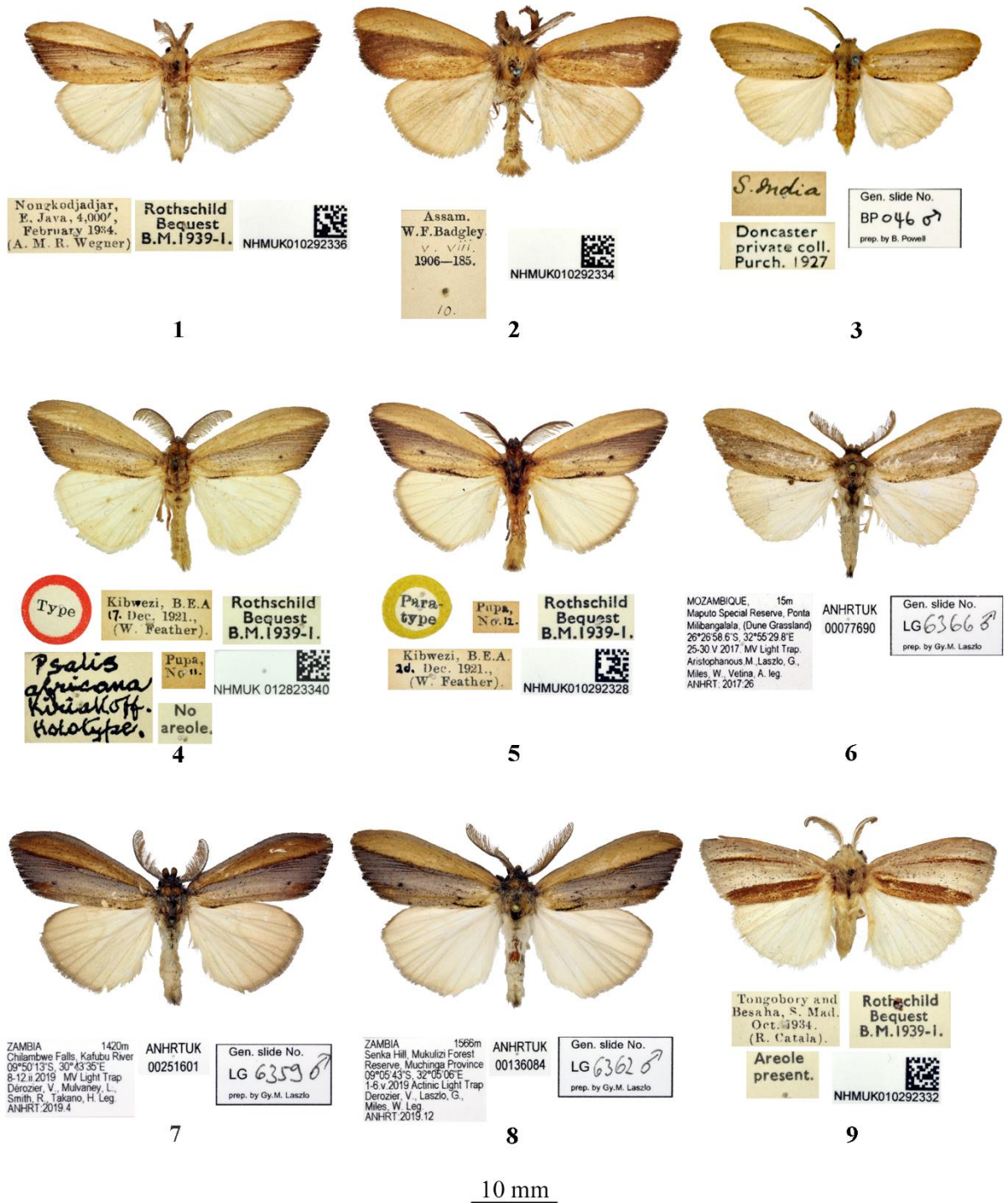
*Rigema falcata* Walker, 1865, *List of the specimens of Lepidopterous Insects in the Collection of the British Museum* 32: 437. 2 syntypes, in coll. NHMUK. Type locality: [Sri Lanka] Ceylon and [Indonesia] Java. **Remark.** Only a female specimen from “Ceylon” was traced in the collection of NHMUK. Walker’s description indeed refers to a female specimen (cf. “antennae slightly pectinated...Fore wings lanceolate, falcate, acute...”) but despite this, he indicated the sex of the specimen as male. Walker included a male specimen from Java as a second (syn)type which was almost certainly the holotype of *Arestha antica* described 10 years before *Rigema falcata*. Based on Walker’s original description, the Sri Lankan specimen would seem the most prudent upon which to fix the name, but this act ought to be implemented within the framework of a comprehensive revision of the Asian taxa, and in this present work, we maintain the synonymy of *R. falcata* with *P. pennatula*.

*Anticyra approximata* Walker, 1865, *List of the specimens of Lepidopterous Insects in the Collection of the British Museum* 32: 440. Holotype, female in coll. NHMUK. Type locality: [North India] “N. I.”. **Remark.** The holotype specimen of *A. approximata* although indicated in the original description as a male, is female in line with the descriptive text. As in the case of *Rigema falcata* above, it may be that the bipectinate nature of the female antennae caused Walker to mistake the sex of the specimens he examined.

### **Material examined.**

**India.** 1 male, Assam, 05.viii.1906, leg. W.F. Badgley. QR code label with unique id.: NHMUK010292334, gen. slide No.: NHMUK 014332603 (prepared by G.M. László); 1 male, Kanara, leg. T. R. Bell, QR code label with unique id.: NHMUK010292335, gen. slide No.: NHMUK 014332604 (prepared by G.M. László); 1 female, N. Assam, Dibrugrah, leg. E.C. Ward, QR code label with unique id.: NHMUK010292338, gen. slide No.: NHMUK 014332607 (prepared by G.M. László) (NHMUK). 2 males, Khasis, ex Doncaster coll., gen. slide No.: BP 047; 1 male, Khasi Hills, x.1889, ex. Brodie coll., gen. slide No.: BP 053; 1 male, Sultanpur, 1888, leg. Captain G. Young, gen. slide No.: BP 054; 1 male, S. India, ex. Doncaster coll., gen. slide No.: BP 046; 1 female, Khasis, ix.1894, ex. Doncaster coll., gen. slide No.: BP 042; 1 female, Assam, Shillong, ix.1893, ex. Doncaster coll., gen. slide No.: BP 049; 1 female, Shillong, ix.1893, ex. Brodie coll., gen. slide No.: BP 048 (OUMNH). **Philippines.** 1 male, Baguio, Benguet, Luzon, 5000 ft, 16.vi.1913 leg. A.E. Wileman, QR code label with unique id.: NHMUK010292337, gen. slide No.: NHMUK 014332606 (prepared by G.M. László) (NHMUK). **Sri Lanka.** 1 male, 1 female, Ceylon, ex. Doncaster coll., QR code labels with unique id.: NHMUK 010292333 (male), NHMUK010292339 (female), gen. slide Nos: NHMUK 014332602 (male), NHMUK 014332608 (female) (prepared by G.M. László) (NHMUK). 1 female, Ceylon, 1873, gen. slide No.: BP 045 (OUMNH).

