Diversity of the tussock moths (Lepidoptera, Erebidae, Lymantriinae) of the wider Maputaland-Pondoland-Albany, with special reference to the fauna of Mozambique

Michal Rindoš[1,2], Alexander Schintlmeister[3], Zdeněk Faltýnek Fric[1]

1 *The Czech Academy of Sciences, Biology Centre, Institute of Entomology, Branišovská 31, 37005 České Budějovice, Czech Republic; E-mail: rindom00@prf.jcu.cz, fric@entu.cas.cz*

2 *University of South Bohemia, Faculty of Science, Branišovská 1760, 37005 České Budějovice, Czech Republic*

3 *Calberla Strasse 3, 1D- 01326 Dresden, Germany; E-mail: schintlm@aol.com*

http://zoobank.org/FE78BDD1-423B-471C-AE96-B4D22F8D9FBA

Received 11 September 2021; accepted 10 January 2022; published: 21 January 2022
Subject Editor: Alberto Zilli.

Abstract. Maputaland-Pondoland-Albany, one of the African biodiversity hotspots, is defined by a high diversity of its fauna and flora. Despite numerous studies published about the Lepidoptera of this region, our knowledge of diversity and distributional patterns of moths still remains inadequate. Our study evaluates the tussock moth richness and endemism of the wider Maputaland-Pondoland-Albany region. We describe for the first time the variety of the tussock moth fauna of Mozambique, with seven newly recorded genera (*Euproctoides* Bethune-Baker, 1911; *Heteronygmia* Holland, 1893; *Leucoma* Hübner, 1822; *Ogoa* Walker, 1856; *Paraproctis* Bethune-Baker, 1911; *Polymona* Walker, 1855; *Tamsita* Kiriakoff, 1954).

Introduction

Biodiversity hotspots are defined as highly threatened biogeographic regions with the occurrence of endemic species of animals and plants (Myers 1988). Containing approximately half of the world's plant and a significant percentage of world's vertebrate diversity (Myers et al. 2000), conservation and thorough investigation of these 35 remarkable regions distributed worldwide became essential for many researchers due to ongoing species mass extinction (Mittermeier et al. 2011; Eisenhauer et al. 2019). The majority of the African hotspots are located in the Afrotropics (Myers et al. 2000). Maputaland-Pondoland-Albany is one of the three recently recognized biodiversity hotspots in the region of southern Africa (Fig. 1). Diversity and endemism are focused in the three major units: Maputaland in the north, Pondoland in the south and Albany in the south-west, comprising fauna and flora of South Africa, Eswatini (Swaziland) and Mozambique (Perera et al. 2011). The dominant habitats of this region bearing the most unique diversity are tropical and subtropical moist broadleaf forests and mountain grasslands and scrublands. Despite the uniqueness of this area serving as a meeting point for six of the eight southern African biomes, only 25% of the original extent of the natural habitat remains preserved (Mittermeier et al. 2004).

The moth subfamily Lymantriinae (Noctuoidea, Erebidae) occurs worldwide and comprises more than 2600 species in almost 360 genera (Kitching and Rawlins 1998). South Africa can be considered a well-studied part of the Maputaland-Pondoland-Albany, with several studies discussing the tussock moth fauna (Hampson 1905 – 77 spp., Janse 1917 – 109 spp., Pinhey 1975 – 57 spp.,

Vári et al. 2002 – 187 spp., Staude et al. 2020 – 34 spp.). However, knowledge of the Lymantriinae of the other southern African countries remains fairly insufficient. Presently, approximately 50 species of tussock moths are known to occur in Eswatini (Duke et al. 1999) and five species are reported from Lesotho (Kopij 2006). The current knowledge of the fauna of Mozambique is based mainly on past taxonomic works carried out on museum materials (e.g., Collenette 1955) counting roughly 50 species. Nonetheless, previously published works also include numerous mistakes in systematics (e.g., published synonyms, identification errors, etc.) and creates "ghost" diversity.

The purpose of this study was to provide an up-to-date overview and fill the gaps in the poor knowledge in the diversity of tussock moths of Afrotropical biodiversity hotspots. Verified distribution data also recovers potential endemic species and thus plays a significant role in the global conservation effort. In addition, we provide a first faunistic summary of the tussock moths of Mozambique, recording seven genera new to the country.

Material and methods

For the compilation of the list of Lymantriinae of the wider Maputaland-Pondoland-Albany we used presence/absence datasets covering the fauna of South Africa, Lesotho, Eswatini and Mozambique (Table 1). The data were mined from literature (e.g., Vári et al. 2002), corrected and supplemented by data obtained by the revision of the following museum collections: African Nat-

