Description of a new genus and species of Metarbelidae (Lepidoptera, Cossoidea) from the Albertine Rift region of Tanzania, East Africa

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Genus *Bjoernstadia* **gen. nov.** designated as new and its single species *B. kasuluensis* **spec. nov.** is described from Kasulu, northwestern Tanzania, East Africa (Afrotropical Region). Wing pattern and male genitalia of the new species are depicted and notes on the habitat are presented.

Key words: Afrotropical Region, Albertine Rift, *Bjoernstadia* **gen. nov.**, *kasuluensis* **spec. nov.**, taxonomy, revision.

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Introduction

Though, no less than 203 species of Metarbelidae belonging to 16 genera are recorded from the Afrotropics (De Prins & De Prins 2012), this group has not received much attention. Lehmann recently discussed the diversity of the family in the Afrotropical Region as well as in Southeast Asia and revised three genera with descriptions of 65 new species from mainland Africa (Lehmann 1997, 2007, 2008a, b, 2010a, b, 2011).

Recent works using molecular methods placed Metarbelidae as one of the seven families of Cossoidea (Regier *et al.* 2009, Mutanen *et al.* 2010, van Nieukerken *et al.* 2011). Cossoidea was found to be a heterogeneous group not forming a monophylum. However, it appears that Metarbelidae share several important morphological characters with Ratardidae, e.g., in having only one strong anal vein on the forewing as well as the deep, 8-shaped ovipositor lobes (Holloway 1986, Edwards *et al.* 1998). The Metarbelidae occur from mainland Africa and Madagascar across southern Arabia to Southeast Asia (Lehmann 2008b). Several alleged New World *Indarbela* Fletcher, 1922 species belong to the Hypoptinae (Edwards *et al.* 1998). The present studies by the author suggest that the Metarbelidae comprise many more than 400 species in the Afrotropical Region.

The Albertine Rift region includes all areas within 100km east of the border of the Democratic Republic of Congo (DRC), and follows the 900m contour line in eastern DRC, including the protected areas in northern Zambia. The Albertine Rift is recognized as an area of endemism. Although Lepidoptera have been poorly surveyed, if compared to mammals, birds, reptiles, amphibians and plants, it has been found that the whole area is rich in a global context. A total of 117 endemic butterfly species from 49 genera are known only from the Albertine Rift (Plumptre *et al.* 2007).

Here and in the frame study of the revision of the Metarbelidae I describe a new genus and one new species based on morphological characters from the Albertine Rift region. This description is based on a single male specimen. Nevertheless, a

description of *Bjoernstadia* **gen. nov.** is justified since a monophyletic sister taxon can be named which is the genus *Arbelodes* Karsch (1896), resurrected and revised by Lehmann (2010). Additionally, the genitalia have unique structures that do not occur in other genera (cf. diagnosis below). The herein described species represents by far the smallest animals that are currently known among the Metarbelidae. Taking into consideration that the Metarbelidae appear to be in general slow dispersers, it is unlikely that the new species is widely distributed.

Lepidoptera are usually linked to certain vegetation types (Van Dyck 2011). A particular association of Metarbelidae to legume-dominated forests, woodlands or other legume-dominated woody vegetation types was emphasized by Lehmann (2008a) based on 14 years of field research in southeast coastal Kenya (Lehmann & Kioko 2000, 2005). Considering the ongoing massive human population pressure in the Albertine Rift, many forests and/or woodlands are becoming islands because of deforestation, destruction of natural habitats and rapidly changing anthropogenic environment (Burgess *et al.* 2004).

Material and methods

The genus and species described herein come from the private collection of Anders Bjørnstad (Norway) and will be deposited in the Natural History Museum, University of Oslo, Norway (NHMO) in the future.

The specimen was photographed and then compared with all described and photographed Metarbelidae, currently comprising 203 published species.

The maceration of the abdomen was done as follows: first, it was detached and macerated for one day in a glass tube containing a cold 10% solution of potassium hydroxide. Secondly, the genitalia were removed from the abdomen and drawn (in a lateral view) on a piece of paper, then transferred to distilled water for cleaning and spreading. The preparation of the genitalia was flooded with isopropyl alcohol and remained as such for 30 minutes before being mounted in Euparal. The genitalia slides were photographed using a digital stereo-microscope (ZEISS-SteREO: Discovery.V20) at ZFMK.