**Remark.** The species has hitherto not been reported from the Philippines but since the males of *P. pennatula* and *P. securis* cannot be reliably distinguished, the identification of the specimen listed above is not conclusive.

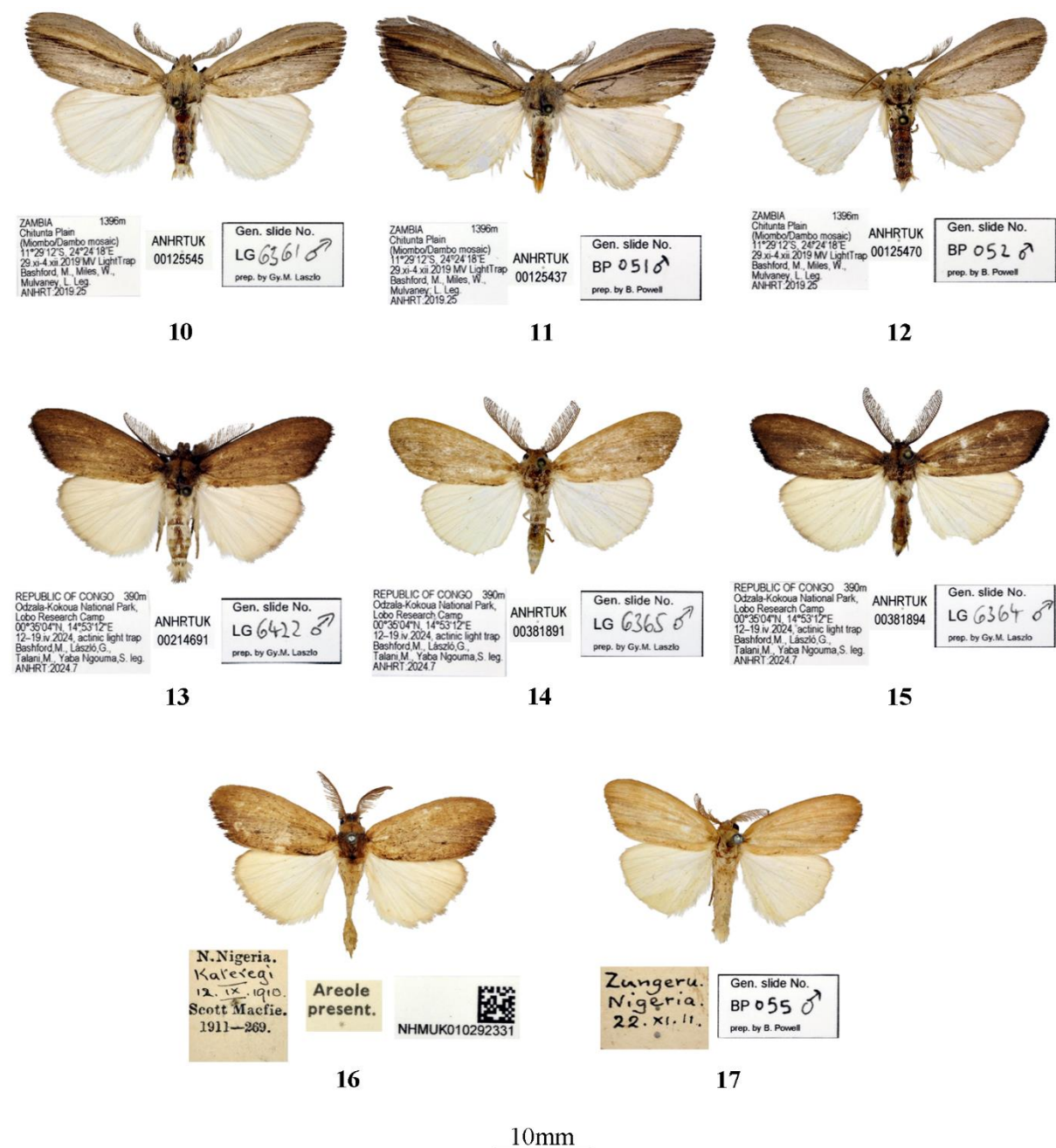


**Figures 1–9.** Adults, male. 1. *Psalis securis* (NHMUK). 2. *P. pennatula* (NHMUK). 3. *Id.* (OUMNH). 4. *P. africana*, HT (NHMUK). 5. *Id.*, PT (NHMUK). 6. *Id.* (ANHRT). 7. *Id.* (ANHRT). 8. *Id.* (ANHRT). 9. *P. punctuligera* (NHMUK).

***Psalis kanshireiensis* Wileman & South, 1917**

*Psalis kanshireiensis* Wileman & South, 1917, *Entomologist* 50: 146. Holotype, male, in coll. NHMUK. Type locality: [Taiwan] Formosa, Kanshirei.

**Remark.** The validity of this Taiwanese taxon needs confirmation as part of a future comprehensive revision of the Asiatic *Psalis*.



Figures 10–17. Adults, male. 10. *Psalis smithi* sp. n., HT (ANHRT). 11. *Id.*, PT (ANHRT). 12. *Id.*, PT (ANHRT). 13. *P. bashfordae* sp. n., HT (ANHRT). 14. *Id.*, PT (ANHRT). 15. *Id.*, PT (ANHRT). 16. *Id.*, PT (NHMUK). 17. *Id.*, PT (OUMNH).

## Taxonomic account of the Afrotropical *Psalis* with descriptions of new species

### *Psalis africana* Kiriakoff, 1956

(Figs 4–8, 21–25, 30–32, 43–47, 51–52)

*Psalis africana* Kiriakoff, 1956, *Entomologische Berichten* 16: 127. Holotype male, in coll. NHMUK. Type locality: Kenya, Kibwezi.

### Primary type material examined.

**Holotype.** Male, [circular label with red margin] “Type” // “Kibwezi, B.E.A. / 17. Dec. 1921., / (W. Feather).” // “Pupa, / No. 11.” // “Rothschild / Bequest / B.M. 1939-I.” // “No / areole.” // [with

handwritten] “*Psalis / africana / Kiriakoff. / Holotype.*” // QR code label with unique id.: NHMUK 012823340 (NHMUK).