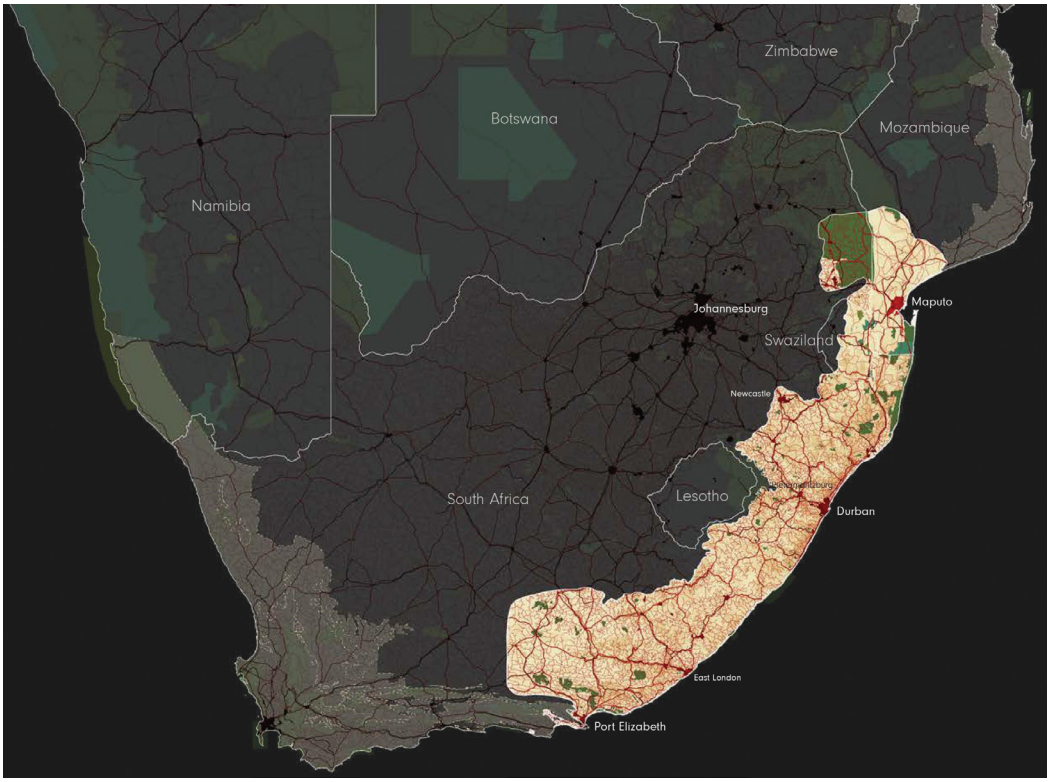

Figure 1. Map of the studied area, modified from Weller et al. (2017). The area of the Maputaland-Pondoland-Albany is highlighted by lighter colour.

Table 1. The presence, or absence of tussock moth species of the wider Maputaland-Pondoland-Albany. New genus records are marked with symbol (*) and endemic species highlighted with bold.

Species	Mozambique	Lesotho	South Africa	Eswatini
***Aroa anthora* (Felder R., 1874)**	0	0	1	0
Aroa difficilis Walker, 1865	0	0	1	1
Aroa discalis Walker, 1855	1	0	1	1
Aroa melanoleuca Hampson, 1905	1	0	1	0
Bracharoa dregei (Herrich-Schäffer, 1854)	0	1	1	0
Bracharoa mixta (Snellen, 1872)	1	0	1	0
Bracharoa quadripunctata (Wallengren, 1875)	1	1	1	1
Bracharoa tricolor (Herrich-Schäffer, 1856)	0	1	1	0
***Cataphractes arenacea* (Linnaeus, 1767)**	0	0	1	0
Cataphractes fasciata (Walker, 1855)	0	0	1	1
Cimola opalina Walker, 1855	1	0	1	1
***Conigephyra rikatia* Collenette, 1956**	1	0	0	0
Creagra liturata (Guérin-Méneville, 1844)	1	0	1	1
Cropera phlebitis (Hampson, 1905)	1	0	1	0
Cropera sericea (Hampson, 1910)	0	0	1	1
Cropera stilpnaroma Hering, 1926	0	1	1	0
Cropera testacea Walker, 1855	1	0	1	1
Crorema adspersa (Herrich-Schäffer, 1854)	0	0	1	1
Crorema fulvinotata (Butler, 1893)	1	0	1	0
Crorema setinoides (Holland, 1893)	0	0	1	0
Dasychira albimaculata Hering, 1926	0	0	1	1
Dasychira amata Hering, 1926	0	0	1	0
***Dasychira aurivillii* Hering, 1926**	0	0	1	0
Dasychira batoides (Plötz, 1880)	0	0	1	0
***Dasychira bryophilina* Hampson, 1910**	0	0	1	0
***Dasychira confinis* Distant, 1899**	0	0	1	0
Dasychira curvivirgata Karsch, 1895	0	0	1	1
***Dasychira didyma* Collenette, 1956**	0	0	1	0
Dasychira diplogramma Hering, 1927	0	0	1	0
***Dasychira eclipes* Collenette, 1939**	0	0	1	0
Dasychira esthlopis Collenette, 1953	0	0	1	0
Dasychira extatura Distant, 1897	1	0	1	1
Dasychira extorta Distant, 1897	1	0	1	1
***Dasychira fusca* (Walker, 1855)**	0	0	1	0
Dasychira gephyra Hering, 1926	0	0	1	0
Dasychira hampsoni Hering, 1926	1	0	1	0
Dasychira herbida (Walker, 1856)	0	0	1	0
***Dasychira hughesi* Collenette, 1933**	0	0	1	0
Dasychira lunensis Hampson, 1905	0	0	1	0
Dasychira mediofasciata Hering, 1926	0	0	1	0
Dasychira nubifuga (Holland, 1893)	0	0	1	1
Dasychira octophora (Hampson, 1905)	1	0	1	1
Dasychira phenax Collenette, 1932	0	0	1	0
Dasychira pheosia Hampson, 1910	0	0	1	1
Dasychira pluto Hering, 1926	0	0	1	0
Dasychira polia Hering, 1926	0	0	1	0
Dasychira postpura Hampson, 1905	0	0	1	1
Dasychira pulcherrima Hering, 1926	0	0	1	0
Dasychira pyrosoma Hampson, 1910	0	0	1	1
Dasychira rocana Swinhoe, 1906	1	0	1	1
Dasychira thanatos Hering, 1926	0	0	1	0
Dasychira vilis (Felder R., 1874)	0	0	1	0
Eudasychira amata (Hering, 1926)	0	0	1	0