The terminology for external characters is based on Janse (1925), Scoble (1995), Edwards *et al.* (1998) and for internal features on Sibatani *et al.* (1954) and Klots (1970). The biogeographical names follow White (1983) and Plumptre *et al.* (2007).

Taxonomic review

***Bjoernstadia* gen. nov.**

Type species: *Bjoernstadia kasuluensis* **spec. nov.**

Diagnosis. *Bjoernstadia* possesses typical metarbelid characters (Holloway 1986; Edwards *et al.* 1998; Lehmann 2008a). They are repeated here with some additions based on recent studies: Head rugulose, not retracted under the prothorax. Antennae bipectinate in males; bipectinate, unipectinate or filiform in females. Wings broad, very rarely fore- and hindwings are of equal surface (butterfly-like), a pattern might be absent, sometimes reticulate or transversely striate on a pale ground-colour. Retinaculum and frenulum usually absent; chaetosemata and tympanum absent; epiphyses often absent; if present, they occur roughly at middle of foretibiae; tibia and first tarsomere of hindleg not dilated as in the Cossidae. Accessory cell absent; anterior branch of R_4+R_5 (in forewing) and of M_1 (in hindwing) in discal cell usually absent (in Cossidae the M_1 vein stem is present and branches within the discal cells of both wings resulting in an anterior M and posterior M vein); CuP in forewing usually obsolete, very rarely present; one strong anal vein occurs always on the forewing. Male genitalia: uncus beak-like or wide; tip bifid or bilobed; usually with separate or fused drumstick-like or hand-like or lever-like appendages from uncus (possibly gnathi); socii very small or absent; valvae small, very rarely long and elongated, usually rounded or rather rectangular, sometimes with thorn-like processes, some modification to the sacculus; aedeagus tube-like. Female genitalia: short, telescopic ovipositor with broad, 8-shaped ovipositor lobes as well

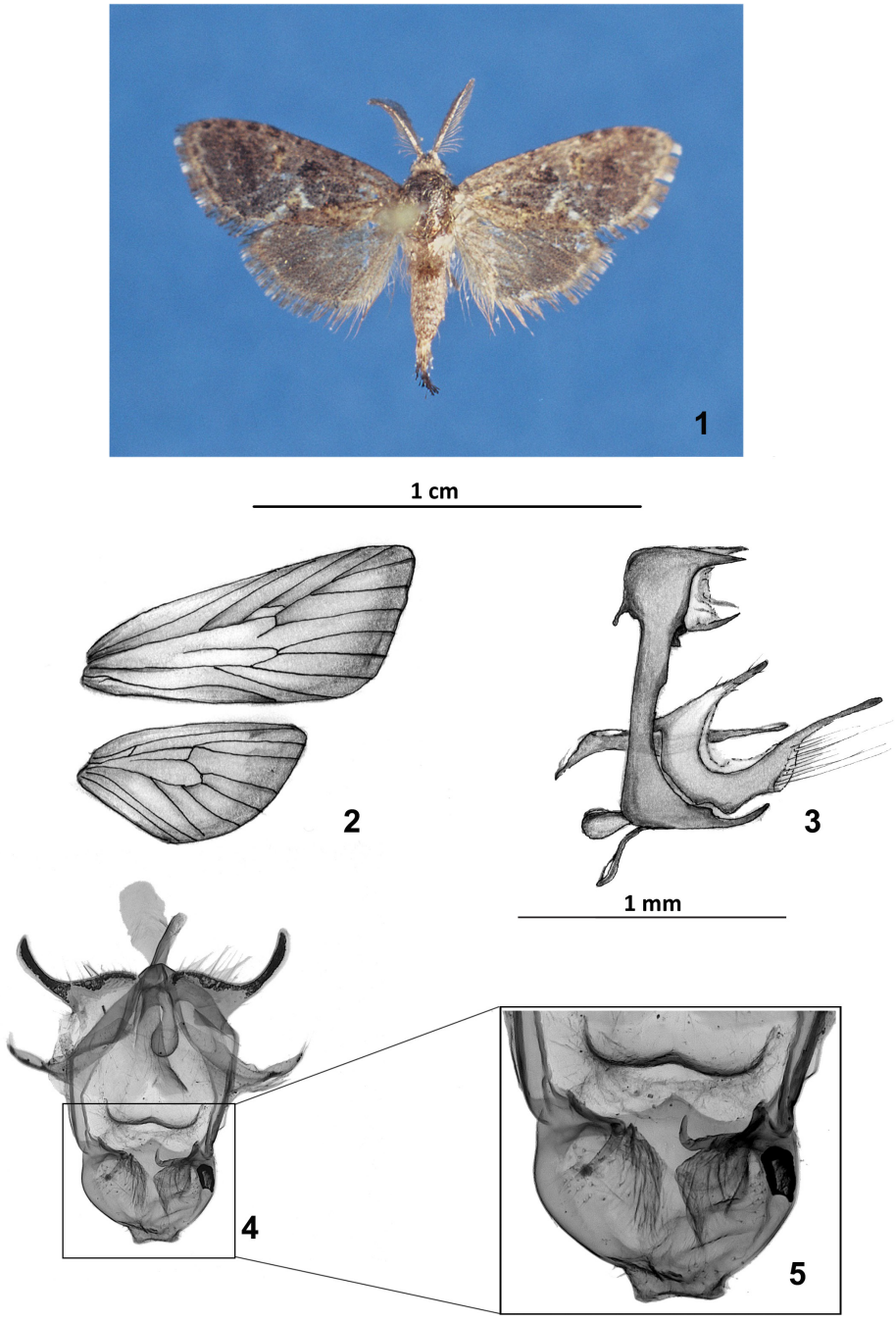
as reduced ductus and corpus bursae (*sensu* Holloway 1986); an often expanded membrane between tergite 7 and 8. *Bjoernstadia* is defined as a new genus based on **i)** the naming of the sister taxon and **ii)** putative morphological apomorphies (Figures 3–5): **i)** It is assumed here that the genera *Arbelodes* Karsch, 1896 and *Bjoernstadia* are two monophyletic groups and sister taxa, sharing an ancestor only common to them. The genera share male genitalia valvae consisting only of two lobes, which is a unique character (apomorphy). The occurrence of two lobes in *Arbelodes* and *Bjoernstadia* is plesiomorphic within the genera. In *Arbelodes* the dorsal lobe is much longer than the ventral lobe, while in *Bjoernstadia* the ventral lobe is much longer than the dorsal one. The occurrence of these two apomorphies suggests the existence of two separated lineages. Another derived character of the sister taxa is the discal cell that is always open towards the termen of the forewing. **ii)** The male genitalia of *Bjoernstadia* has a sack-like structure, which is twice as large as the uncus and is probably attached to the caudal margin of the tegumen, from where it extends towards the tips of the uncus. Two narrow thorn-like processes occur below the ventral edge of this sack-like structure; not extending beyond the uncus.