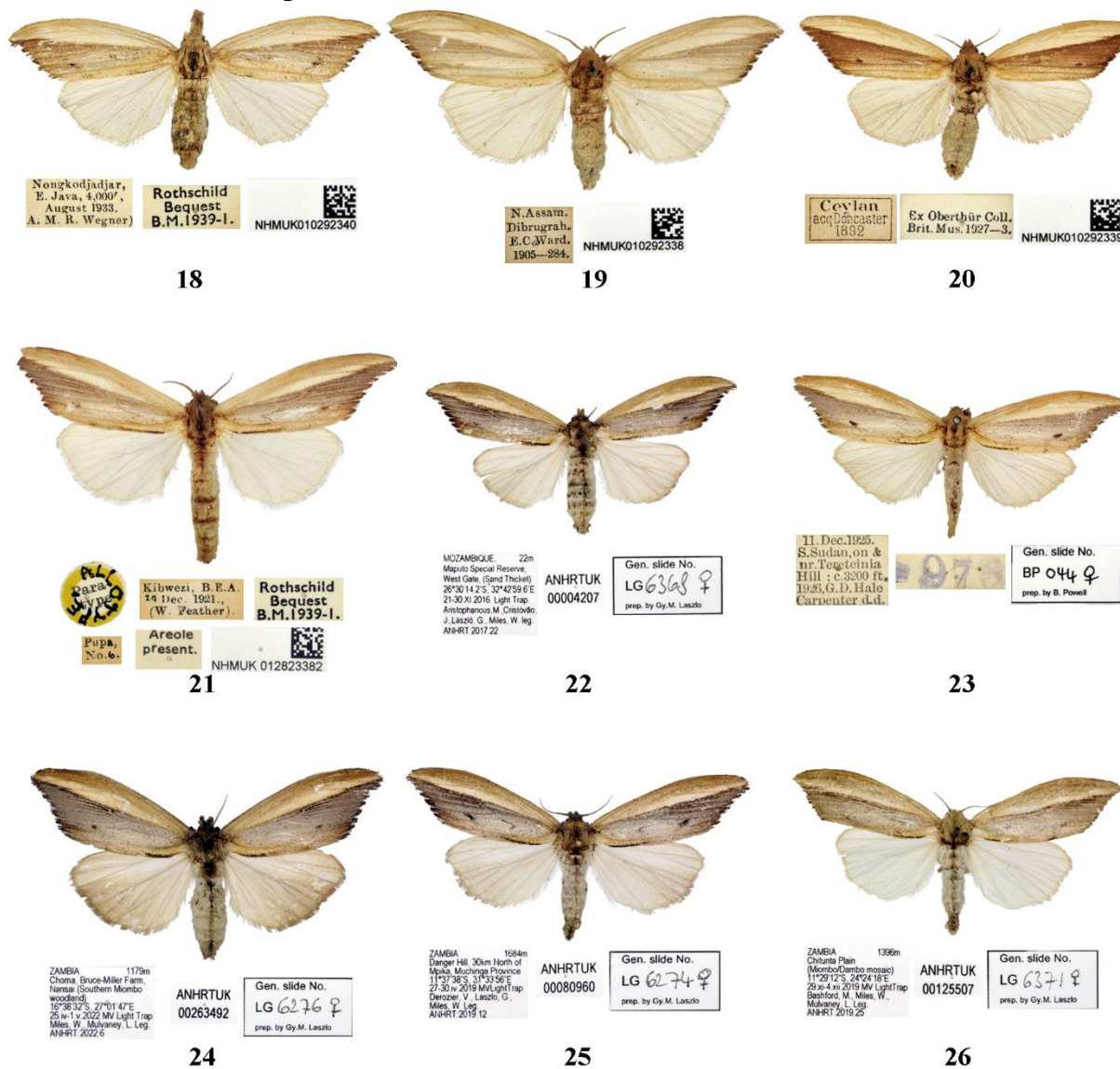
#### **Additional material examined.**

**Angola.** 1 male, N'Dalla Tando, 2700 ft, 25.xi.1908, leg. Dr W.J. Ansorge, QR code label with unique id.: NHMUK 010292329, gen. slide No.: NHMUK 014332598 (prepared by G.M. László) (NHMUK). **Kenya.** 1 male, paratype, same locality and collector as in holotype but collected on 20.xii.1921, QR code label with unique id.: NHMUK 010292328, gen. slide No.: NHMUK 014332597 (prepared by G.M. László); 1 female, paratype, same locality and collector, QR code label with unique id.: NHMUK 012823382 (NHMUK). **Mozambique.** 2 males, Maputo Special Reserve, Ponta Milibangalala, (Dune Grassland), 15m, 26°26'58.6"S, 32°55'29.8"E, 25–30.v.2017, MV and actinic Light Trap, leg. Aristophanous, M., László, G., Miles, W., Vetina, A., ANHRT:2017.26, unique ids: ANHRTUK 00077690, 00096711, gen. slide Nos: LG 6366, LG 6367; 1 female, Maputo Special Reserve, West Gate, (Sand Thicket), 22m, 26°30'14.2"S, 32°42'59.6"E, 21–30.xi.2016, Light Trap, leg. Aristophanous, M., Cristóvão, J., László, G., Miles, W., ANHRT:2017.22, unique id.: ANHRTUK 00004207, gen. slide No.: LG 6368; 1 female, Maputo Special Reserve, West Gate, (Sand Forest), 22m, 26°30'14.2"S, 32°42'59.6"E, 21–22.ii.2018, MV Light Trap, leg. László, G., Mulvaney, J., Smith, L., ANHRT:2018.2, unique id.: ANHRTUK 00150097, gen. slide No.: LG 6373; 1 male, Manica Province, Chimanmani National Reserve, Nyabawa village (Eastern Miombo Woodland), 708m, 19°42'09.4"S, 33°01'53.1"E, 5–6.viii.2018, LepiLED Light Trap, leg. László, G., Miles, W., Vetina, A., ANHRT:2018.30, unique id.: ANHRTUK 00046968, gen. slide No.: LG 6372 (ANHRT). **South Africa.** 1 male, Natal, Durban, ii.1906, leg. Bell Marley, QR code label with unique id.: NHMUK 010292330, gen. slide No.: NHMUK 014332599 (prepared by G.M. László) (NHMUK). **South Sudan.** 1 female, Tereteinia Hill, 11.xii.1925, ca. 3200 ft, leg. G.D. Hale Carpenter, gen. slide No.: BP 044 (OUMNH). **Zambia.** 1 male, Chilambwe Falls, Kafubu River, 1420 m, 09°50'13"S, 30°43'35"E, 08–12.ii.2019, MV Light Trap, leg. Dérozier, V., Mulvaney, L., Takano, H., ANHRT:2019.4, unique id.: ANHRTUK 00251601, gen. slide No.: LG 6359; 1 male, 1 female, Choma, Bruce-Miller Farm Nansai (Southern Miombo woodland), 1179m, 16°38'32"S, 27°01'47"E, 25.iv.–01.v.2022, MV Light Trap, Miles, W., Mulvaney, L. leg., ANHRT:2022.6, unique ids: ANHRTUK 00263214, 00263492, gen. slide Nos: LG 6360, LG 6376; 1 male, Senka Hill, Mukulizi Forest Reserve, Muchinga Province, 1566m, 09°05'43"S, 32°05'06"E, 01–06.v.2019, MV Light Trap, leg. Dérozier, V., László, G., Miles, W., ANHRT:2019.12, unique id.: ANHRTUK 00136084, gen. slide No.: LG 6362; 1 male, Lukwakwa, West Lunga NP, (Cryptosepalum forest/Dambo), 1147m, S12°39'40", E24°26'13", 09–15.xi.2018, MV Light Trap, leg. Aristophanous, M., Dérozier, V., László, G., Oram, D., ANHRT:2018.40, unique id.: ANHRTUK 00066307, gen. slide No.: LG 6363; 1 female, Jiwundu Swamp, (Miombo/Riverine forest mosaic), 1340m, 11°51'54"S, 25°33'20"E, 29.x.–04.xi.2018, MV Light Trap, leg. Aristophanous, M., Dérozier, V., László, G., Oram, D., ANHRT:2018.40, unique id.: ANHRTUK 00063044, gen. slide No.: LG 6369; 3 females, Danger Hill, 30 km North of Mpika, Muchinga Province, 1684m, 11°37'38"S, 31°33'56"E, 27–30.iv.2019, MV and LepiLED Light Trap, leg. Dérozier, V., László, G., Miles, W., ANHRT:2019.12, unique ids: ANHRTUK 00080959, 00080960, 00083764, gen. slide Nos: LG 6370, LG 6374, LG 6375 (ANHRT).