Species	Mozambique	Lesotho	South Africa	Eswatini
Eudasychira georgiana (Fawcett, 1901)	1	0	1	0
Eudasychira metathermes (Hampson, 1905)	1	0	1	1
Eudasychira poliotis (Hampson, 1910)	0	0	1	0
Eudasychira proleprota (Hampson, 1905)	0	0	1	0
Euproctis aethiopica Snellen, 1872	0	0	1	1
***Euproctis aspersum* (Felder R., 1874)**	0	0	1	0
Euproctis beato Bryk, 1934	0	0	1	0
Euproctis bicolor Walker, 1855	1	1	1	1
***Euproctis chionea* Collenette, 1956**	0	0	1	0
Euproctis crocata (Boisduval, 1847)	0	0	1	0
***Euproctis flavicincta* Janse, 1915**	0	0	1	0
Euproctis haemodetes Hampson, 1905	0	0	1	1
***Euproctis hardenbergia* (Janse, 1915)**	0	0	1	0
***Euproctis iridescens* Janse, 1915**	0	0	1	0
***Euproctis kettlewelli* Collenette, 1956**	0	0	1	0
Euproctis mayottensis Collenette, 1956	0	0	1	0
***Euproctis melanura* (Wallengren, 1860)**	0	0	1	0
***Euproctis nigripuncta* Janse, 1915**	0	0	1	0
Euproctis pallida (Kirby, 1896)	1	0	1	1
***Euproctis petavia* (Stoll, 1782)**	0	0	1	0
Euproctis producta (Walker, 1863)	0	1	0	0
Euproctis punctifera (Walker, 1855)	1	0	1	0
Euproctis rufopunctata (Walker, 1862)	1	0	1	0
Euproctis sanguigutta Hampson, 1905	0	0	1	1
***Euproctis stellata* Distant, 1897**	0	0	1	0
***Euproctis straminicolor* Janse, 1915**	0	0	1	0
***Euproctis subalba* (Janse, 1915)**	0	0	1	0
Euproctis terminalis (Walker, 1855)	0	1	1	1
Euproctoides ertli (Wichgraf, 1922) *	1	0	1	0
Griveaudyria cangia (Druce, 1887)	1	0	1	0
Hemerophanes libyra (Druce, 1896)	1	0	1	1
Heteronygmia dissimilis (Aurivillius, 1910) *	1	0	1	0
***Homochira poecilosticta* Collenette, 1938**	1	0	0	0
Homochira rendalli (Distant, 1897)	1	0	1	1
***Homoeomeria flavicapilla* (Wallengren, 1860)**	0	0	1	0
Homoeomeria nivea Aurivillius, 1909	0	0	1	1
Lacipa bizonoides Butler, 1893	1	0	1	0
***Lacipa exetastes* Collenette, 1952**	1	0	0	0
Lacipa florida (Swinhoe, 1903)	0	0	1	0
Lacipa gracilis Hopffer, 1857	1	0	1	0
Lacipa nobilis (Herrich-Schäffer, 1855)	1	1	1	0
Lacipa ostra (Swinhoe, 1903)	1	0	0	0
***Lacipa picta* (Boisduval, 1847)**	0	0	1	0
***Lacipa pulverea* Distant, 1898**	0	0	1	0
Lacipa quadripunctata Dewitz, 1881	1	1	1	1
***Lacipa sarcistis* Hampson, 1905**	0	0	1	0
***Lacipa sexpunctata* Distant, 1897**	0	0	1	0
Laelia amaura Hering, 1926	0	0	1	0
***Laelia angustipennis* (Walker, 1855)**	0	0	1	0
Laelia aureus Janse, 1915	0	0	1	1
Laelia bifascia Hampson, 1905	0	0	1	0
Laelia bonaberiensis (Strand, 1915)	0	0	1	0
Laelia clarki Janse, 1915	0	0	1	1