The combination of characters presented above demand the erection of a new genus. The most outstanding external character is the small size of the animals even in a worldwide context in regard to Metarbelidae. Only one Afrotropical species is currently recognized: *Bjoernstadia kasuluensis*.

Description. Regarding the Metarbelidae the moth of this genus is tiny (wingspan 14.5 mm). *Head*. Rough-scaled, without pits on lower frontoclypeus but with a pair of small conical projections; the labial palpi are short and less than the diameter of the eye; male antennae bipectinate, flagellum scaled dorsally; dorsal side of branches not scaled; ventral side of branches with unusual long hairs, which are three times longer than the width of branch. *Thorax*. Densely covered with hair-like scales, without a collar ring; with a short crest on metathorax; very long and narrow epiphyses from base of foretibiae to one-third of first tarsomere. Hindlegs with only one pair of narrow tibial spurs (ca. 0.5mm). Forewing upperside with a simple pattern with few contrasting colours (Figure 1). Wing venation (Figure 2) similar to the genus *Ortharbela* Aurivillius 1910, with the difference that *Bjoernstadia* has an areole in the forewing that is absent in the former genus, as well as to the genus *Arbelodes* Karsch 1896, with the difference that in the hindwing the base of vein $Sc+R_1$ does not cross the base of the upper median of the cell in *Bjoernstadia*. In forewing 1A+2A forked at base, CuP obsolete, CuA_2 originating from hind margin of posterior cell, CuA_1, M_3 and M_2 separated and initiating from apical angle of posterior cell, M_1 initiating from distal margin of median cell, distal margin of cell open towards termen (as in *Arbelodes*), R_1 initiating from anterior margin of median cell, R_2 initiating from anterior angle of areole, R_3 initiating from posterior angle of areole R_4 and R_5 are separated and originate from about one-third of R_3 (similar in *Ortharbela*), Sc more or less parallel to R_1. In hindwing 3A and CuP present, CuA_2 initiating from hind margin of posterior cell; CuA_1, M3 and M2 initiating from apical angle of posterior cell, separated; M1 and Rs initiating from the same point of apical angle of anterior cell, with a bar from Rs to $Sc+R_1$; with a small vein in discocellular cell on both forewing and hindwing; cilia long. Retinaculum and frenulum absent. Abdomen: With dense hair-like scales and abdominal tuft, tuft not longer than one-third of the length of the abdomen. *Male genitalia*. Saccus long, broad, and rounded; uncus small, acuminate at tips, bifid. Valva with a broad outer base with two long lobes, ventral lobe longer, both with a rounded tip; long setae on sacculus extending towards base of ventral lobe; in between the lobes a large emargination. Gnathos absent. Juxta small, triangular shaped. Phallus simple but almost two-thirds of genitalia length (in a lateral view), vesica without cornuti (Figure 3).