**Diagnosis.** Although externally indistinguishable, in the male genitalia, the following subtle differences can be observed between *P. africana* and the Asian species: *P. africana* has a noticeably narrower valvula and a somewhat larger, more inflated basal section and distal diverticulum of the vesica. In the female genitalia, the differences between *P. africana* and *P. pennatula* are more distinctive, expressed by the markedly heavier sclerotization of the ostium bursae, the considerably shorter, anteriorly more abruptly constricted antrum, the narrower and more strongly sclerotized ductus bursae and the shorter transverse ovoidal plate of the signum bursae in *P. africana* compared to those of the *P. pennatula-securis* species pair.

**Taxonomic note.** In their conference paper, Balaji *et al.* (2021) briefly referred to a phylogenetic analysis in which samples from Kenya and Tamil Nadu (India) clustered separately, though diverging only very slightly, whilst a sample from Australia diverged considerably from the *P. pennatula-africana* cluster. It is also interesting to note that the configuration of the ostium bursae seems to be constantly different in the East African and the Zambian populations: the former has an evenly arcuate distal margin

of the ostium (similar to that of *P. pennatula* but much more heavily sclerotized) while the latter has a conspicuous U-shaped medial notch, somewhat similar to the shallower and rather V-shaped ostial notch in *P. securis*. Unsurprisingly for this group, no constant distinctive characters were observed in the external habitus and male genital morphology of the southern-eastern and southern-central African *P. africana* populations; molecular studies however might elucidate the taxonomic value of the observed differences in the female genitalia structures.



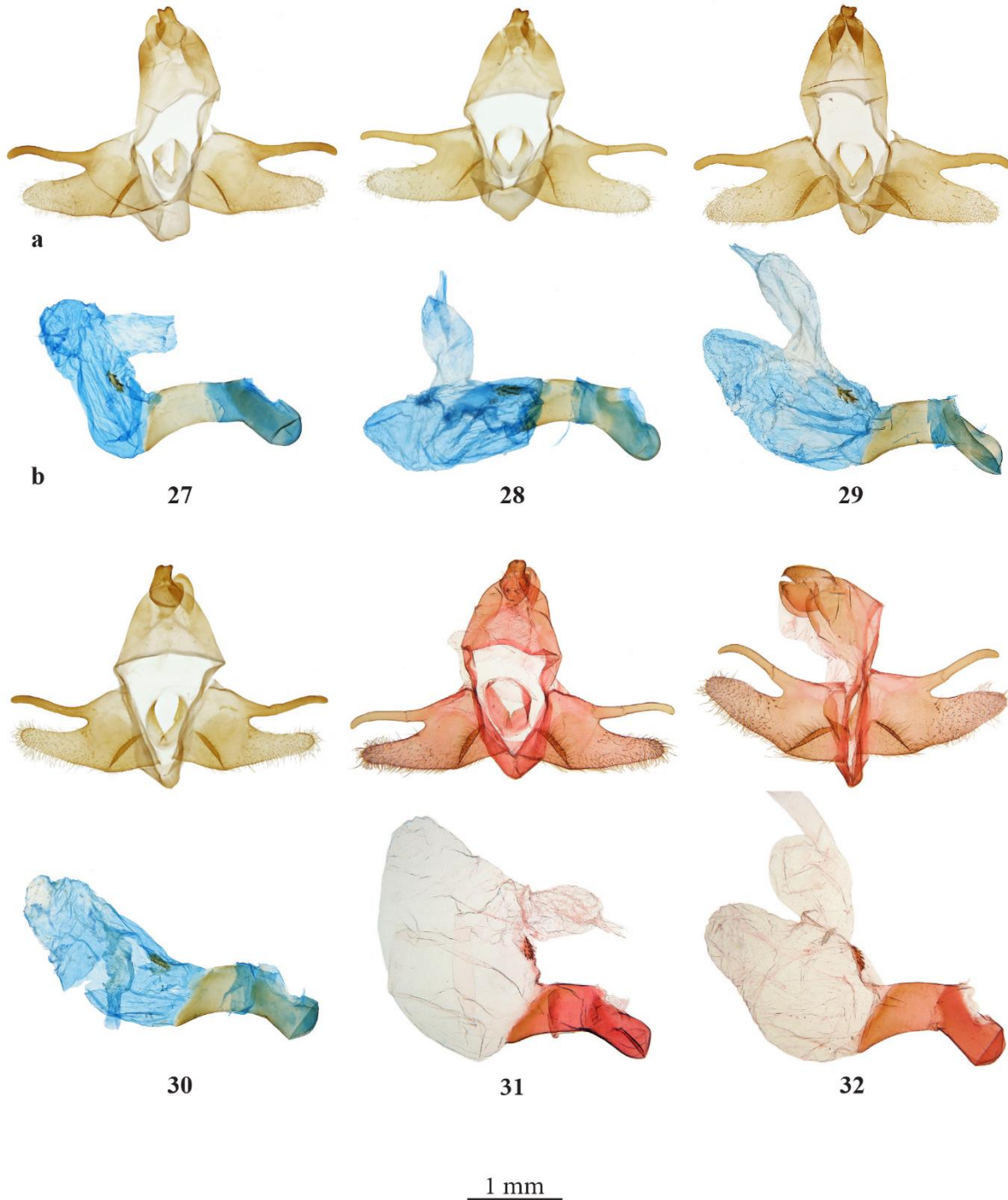
### 10mm

**Figures 18–26.** Adults, female. **18.** *Psalis securis* (NHMUK). **19.** *P. pennatula* (NHMUK). **20.** *Id.*, (NHMUK). **21.** *P. africana*, PT (NHMUK). **22.** *Id.* (ANHRT). **23.** *Id.* (OUMNH). **24.** *Id.* (ANHRT). **25.** *Id.* (ANHRT). **26.** *P. smithi* sp. n., PT (ANHRT).