Species	Mozambique	Lesotho	South Africa	Eswatini
Laelia figlina Distant, 1899	0	0	1	1
Laelia fracta Schaus & Clements, 1893	1	0	1	1
Laelia gwelila (Swinhoe, 1903)	0	0	1	0
Laelia haematica Hampson, 1905	0	0	1	0
Laelia janenschi Hering, 1926	0	0	1	0
Laelia lavia Swinhoe, 1903	0	0	1	0
***Laelia melaxantha* (Walker, 1865)**	0	0	1	0
Laelia municipalis Distant, 1897	1	0	1	0
***Laelia nigripulverea* Janse, 1915**	0	0	1	0
***Laelia punctulata* (Butler, 1875)**	0	0	1	0
Laelia robusta Janse, 1915	0	0	1	1
Laelia rosea Schaus & Clements, 1893	0	0	1	0
Laelia subrosea (Walker, 1855)	1	0	1	1
***Laelia subviridis* Janse, 1915**	0	0	1	0
***Laelia swinnyi* Janse, 1915**	0	0	1	0
Laelioproctis leucosphena Collenette, 1939	0	0	1	0
Lepidopalpus hyalina Janse, 1915	0	0	1	1
Leptaroa sp.	1	0	0	0
Leptaroa paupera Hering, 1926	0	0	1	0
Leucoma ogovensis (Holland, 1893) *	0	0	1	0
Leucoma parva Plötz, 1880 *	1	0	1	0
Leucoma sevastopuloi Collenette, 1955 *	1	0	0	0
***Lymantria kettlewelli* Collenette, 1953**	0	0	1	0
***Lymantria lutea* (Boisduval, 1847)**	0	0	1	0
***Lymantria subfusca* (Boisduval, 1847)**	0	0	1	0
Marblepsis flabellaria (Fabricius, 1787)	1	0	1	1
Marblepsis melanocraspis (Hampson, 1905)	1	0	1	0
***Micraroa minima* Janse, 1915**	0	0	1	0
Micraroa rufescens Hampson, 1905	0	0	1	0
Morasa modesta Walker, 1855	1	0	1	1
Naroma varipes (Walker, 1865)	1	0	1	1
Ogoa simplex Walker, 1856 *	1	0	1	1
Olapa fulviceps Hampson, 1910	1	0	1	0
Olapa nigribasis Janse, 1917	0	0	1	1
Olapa nigricosta Hampson, 1905	0	0	1	0
Olapa tavetensis (Holland, 1892)	1	0	1	0
Olene basalis (Walker, 1855)	1	0	1	0
Palasea albimacula Wallengren, 1863	1	0	1	1
Paraproctis chionopeza Collenette, 1954 *	1	0	1	0
Pirga pellucida Wichgraf, 1922	1	0	1	0
***Pirga transvalensis* Janse, 1915**	0	0	1	0
Pirgula atrinotata (Butler, 1897)	1	0	1	0
Polymona rufifemur Walker, 1855 *	1	1	1	1
Porthesaroa maculata Collenette, 1938	1	0	1	0
Psalis securis Hübner, 1823	1	0	1	1
Pseudobazisa perculta (Distant, 1897)	0	0	1	1
Pteredoa monosticta (Butler, 1898)	1	0	1	1
Pteredoa subapicalis Hering, 1926	1	0	1	0
Pteredoa usebia (Swinhoe, 1903)	0	0	1	0
Rhypopteryx hemichrysa Collenette, 1960	0	0	1	0
Rhypopteryx lugardi (Swinhoe, 1903)	0	0	1	0
Rhypopteryx rhodalipha (Felder R., 1874)	1	0	1	1
Rhypopteryx rhodea (Hampson, 1905)	1	0	1	0

Species	Mozambique	Lesotho	South Africa	Eswatini
Rhypopteryx rubripunctata (Weymer, 1892)	0	0	1	0
Rhypopteryx tacita (Hering, 1927)	0	0	1	1
Rhypopteryx triangulifera (Hampson, 1910)	0	0	1	0
Ruanda eleuteriopsis Hering, 1926	1	0	0	0
Ruanda furva (Hampson, 1905)	1	0	1	0
Ruanda nuda (Holland, 1897)	0	0	1	0
Stracena bananae (Butler, 1897)	1	0	1	0
Tamsita habrotima (Tams, 1930) *	1	0	0	0

ural History Research Trust (Leominster, United Kingdom), Natural History Museum (London, United Kingdom), Museum Witt (Munich, Germany), Bavarian State Collection of Zoology (Munich, Germany), and Naturalis Biodiversity Centre (Leiden, Netherlands). In total 2352 specimens from South Africa, 2079 specimens from Mozambique, 18 specimens from Lesotho and 61 specimens from Eswatini were revised. The specimens were photographed using a Nikon D90 camera with Nikkor AF Micro 60 mm lens and assembled for our plates using the Corel DRAW X7 computer program.

We compared the faunal diversity of the regions using number of species, and similarity or uniqueness of the species composition expressed as a nestedness of the species and species turnover expressed as binary presence/absence data. We calculated the data in R v. 4.0.3. (R Core Team 2018), by a command "nestedbetajac" (package vegan – Oksanen et al. 2019). Species endemicity was evaluated based on the data of species occurrence available from online database (De Prins and De Prins 2021) and from literature (e.g., Swinhoe 1903).

Results

We reported altogether 168 species of tussock moths belonging to 43 genera currently occurring in the Maputaland-Pondoland-Albany biodiversity hotspot. We are listing 158 species from South Africa, 62 species from Mozambique, 48 species from Eswatini and 10 species from Lesotho. The faunal comparison analysis also revealed 44 potentially endemic species from South Africa and six potentially endemic species from Mozambique (Table 1). By the term "potential endemic species" we mean a species reported so far from only one country, but we cannot rule out its distribution in surrounding countries.

The following genera are recorded for the first time from Mozambique: *Euproctoides* Bethune-Baker, 1911; *Heteronygmia* Holland, 1893; *Leucoma* Hübner, 1822; *Ogoa* Walker, 1856; *Paraproctis* Bethune-Baker, 1911; *Polymona* Walker, 1855; *Tamsita* Kiriakoff, 1954 (Fig. 2).

Euproctoides Bethune-Baker, 1911
Euproctoides ertli (Wichgraf, 1922)

Fig. 2A

Material. Mozambique • 1♂; Zambezia Province, Mt. Namuli, SW slopes near Mucunha village (forest remnant); 15°22'33"S, 37°05'05.7"E; 15–16 Aug. 2018; 1245 m; MV Light Trap; G. László, W. Miles, A. Vetina leg.; ANHRT: 2018.30, ANHRTUK 00094093.

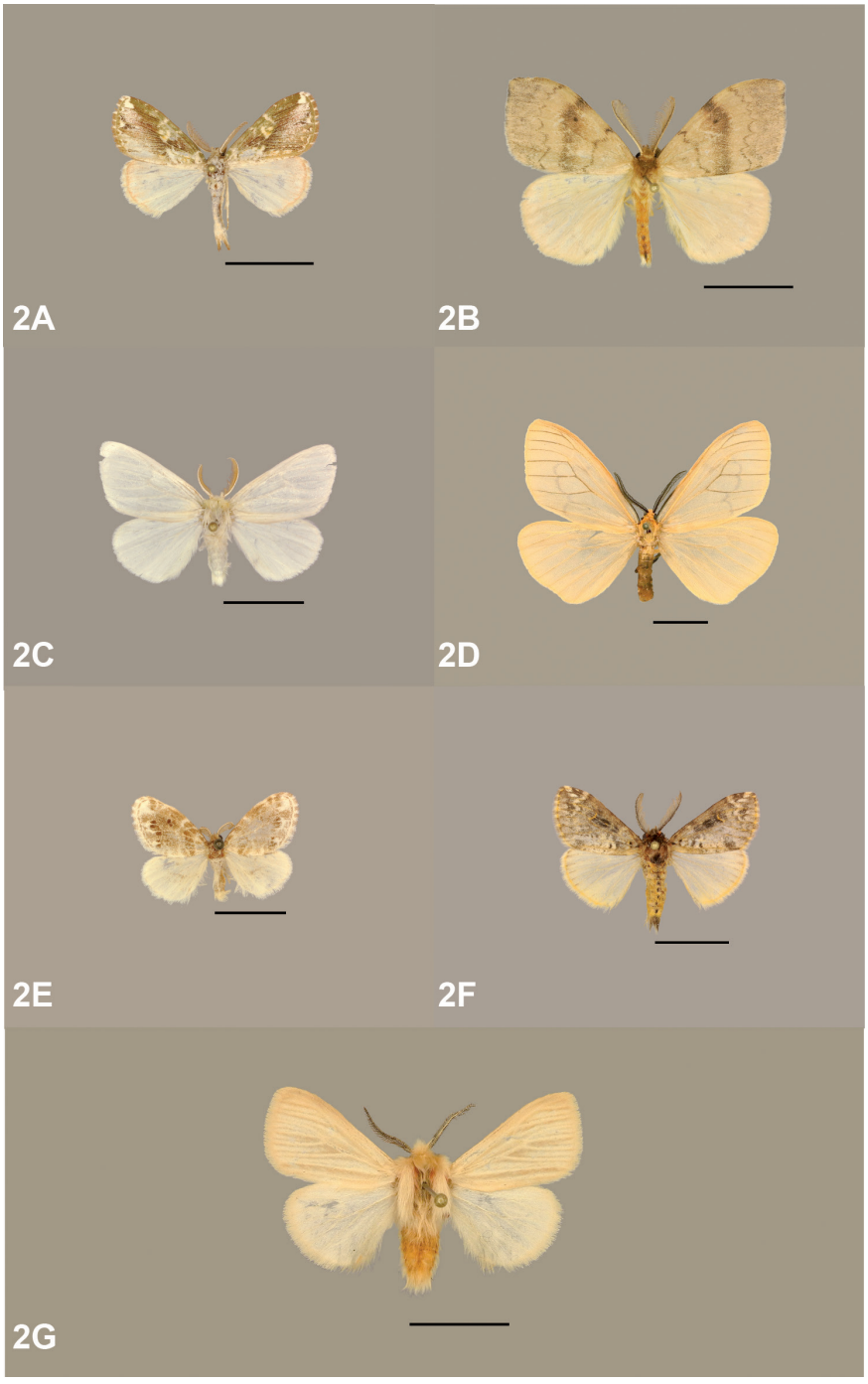

Figure 2. Seven representatives of newly recorded genera of tussock moths in Mozambique. **A.** *Euproctoides ertli* (Wichgraf, 1922); **B.** *Heteronygmia dissimilis* (Aurivillius, 1910); **C.** *Leucoma ogovensis* (Holland, 1893); **D.** *Ogoa simplex* Walker, 1856; **E.** *Paraproctis chionopeza* Collenette, 1954; **F.** *Polymona rufifemur* Walker, 1855; **G.** *Tamsita habrotima* (Tams, 1930). Scale bars: 1 cm.

Distribution. Angola (Wichgraf 1922), South Africa (Vári et al. 2002).

Heteronygmia Holland, 1893
Heteronygmia dissimilis (Aurivillius, 1910)

Fig. 2B

Material. Mozambique • 1♂; Manica Province, Chimanimani National Reserve, Moribane Forest, Ndzou Camp (Moist Forest); 19°44'01.4"S, 33°20'15.1"E; 3–5 Aug. 2018; 630 m; Actinic Light Trap; G. László, W. Miles, A. Vetina leg.; ANHRT: 2018.30, ANHRTUK 00046725.

Distribution. Kenya (Hering 1926), Malawi (Murphy and Chipeta 2018), Tanzania (Aurivillius 1910), Zimbabwe (Hering 1929).

Leucoma Hübner, 1822
Leucoma ogovensis (Holland, 1893)

Fig. 2C

Material. Mozambique • 1♂; Maputo Special Reserve, West Gate (Sand Forest); 26°30'14.2"S, 32°42'59.6"E; 21–22 Feb. 2018; 22 m; MV Light Trap; G. László, J. Mulvaney, L. Smith leg.; ANHRT: 2018.2, ANHRT 00027695.

Distribution. Cameroon (Aurivillius 1904), Congo (Holland 1920), Gabon (Holland 1893), Ghana (Swinhoe 1903), Kenya (Le Cerf 1922), Nigeria (Swinhoe 1903), South Africa (Hering 1926).