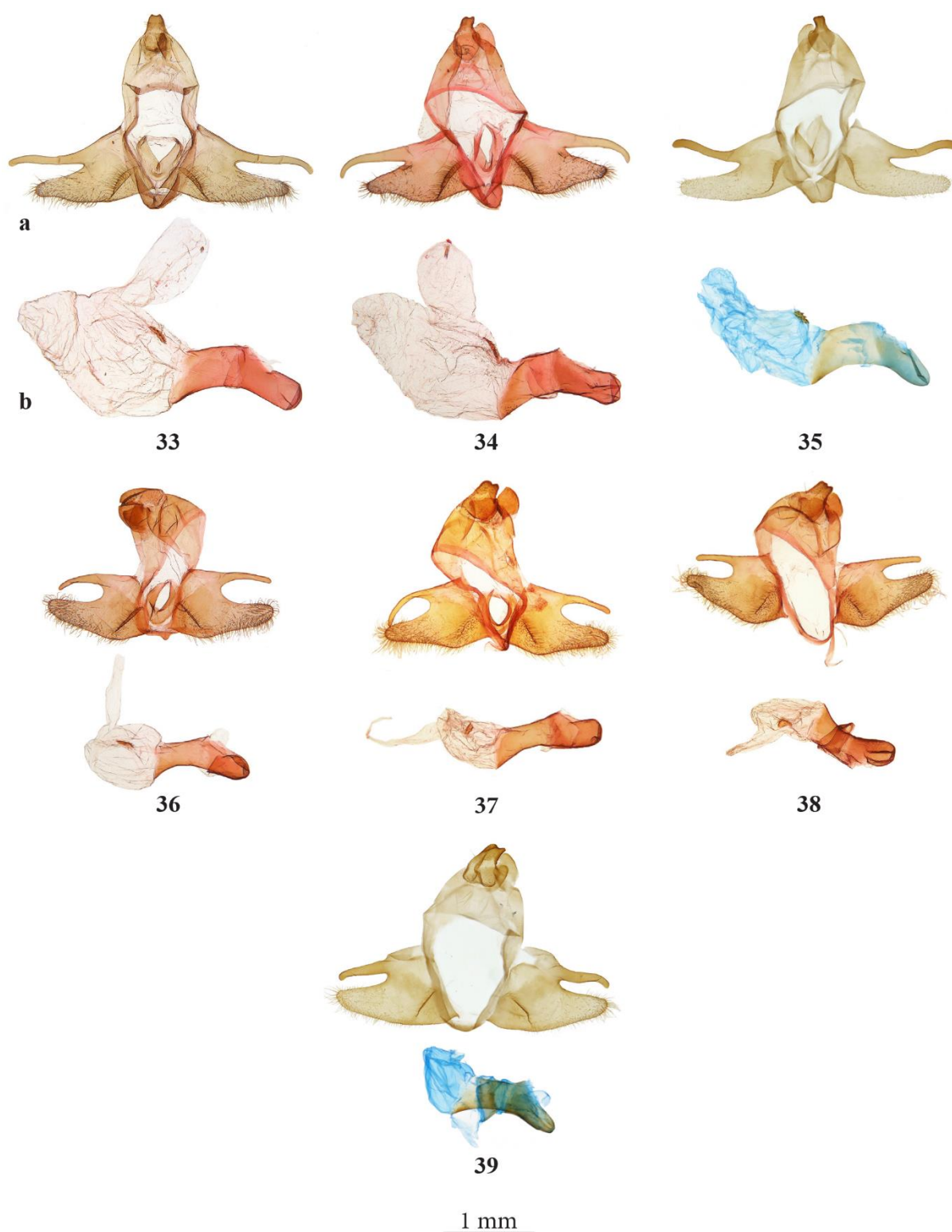
**Bionomics and distribution.** Kiriakoff (1956a) reported *P. africana* from Angola (a specimen has been dissected in the NHMUK, see above), DRC, Burundi, Rwanda, Kenya, Malawi, Mozambique, South Africa, Tanzania and Zimbabwe; some of the records from central and western DRC, Ghana (not traced during this study) and Nigeria (3 specimens examined and dissected in NHMUK and OUMNH), refer to *P. bashfordae* sp. n., as does Aurivillius' (1900) record of *P. pennatula* from Mukinbungu (DRC). Additionally, Dall' Asta (1977) reported the species from Ethiopia, and Sevastopulo (1957) from Uganda as *Psalis pennatula*. *Psalis securis* was accounted for from several African countries (Kenya: Butler (1894), Mozambique: Pagenstecher (1893), South Africa: Janse (1915), Distant (1897), Hampson

(1905), Zimbabwe: Hampson (1905)) prior to Kiriakoff's description of the Afrotropical *Psalis* and these records refer to *P. africana*. The specimens examined from Zambia during this study represent a new country record.

*Psalis africana* seems to be more prevalent in open woodland habitats, although it occurs sympatrically in northwest Zambia with *P. smithi* sp. n. in wetlands and hygrophilous grasslands (*dambo*), as well. This species is polyvoltine with records from both the rainy and dry seasons. The larva of *P. africana* has been reported (as *P. pennatula*) to feed on various cereals and undefined grasses (Sevastopulo 1975) and, similarly to its Asian sisters, may have the potential to be considered as an agricultural pest on farm crops of the Poaceae family (Kroon 1999).



**Figures 27–32.** Male genitalia, a: clasp apparatus, b: phallus. **27.** *Psalis securis*, Indonesia, Java, NHMUK 014332605 (NHMUK). **28.** *P. pennatula*, India, Kanara, NHMUK 014332604 (NHMUK). **29.** *Id.*, Sri Lanka, NHMUK 014332602 (NHMUK). **30.** *P. africana*, Kenya, Kibwezi, NHMUK 014332597 (NHMUK). **31.** *Id.*, Mozambique, MSR, LG 6366 (ANHRT). **32.** *Id.*, Zambia, Chilambwe Falls, LG 6059 (ANHRT).



**Figures 33–39.** Male genitalia, a: clasp apparatus, b: phallus. **33.** *Psalis bashfordae* sp. n., HT, Republic of Congo, OKNP, LG 6422 (ANHRT). **34.** *Id.*, PT, Republic of Congo, OKNP, LG 6364 (ANHRT). **35.** *Id.*, PT, Nigeria, Kareregi, NHMUK 014332600 (NHMUK). **36.** *P. smithi* sp. n., HT, Zambia, Chitunta Plain, LG 6361 (ANHRT). **37.** *Id.*, PT, Zambia, Chitunta Plain, BP 051 (ANHRT). **38.** *Id.*, PT, Zambia, Chitunta Plain, BP 052 (ANHRT). **39.** *P. punctuligera*, Madagascar, NHMUK 014332601 (NHMUK).