Ogoa Walker, 1856
Ogoa simplex Walker, 1856

Fig. 2D

Material. Mozambique • 1♂; Maputo Special Reserve, West Gate (Sand Forest); 26°30'14.2"S, 32°42'59.6"E, 13–15 Feb. 2018; 22 m; MV Light Trap; G. László, J. Mulvaney, L. Smith leg.; ANHRT: 2018.2, ANHRTUK 00038737.

Distribution. Kenya (Butler 1898), South Africa (Walker, 1856), Tanzania (Grünberg 1907).

Paraproctis Bethune-Baker, 1911
Paraproctis chionopeza Collenette, 1954

Fig. 2E

Material. Mozambique • 1♂; Maputo Special Reserve, Mangrove Camp (Mangrove-Woodland Mosaic); 26°19'35.9"S, 32°42'35.7"E; 7–9 Dec. 2016; 9 m; MV Light Trap; M. Aristophanous, J. Cristóvão, G. László, W. Miles leg.; ANHRT: 2017.22, ANHRTUK 00053987.

Distribution. DR Congo (Afromoths, N. Voaden), South Africa (Vári et al. 2002), Zambia (Collenette 1954), Zimbabwe (Afromoths, R. Butler).

Polymona Walker, 1855
Polymona rufifemur Walker, 1855

Fig. 2F

Material. Mozambique • 1♂; Maputo Special Reserve, Ponta Milibangalala (Dune Grassland – Dune-Forest Ecotone); 26°26'58.6"S, 32°55'29.8"E; 30 Nov.-3 Dec. 2016; 15 m; Light Trap; M. Aristophanous, J. Cristóvão, G. László, W. Miles leg.; ANHRT: 2017.22, ANHRTUK 00055859.

Distribution. Botswana (Pinhey 1975), Djibouti (Dall'Asta 1977), Eritrea (Berio 1939), Ethiopia (Collenette 1938), Gambia (Druce 1887), Kenya (Le Cerf 1922), Lesotho (Kopij 2006), Malawi (Swinhoe 1903), Namibia (Dall'Asta 2004), South Africa (Janse 1915), Tanzania (Pinhey 1975), Zambia (Pinhey 1975), Zimbabwe (Swinhoe 1903).

Tamsita Kiriakoff, 1954
Tamsita habrotima (Tams, 1930)

Fig. 2G

Material. Mozambique • 1♂; Zambezia Province, Mt. Namuli, SW slopes near Mucunha village (forest remnant); 15°22'33"S, 37°05'05.7"E; 15–16 Aug. 2018; 1245 m; MV Light Trap; G. László, W. Miles, A. Vetina leg.; ANHRT: 2018.30, ANHRTUK 00050678.

Distribution. Kenya (Tams 1930), Uganda (Tams 1930).

Lymantriinae diversity patterns

The highest species richness of tussock moths was recognised in the Republic of South Africa (N = 157) representing 93% of all recorded species (Table 2). The highest turnover among studied countries was found in Lesotho (37.8%).

The neighbouring countries Mozambique, Lesotho and Eswatini yielded approximately the same values (60%) of species exchange between each other (Table 3). Surprisingly, neither Leso-

Table 2. Evaluation of tussock moth richness patterns in the wider Maputaland-Pondoland-Albany.

	species	nestedness	turnover
Mozambique	62	0.315	0.295
Lesotho	10	0.265	0.379
South Africa	157	0.532	0.103
Eswatini	12	0.380	0.238

Table 3. Faunal exchange (turnover) among studied countries of the Maputaland-Pondoland-Albany.

	Mozambique	Lesotho	South Africa	Eswatini
Mozambique	0.000	0.667	0.229	0.648
Lesotho	0.667	0.000	0.182	0.667
South Africa	0.229	0.182	0.000	0.000
Eswatini	0.648	0.667	0.000	0.000

Table 4. Faunal nestedness among the countries of the Maputaland-Pondoland-Albany.

	Mozambique	Lesotho	South Africa	Eswatini
Mozambique	0.000	0.259	0.446	0.058
Lesotho	0.259	0.000	0.762	0.239
South Africa	0.446	0.762	0.000	0.696
Eswatini	0.058	0.239	0.696	0.000

tho nor Eswatini show any faunal exchange with South Africa. All three countries also displayed high species richness differences towards South Africa (Table 4). Due to its geography, the fauna of Lesotho is, not surprisingly, deeply nested in the fauna of South Africa. However, South Africa showed the lowest value in nestedness towards Mozambique (44.6%).

Discussion

Our study has reviewed the tussock moth fauna hitherto recorded from the wider Maputaland-Pondoland-Albany and analysed the faunal diversity between those four southern African countries abutting the area of the hotspot. We also have presented a first summary of the tussock moths occurring in Mozambique along with seven genera newly recorded in the country. All these were expected to occur in Mozambique because of their presence in neighbouring countries and these records connect their disjunctive distribution ranges with South Africa. The only exception is the genus *Tamsita* Kiriakoff, 1954, the presence of which in Mozambique represents the southernmost occurrence of the genus.