***Psalis smithi* sp. n.**

<https://zoobank.org/urn:lsid:zoobank.org:act:A5D6F1AF-7072-4578-8608-AAEDD23BED01>

(Figs 10–12, 26, 36–38, 48, 54)

**Holotype.** Male, “ZAMBIA 1396m / Chitunta Plain / (Miombo/Dambo mosaic) / 11°29'12"S, 24°24'18"E / 29.xi.–4.xii.2019 MV LightTrap / Bashford, M., Miles, W., / Mulvaney, L. Leg. / ANHRT:2019.25” // unique id.: ANHRTUK 00125545, gen. slide No.: LG 6361 (ANHRT).

**Paratypes. Zambia.** 5 males, 1 female, with the same data as in holotype, unique ids: ANHRTUK 00266197, 00125470, 00125541, 00125582, 00141801 (males), 00125507 (female), gen. slide Nos: BP 051, BP 052 (males), LG 6371 (female); 1 male, same data but collected by actinic light trap, unique id.: ANHRTUK 00124701; 1 male, Mwinilunga, Nkwaji, 1316m, 11°36'22"S, 24°33'17"E, 03–10.xii.2020, MV Light Trap, leg. Chizuwa, D., Choongo, W., ANHRT:2022.4, unique id.: ANHRTUK 00265038; 1 male, Jiwundu Swamp, (Miombo/Riverine forest mosaic), 1340m, 11°51'54"S, 25°33'20"E, 29.x.–04.xi.2018, MV Light Trap, leg. Aristophanous, M., Dérozier, V., László, G., Oram, D., ANHRT:2018.40, unique id.: ANHRTUK 00063051 (ANHRT).

**Description.**

**Adult** (Figs 10–12, 26). Forewing length 16–17 mm in male, 20 mm in female paratype. Head relatively large, antenna bipectinate, rami of female antenna ca. one-quarter as long as those of male, ochreous in both sexes, dorsal side of antenna shaft pale ochreous grey; labial palp short and broad, porrect, third segment as long as first and second combined, covered in long ochreous piliform scales, first and second segments interspersed with dark brown scales. Frons, vertex and collar pale ochreous, vertex with some admixture of darker scales medially. Tegula covered in pale ochreous, long piliform scales turning pale grey apically; mesothorax pale ochreous grey. Legs. Fore- and midleg covered in long greyish brown piliform scales, hindleg pale ochreous; index of spurs 0-2-4. Abdomen shiny whitish grey. Forewing narrow and relatively short, costal margin very gently arched, apex rounded in male, pointed and slightly produced in female, termen evenly convex in male, slightly falcate in female, anal margin gently arcuate. Ground colour pale greyish brown, with blackish longitudinal streak along medial vein followed by a narrow, pale ochreous brown longitudinal area dorsally filling in cell and area between R5 and M1; transverse lines and discal spot absent, cilia relatively long, chequered with pale grey and dark brown. Underside pale ochreous brown in costal two-thirds, creamy white in anal third, longitudinal streak weakly discernible. Hindwing white with some creamy tinge along termen; transverse lines and discal spot absent; cilia relatively long, white. Underside as of upperside. Sexual dimorphism marked, forewing of female paratype ca. 15% longer than that of males with acute forewing apex and slightly falcate subapical section of termen.

**Male genitalia** (Figs 36–38). Uncus short and robust, dorsomedially with wide longitudinal groove produced to short laterodistal processes forming bifid apex. Socii very short but broad basally, with slightly concave dorsal margin, short produced apex and evenly rounded ventral margin. Tegumen short with relatively broad lateral arms gradually tapered proximad. Valva very short, broad at base, deeply cleft comprising a thin, finger-like sclerotized costal process and a wider, slightly tapered, tongue-shaped, sparsely setose and membranous valvula divided by deep, U-shaped depression; sacculus small, bearing a short, sclerotized straight ridge running at 45° angle from base of valva. Juxta ring-shaped, constructed of broad, curved, basally fused, apically pointed plates; vinculum very short with small, rounded-triangular saccus. Phallus short, moderately thick, coecum penis rounded, ventral margin gently curved, dorsal margin straight, carina unmodified; vesica very short, inflated spherical with very short distal diverticulum and small, elongate serrate plate of cornuti medially; vesica ejaculatorius narrow tubular.

**Female genitalia** (Fig. 48). Papilla analis short and very broad with small rounded pseudopapilla, ovipositor short, broad trapezoidal; apophysis posterioris thin, medium long, as long as apophysis anterioris; 8<sup>th</sup> tergite very short and broad, ribbon-like. Ostium bursae wide, heavily sclerotized with densely spinulose margin, curly bracket-shaped; antrum short and broad, conspicuously quadrangular, moderately sclerotized; ductus bursae medium long, as long as diameter of corpus bursae, gradually dilated proximad; corpus bursae relatively small, spherical, fully membranous, signum bursae absent.



**Figures 40–45.** Female genitalia. **40.** *Psalis securis*, Indonesia, Java, NHMUK 014332609 (NHMUK). **41.** *P. pennatula*, India, Assam, NHMUK 014332607 (NHMUK). **42.** *Id.*, Sri Lanka, NHMUK 014332608 (NHMUK). **43.** *P. africana*, Mozambique, MSR, LG 6368 (ANHRT). **44.** *Id.*, South Sudan, Tereteinia Hill, BP 044 (OUMNH). **45.** *Id.*, Zambia, Danger Hill, LG 6370 (ANHRT).

**Diagnosis.** *Psalis smithi* sp. n. is readily distinguished from *P. africana* by its smaller size (the forewing length of the latter species ranges between 16–19 mm in males and 20–24 mm in females), slimmer body and the more uniformly greyish brown ground colour and sharply defined longitudinal streak of

the forewing. Contrastingly in *P. africana*, the bicoloured forewing, where the dorsal area is fawn and the ventral area is either grey with a purplish hue or fading into dark fawn and the transition between the different coloured areas is, although abrupt, never marked with a contrasting dark streak. Furthermore, the hindwing of the new species is uniformly white, whilst it is variably creamy white or pale ochreous often with a brown fringe in *P. africana*.

In the male genitalia, compared to *P. africana*, the new species has a dorsomedially deeply excavated uncus (it is only very slightly excavated in *P. africana*), shorter, more pointed socii, ca. 25% shorter valva with thinner costal process and a markedly shorter vinculum. The phalli of both species are similar with a slightly shorter coecum penis in *P. smithi* **sp. n.** which has a considerably smaller, spherical inflated proximal section of the vesica in contrast to the ca. twice larger, ovoid vesica of *P. africana*.

Compared to *P. africana*, the female genitalia of *P. smithi* **sp. n.** have a markedly shorter, apically less lobate anal papilla, a slightly wider, curly bracket-shaped ostium bursae (it is evenly concave or deeply notched in *P. africana*), a considerably shorter, less sclerotized antrum, a narrower and shorter ductus bursae and a much smaller, spherical corpus bursae lacking signum bursae in contrast to the ovoid bursa copulatrix of *P. africana* possessing a large elliptical plate of signum bursae.

**Etymology.** The new species is named in honour of Richard Smith, Chairman of the Board of Trustees, African Natural History Research Trust, acknowledging his remarkable support of entomological research in Sub-Saharan Africa.

**Bionomics and distribution.** *Psalis smithi* **sp. n.** is exclusively known to date from northwest Zambia where it inhabits marshlands and hygrophilous grasslands (*dambo*). All individuals were captured during the early rainy season.



**Figures 46–48.** Female genitalia. **46.** *Psalis africana*, Zambia, Choma, LG 6376 (ANHRT). **47.** *Id.*, Zambia, Jiwundu, LG 6369 (ANHRT). **48.** *P. smithi* **sp. n.**, PT, Zambia, Chitunta Plain, LG 6371 (ANHRT).

***Psalis bashfordae* sp. n.**

<https://zoobank.org/urn:lsid:zoobank.org:act:069F8495-F9A4-4DD9-945E-41DF6C4AFFB4>

(Figs 13–17, 33–35, 53)

**Holotype.** Male, “REPUBLIC OF CONGO 390m / Odzala-Kokoua National Park, / Lobo Research Camp / 00°35'04"N, 14°53'12"E / 12–19.iv.2024, actinic light trap / Bashford,M., László,G., / Talani,M., Yaba Ngouma,S. leg. / ANHRT:2024.7” // unique id.: ANHRTUK 00214691, gen. slide No.: LG 6422 (ANHRT).

**Paratypes. DRC.** 1 male, Léopoldville, 24.v.1949, leg. Dr. Fontaine, QR code label with unique id: NHMUK 010292341 (NHMUK). **Nigeria.** 2 males, Kateregi, 12.ix.1910, leg. Scott Macfie, QR code label with unique id: NHMUK 010292331, gen slide No.: NHMUK 014332600 (NHMUK); 1 male, Zungeru, 22.xi.1911, gen slide No.: BP 055 (OUMNH). **Republic of Congo.** 5 males, with same data as in holotype, unique ids: ANHRTUK 00381891, 00381894, 00381893, 00381892, 00214725, gen slide Nos: LG 6365, 6364; 6 males, same data but collected by MV light trap, 13–18.iv.2024, unique ids: ANHRTUK 00381896, 00381895, 00381897, 00214722, 00214733, 00214734; 1 male, same data but collected by LepiLED light trap, 16–17.iv.2024, unique id: ANHRTUK 00381898 (ANHRT).

**Description.**

**Adult.** Male (Figs 13–17). Forewing length 12–13 mm in male. Head relatively large, antenna bipectinate, rami ochreous brown, antenna shaft greyish brown; labial palp short and broad, covered in long piliform scales, dorsal side pale ochreous, ventral side greyish. Frons covered in mixture of dark grey, whitish and ochreous scales; vertex ochreous grey; collar hairy, vertex with some admixture of darker scales medially. Tegula and mesothorax covered in long brownish grey piliform scales dusted with white. Legs. Foreleg greyish brown with some white scales, midleg femur ochreous brown, tibia darker towards tarsi, hindleg, femur yellowish white, tibia darker toward tarsi; index of spurs 0-2-4. Abdomen whitish. Forewing narrow and relatively short, costal margin very gently arched, apex rounded, termen straight, tornus smoothly rounded, anal margin very gently convex. Ground colour dark brown to fawn, longitudinal streak along medial vein not distinguishable, subterminal triangle beneath median vein darker than rest of wing; small blackish spot present postmedially near tornus; transverse lines and discal spot absent; cilia greyish brown. Underside as of upperside but paler, triangular patch weakly discernible. Hindwing white with some creamy tinge along termen; transverse lines and discal spot absent; cilia pale brownish white, slightly darker around apex. Underside as of upperside.

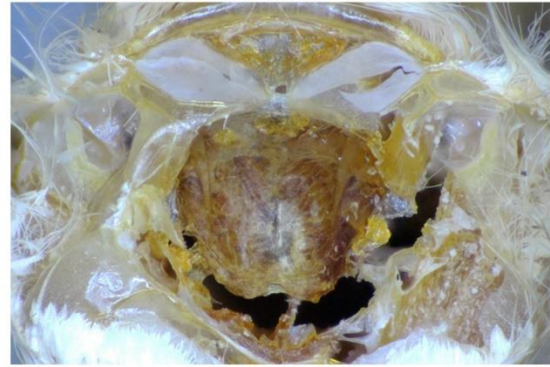
**Male genitalia** (Figs 33–35). Uncus short, quadrangular, apex bifid with short rounded processes. Socii very short, broad basally, with rounded margins and apex. Tegumen short with relatively broad lateral arms gradually tapered proximad. Valva short, broad at base, deeply cleft comprising a thin, long, finger-like sclerotized costal process overreaching a wider, strongly tapered, triangular, sparsely setose and membranous valvula. Valval lobes divided by deep, V-shaped depression; sacculus relatively long, with a sclerotized straight ridge running at 45° angle from base of valva. Juxta ring-shaped, constructed of broad, curved, basally fused, apically pointed plates; vinculum short with well-developed, rounded-triangular saccus. Phallus short, moderately thick, coecum penis rounded, ventral margin gently curved, dorsal margin straight, carina unmodified; vesica short, largely inflated ovoid with large distal diverticulum and small, elongate serrate plate of cornuti basally; vesica ejaculatorius thick tubular.

Female unknown.

**Diagnosis.** *Psalis bashfordae* sp. n. is readily distinguished from *P. africana* by its much smaller size (the forewing length of the latter species ranges between 16–19 mm in males), slimmer body and the more uniformly dark brown ground colour. *Psalis bashfordae* sp. n. has a slightly darker triangular area in the distal half of the forewing in contrast to the longitudinally divided bicolorous forewing of *P. africana* where the dorsal area is fawn and the ventral area is either grey with a purplish hue or fading into dark fawn. This transition is abrupt in *P. africana* but is only represented by a lightly contrasting triangle in *P. bashfordae* sp. n. Additionally, a subternal spot is present in both species, but is more heavily marked in *P. africana*.



49



50



51



52



53



54



55

**Figures 49–55.** Tympanal organs, ct – counter-tympanum, ty – tympanum. **49.** *Psalis pennatula*, India, Khasis (OUMNH). **50.** *Id.*, India, Khasis (OUMNH). **51.** *P. africana*, Mozambique (ANHRT). **52.** *Id.*, Zambia (ANHRT). **53.** *P. bashfordae* sp. n., PT, Republic of Congo (ANHRT). **54.** *P. smithi* sp. n., PT, Zambia (ANHRT). **55.** *P. securis*, Indonesia, Java (OUMNH).

In the male genitalia, the new species has a slightly narrower uncus and noticeably shorter valvula, where the long costal process extends further past the tip of the valvula than in *P. africana*. The inflated vesica is more greatly elongate in *P. bashfordae* **sp. n.**, near ovoid in shape, as opposed to the more spherical vesica in *P. africana*.