The diversity of the tussock moths in Maputaland-Pondoland-Albany displayed several peculiar distributional trends. In spite of the large amount of faunistic studies published about the South African fauna and flora, only very few of them discussed their distributional or biogeographic patterns with regards to the studied countries. We found that the fauna of Lesotho is deeply nested in the South African fauna, but otherwise it has a high turnover among all other countries. This result outlined the potential origin scenario. Lesotho is a country with the high average altitude and the occurrence of specific alti-montane ecoregions (e.g., Drakensberg grasslands and woodlands) with difficult accessibility and hard conditions. Therefore, it was colonized by tussock moth species from neighbouring countries (Sayre et al. 2013). On the other hand, the South African fauna can be considered very similar to the fauna of Mozambique based on the values of nestedness, and simultaneously does not exhibit any faunal exchange towards Eswatini and Lesotho. Thus it forms a gradient of almost the same fauna along the Indian Ocean coast. Our results also highlighted that approximately 27.8% of the South African fauna and 9.6% of the species of Mozambique are potentially endemic to the Maputaland-Pondoland-Albany.

In conclusion, we reviewed and extended the current knowledge of the diversity and distribution patterns of tussock moths in southern Africa. What is more, we also provided a pilot snapshot of species endemicity of Lymantriinae in this region, which contributes to future conservation efforts of this remarkable biodiversity hotspot.

Acknowledgements

We are greatly indebted to Gyula M. László (The African Natural History Research Trust, United Kingdom) for his help with photographing of specimens and draft reading. We would also like to thank Richard Smith

(The African Natural History Research Trust, United Kingdom), Alberto Zilli, Geoff Martin (Natural History Museum London, United Kingdom), Thomas Witt (†) (Museum Witt/Witt Foundation, Germany), Axel Hausmann (Bavarian State Collection of Zoology, Germany) and Rob de Vos (Naturalis Biodiversity Centre, Netherlands) for providing us access to the collections under their care. Work of MR was supported by grant GA JU 038/2019/P provided by the University of South Bohemia.

References

De Prins J, De Prins W (2021) Afromoths, online database of Afrotropical moth species (Lepidoptera). http://www.afromoths.net/ [Accessed on 29.10.2021]

Aurivillius C (1904) Beiträge zur Kenntniss der Insektenfauna von Kamerun. 11. Lepidoptera Heterocera II. Arkiv för Zoologi 2(4): 1–68. https://doi.org/10.5962/bhl.part.4541

Aurivillius C (1910) Wissenschaftliche ergebnisse der Schwedischen zoologischen expedition nach dem Kilimandjaro, dem Meru und den umgebenden Massaisteppen Deutsch-Ostafrikas 1905–1906, unter leitung von prof. Dr. Yngve Sjöstedt. P. Palmquists aktiebolag, Stockholm, Sweden, 21–22.

Berio E (1939) Contributi alla conoscenza dei lepidotteri eteroceri dell'Eritrea I. Lista delle specie con descrizioni delle nuove entità raccolte negli anni 1934 al 1937 dal sig. Francesco Vaccaro. Memorie della Società Entomologica Italiana 17: 47–62.

Butler AG (1898) On a collection of Lepidoptera made in British East Africa by Mr. C. S. Betton. Proceedings of the Zoological Society of London 57: 395–444. https://doi.org/10.1111/j.1096-3642.1898.tb03161.x

Collenette CL (1938) New species of Lymantriidae (Lepidoptera, Heterocera) from the Haut Katanga and other localities. Annals and Magazine of Natural History (11)1: 209–223. https://doi.org/10.1080/00222933808526757

Collenette CL (1954) New and little-known African Lymantriidae (Lepidoptera: Heterocera). Proceedings of the Entomological Society of London (B) 23: 146–154. https://doi.org/10.1111/j.1365-3113.1954.tb00117.x

Collenette CL (1955) Further new and little-known African Lymantriidae. Annals and Magazine of Natural History (12)93: 641–651. https://doi.org/10.1080/00222935508655680

Dall'Asta U (1977) Lépidoptères. Hétérocères. Lymantriidae. In: Rougeot PC (Ed.) Missions entomologiques en Ethiopie 1973–1975. Fascicule 1. Mémoires du Muséum national d'Histoire naturelle (A) 105: 39–42.

Dall'Asta U (2004) Lymantriidae and Notodontidae: Thaumetopoeinae (Lepidoptera, Noctuoidea). In: Mey W (Ed.) The Lepidoptera of the Brandberg Massif in Namibia. Esperiana, Memoir 1: 305–309.

Druce H (1887) Appendix V: Lepidoptera, Heterocera. In: Moloney AC (Ed.) Sketch of the forestry of West Africa with particular reference to its present principal commercial products. Sampson Low, Marston, Searle, Rivington Publishing, London, UK, 492–507.

Duke N, Saunders J, Saunders C (1999) A checklist of insects of Swaziland. The Conservation Trust of Swaziland and The Natural History Society of Swaziland, Swaziland, 74 pp.

Eisenhauer N, Bonn A, Guerra AC (2019) Recognizing the quiet extinction of invertebrates. Nature Communications 10: 50. https://doi.org/10.1038/s41467-018-07916-1

Grünberg K (1907) Neue afrikanische Heteroceren nebst einigen synonymischen Bemerkungen. Berliner entomologische Zeitschrift 52: 63–75.

Hampson GF (1905) The moths of South Africa (part III). Annals of the South African Museum 3: 390–412.

Hering EM (1926) Lymantriidae. In: Seitz A (Ed.) Die Gross-Schmetterlinge der Erde: Eine Systematische Bearbeitung der bis jetzt bekannten Gross-Schmetterlinge. Die Afrikanischen Spinner und Schwärmer. Band 14. Alfred Kernen Verlag, Stuttgart, Germany, 127–198.

Hering EM (1929) Neue Heteroceren aus dem Congo-Museum. Revue de Zoologie et Botanique Africaines 18: 32–36.

Holland WJ (1893) New African Nyctemeridae and Liparidae. Entomological News 4: 59–64.