**Etymology.** It is with great pleasure that this new species is dedicated to Molly Bashford (ANHRT), committed museologist and experienced field worker, collector of a substantial number of new insect species in Africa.

**Bionomics and distribution.** *Psalis bashfordae* **sp. n.** is known to date from northern Congo, western DRC, and Nigeria. Kiriakoff (1956a) listed specimens from throughout DRC (all in the collections of the Royal Museum for Central Africa, Tervuren, Belgium) and although require confirmation, those from Congo-Ubangi, Stanleyville, Tshuapa, Bas-Congo and Sankuru probably belong to this species. The specimen cited from Ghana by Kiriakoff (1965a) could not be traced but most likely belongs to this species. The specimens in northern Congo were collected in a wet savannah habitat surrounded by marshland and forest patches in the beginning of the rainy season.

***Psalis punctuligera* (Mabille, 1880)**  
(Figs 9, 39)

*Anchirithra punctuligera* Mabille, 1880, *Annales de la Société entomologique de France* (5) 9: 315. Holotype, male in coll. NHMUK. Type locality: Madagascar.

**Material examined.**

**Madagascar.** 1 male, Tongobory and Besaha, x.1934, leg. R. Catala, QR code label with unique id: NHMUK 010292332, gen. slide No.: NHMUK 014332601 (prepared by G.M. László) (NHMUK).

**Remark.** The facies of the Madagascan *Psalis* species is highly distinct displaying a broad dark brown longitudinal band in the anal third and a narrow, gently arched, brown longitudinal streak in the costal third of the forewing, largely dissimilar to the other *Psalis* species. Based on the male genitalia morphology, *P. punctuligera* has closer affinities to *P. smithi* **sp. n.**, possessing a similarly short valva and a small spherical basal section of the vesica, however, without cornuti.

## Discussion

Our morphological investigations confirmed the distinctness of the Afrotropical tussock moth *Psalis africana*, a species which cannot be safely distinguished from its Asian relatives based on habitus or male genital morphology. The original description of *P. africana* (Kiriakoff 1956a) was somewhat vague referring to diagnostic features relying primarily on the differing tympanum/counter tympanum ratio between the Asian and African specimens. Kiriakoff provided an illustration of *P. africana* in the Lymantriinae instalment of his series on the tympanal organ (Kiriakoff 1956b) but as a comparative illustration of *P. pennatula* was not included, it was difficult to discern the degree of difference between the ratios. As such, we intended to test Kiriakoff's assertion.

For the purposes of this paper, we examined the width of the tympanal and counter tympanal membranes, to ascertain whether there was a difference in the ratio of these structures between taxa. After examining a variety of Asian *P. pennatula* and African *P. africana* specimens, as well as the two new species described in this paper, we concluded there was no clear difference in ratio of tympanum to counter tympanum between species (Figs 49–55), and so it was deemed unnecessary to include measurements of the width of either membrane within this paper. We did, however, find variation between specimens belonging to the same species as reported by Kiriakoff (1956a), where the tympanum is closer in size to the counter tympanum (Figs 51–52). It was therefore by chance, that the African and Asian specimens studied by Kiriakoff respectively grouped together using this character. However, in agreement with Kiriakoff's (1956a) statements in the original description of *P. africana*,

we found constant differences between certain structures of the ostium bursae and the signum bursae of the female genitalia of African and Asian specimens confirming the validity of *P. africana* (Figs 40–47). It is important to mention, however, that the different configuration of the ostium bursae and signum bursae (Figs 40–42) was also observed between Indian and Javan specimens confirming that *P. pennatula* from the Indian subcontinent is morphologically distinguishable from *P. securis* described from Java, resulting in the latter species being reinstated from synonymy with the former.

In their conference poster, Balaji *et al.* (2021) provided a morphological characterisation of *P. pennatula*, which is considered to be an agricultural pest of rice in India. Additionally, the authors illustrated a phylogram built from seven samples showing little divergence between Indian and African samples but both distinct from an Australian sample suggesting perhaps that *P. africana* and *P. pennatula* underwent speciation more recently after an initial split from the Australian species (either *P. securis* or *P. tacta*). As the genus seems to be widespread in South East Asia and is known from the Australian continent as well, a respective revisional study is required to clarify the taxonomic content and distribution of the Asian *Psalis* which, much like our present discoveries in the African fauna, is probably more diverse than it is currently believed.

Further examination of the African *Psalis* revealed two additional, hitherto undescribed species, increasing thus the species number on continental Africa from one to three (with a fourth on Madagascar). Based on small but constant differences in female genital morphology, another potential taxon inhabiting the Zambian plateau may also be delimited if additional diagnostic features, for instance genetic traits, provide another strain of evidence for the taxonomic distinctness of this population. The sympatric *P. africana* and *P. smithi* **sp. n.** are largely distinguished in both external as well as genital morphology, whilst the allopatric central-western African *P. bashfordae* **sp. n.** displays a highly distinctive external habitus whilst its genital morphology suggests close affinities to *P. africana*, as might be expected with allopatric speciation.

Whilst molecular studies cannot be discounted, as discussed throughout this paper, our study is a further example of the importance of in-depth morphological investigations in revealing the true diversity of the Afrotropical Lepidoptera (cf. László *et al.* 2023, Takano & László 2024, Volynkin 2023, Taberer *et al.* 2023) where countless new taxa still await description, even in such well-known, appealing genera like *Psalis*.

## Acknowledgements

In the Republic of Congo, we are indebted to the staff of the Odzala-Kokoua National Park, in particular to Jonas Erickson (director), Gwili Gibbon (head of research) Sylvain Yaba Ngouma (research assistant) and Adrich Mouamana (head of logistics) for their continuous support during ANHRT's fieldwork. Merlia Talani (Marien Ngouabi University, Brazzaville) is thanked for her invaluable assistance in the field as well as for acting as an interpreter. We are indebted to the Ministère de l'Enseignement Supérieur de la Recherche Scientifique et de l'Innovation Technologique for granting us a research permit and Joseph Moumbouilou (Direction de la Faune et des aires protégées, DEFAP) and Victor Mamonekene (Institut National de Recherche en Sciences Exactes et Naturelles, IRSEN) for issuing the necessary export permits. In Zambia, Rhoda Kachali (Department of National Parks and Wildlife – ZAWA, Lusaka), Claire Mateke and Martha Imakando (Livingstone Museum, Livingstone) are thanked for the diverse administrative and technical assistance provided during fieldwork as well as for issuing the research and export permits.

We are grateful to Alberto Zilli and Geoff Martin (NHMUK) and James Hogan (OUMNH) for kindly facilitating access to the Lymantriinae type and accession material under their care. The images of the holotype and paratype of *Psalis africana* are reproduced with permission from the Trustees of the Natural History Museum, London, and made available under Creative Commons License 4.0 (<https://creativecommons.org/licenses/by/4.0/>).

The authors declare that to the best of their knowledge they conform to the national regulations and meet with the conditions and requirements of International Conventions concerning collecting/export and handling of the specimens presented in this Article.

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