Holland WJ (1920) Lepidoptera of the Congo, being a systematic list of the butterflies and moths collected by the American Museum of Natural History Congo Expedition, together with descriptions of some hitherto undescribed species. Bulletin of the American Museum of Natural History 43(6): 109–369. https://doi.org/10.5962/bhl.title.11468

Janse AJT (1915) Contribution towards our knowledge of the South African Lymantriadae. Annals of the Transvaal Museum 5: 1–67.

Kitching IJ, Rawlins J (1998) The Noctuoidea. In: Kristensen NP (Ed.) Handbook of Zoology. Volume 4: Lepidoptera, Moths and Butterflies. Volume 1: Evolution, Systematics and Biogeography. Walter de Gryuter, Berlin, Germany, 355–402. https://doi.org/10.1515/9783110804744.355

Kopij G (2006) Lepidoptera fauna of Lesotho. Acta Zoologica Cracoviensia – series B: Invertebrata 49: 137–180. https://doi.org/10.3409/000000006783995256

Le Cerf F (1922) Voyage de M. le Baron Maurice de Rothschild en Ethiopie et en Afrique orientale anglaise (1904–1905). Résultats scientifiques, Animax Arcticulés, Première Partie: Lépidoptères. Hétérocères. Muséum National d'Histoire Naturelle, Paris, France, 434–438.

Mittermeier RA, Gill PR, Hoffmann M, Pilgrim J, Brooks T, Mittermeier CG, da Fonseca, GAB (2004) Hotspots Revisited: Earthís Biologically Richest and Most Endangered Ecoregions. CEMEX, Mexico City, Mexico, 392 pp.

Mittermeier RA, Turner WR, Larsen FW, Brooks TM, Gascon C (2011) Global Biodiversity Conservation: The Critical Role of Hotspots. In: Zachos F, Habel J (Eds) Biodiversity Hotspots. Springer, Berlin, Germany, 3–22. https://doi.org/10.1007/978-3-642-20992-5_1

Murphy R, Chipeta J (2018) BID-Malawi's Lymantriidae-Biodiversity-Data-Records. Version 1.1. The Department of Museums and Monuments. GBIF. https://doi.org/10.15468/2pqrux [26.12.2020]

Myers N (1988) Threatened biotas: 'hotspots' in tropical forests. Environmentalist 8: 187–208. https://doi.org/10.1007/BF02240252

Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403: 853–858. https://doi.org/10.1038/35002501

Oksanen J, Blanchet FG, Friendly M, Kindt R, Legendre P, McGlinn D, Minchin PR, O'Hara RB, Simpson GL, Solymos P, Stevens MNH, Szoecs E, Wagner H (2019) vegan: Community Ecology Package. R package, version 2.5-6. https://CRAN.R-project.org/package=vegan [26.12.2020]

Perera SJ, Ratnayake-Perera D, Proches S (2011) Vertebrate distributions indicate a greater Maputaland-Pondoland-Albany region of endemism. South African Journal of Science 107: 1–15. https://doi.org/10.4102/sajs.v107i7/8.462

Pinhey ECG (1975) Moths of Southern Africa. Tafelberg, Cape Town, South Africa, 273 pp.

R Core Team (2018) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/ [26.12.2020]

Sayre R, Comer P, Hak J, Josse C, Bow J, Warner H, Larwanou M, Kelbessa E, Bekele T, Kehl H, Amena R, Andriamasimanana R, Ba T, Benson L, Boucher T, Brown M, Cress J, Dassering O, Friesen B, Gachathi F, Houcine S, Keita M, Khamala E, Marangu D, Mokua F, Morou B, Mucina L, Mugisha S, Mwavu E, Rutherford M, Sanou P, Syampungani S, Tomor B, Vall A, Vande Weghe J, Wangui E, Waruingi L (2013) A new map of standardized terrestrial ecosystems of Africa. Association of American Geographers, Wahington DC, District of Columbia, USA, 24 pp.

Staude HS, Maclean M, Mecenero S, Pretorius RJ, Oberprieler RG, Van Noort S, Sharp A, Sharp I, Balona J, Bradley S, Brink M, Morton AS, Botha MJ, Collins SC, Grobler Q, Edge DA, Williams MC, Sihvonen P (2020) An overview of Lepidoptera-host-parasitoid associations for southern Africa, including an illustrated report on 2 370 African Lepidoptera-host and 119 parasitoid-Lepidoptera associations. Metamorphosis 31(3): 1–380.

Swinhoe C (1903) A revision of the Old World Lymantriidae in the national collection. Transactions of the entomological Society of London 3: 375–498. https://doi.org/10.1111/j.1365-2311.1903.tb01142.x

Tams WHT (1930) XLVIII. – Descriptions of new African Moths in the British Museum Collection. Annals and Magazine of Natural History 5: 484–493. https://doi.org/10.1080/00222933008673158

Vári L, Kroon DM, Krüger M (2002) Classification and Checklist of the Species of Lepidoptera recorded in Southern Africa. Simple Solutions, Chatswood, Australia, 384 pp.

Walker F (1856) List of the specimens of lepidopterous insects in the collection of the British Museum. Volume 7: Lepidoptera heterocera. Printed by order of the Trustees, London, UK, 1763–1764.

Weller RJ, Hoch C, Huang C (2017) Atlas for the End of the World. http://atlas-for-the-end-of-the-world.com [26.12.2020]

Wichgraf FLO (1922) Neue afrikanische Lepidopteren aus der Ertlschen Sammlung. Internationale entomologische Zeitschrift 15(25): 196–197.