Female. Unknown.

Distribution. *Bjoernstadia* is found in and around Kasulu, which is part of the Albertine Rift of Tanzania (East Africa). The new genus is treated herein preliminarily as endemic to the Albertine Rift region as defined by Plumptre *et al.*



FIGURES 1-5. 1. *Bjoernstadia kasuluensis* **spec. nov**., male, holotype with wing pattern **2.** Wing venation. **3**. Genitalia in lateral view with sack-like structure and thorn-like processes below the uncus. **4**. Genitalia in ventral view. **5**. Enlarged sack-like structure with thorn-like processes.

(2007).

Ecology. The Kasulu area is at the borderline of the "Afromontane archipelago-like regional centre of endemism" and the "Zambezian regional centre of endemism" *sensu* White (1983). The species of *Bjoernstadia* is associated to a mosaic with lowland and riparian forest patches and a wooded grassland with an average annual rainfall of 1100mm. Due to the heavy population pressure in the Kasulu area only small remnants of "Zambezian dry evergreen forest" *sensu* White (1983) might still occur with either Guineo-Congolian linking species or Afromontane linking species, largely surrounded by cultivation or secondary wooded grassland today.

Etymology. *Bjoernstadia* is named for the botanist Anders Bjørnstad (Skien, Norway) to honour his attention to conservation issues of the Ruaha National Park and several forests in the Kagera River Catchment (Tanzania) in 1970, as well as for his kind provision of Metarbelidae and unpublished information on various habitats in northwestern Tanzania. The gender of the new genus is feminine.

***Bjoernstadia kasuluensis* spec. nov.**
Figures 1–5.

Material examined. Holotype male, TANZANIA, Kigoma Region, Kasulu District, Kasulu 16. September.1990, leg. A. Bjørnstad, label number 21415, genitalia slide number 12/022012 I. Lehmann (in coll. NHMO).

Diagnosis. This is by far the smallest species of Metarbelidae. The genitalia have peculiar characters that were already described above (see description of the genus *Bjoernstadia*).

Description. Length of forewing in males 6.1mm (wingspan 14.5mm), females unknown; antenna-wing ratio 0.38:1. *Head*. Pale grey mixed with scales of dark brown and black; eyes grey with large black spots; antennae long, same colour as head; branches of antennae 8 × width of shaft, no scales; antennal tips with long hairs, bending towards apex; labial palpi grey. *Thorax*. Patagia and tegulae grey mixed with olive-ocher and black with glinty shine. Hindfemora, -tibiae and -tarsi with grey hair-like scales with glinty shine, with one pair of tibial spurs, of which anterior spur is longer. Forewing dark olive, glossy, with a small rounded olive-ocher spot in the centre of CuA_2, the latter with a pure white band; an olive-ocher spot in the anterior part of cell and a small round spot of dark brown distally, forming almost an "8"; cilia very long, 0.9mm, olive, glossy. Underside of forewing grey, glossy. Hindwing upperside light olive, glossy; underside as in forewing. Wing venation see Figure 1. *Abdomen*. Mainly grey with an abdominal tuft of dark brown, glinty shine. *Male genitalia*. Uncus rather triangular shaped; valva more or less C-shaped, near sacculus with very long setae, two lobes with rounded setose tips, median sector without setae, ventral margin of valva with long setae; vinculum and tegumen fused, forming a firm and broad ring with a rod-like structure in its upper half (ventral view). Saccus long, finger-shaped, broadly rounded caudally. Phallus long, approximately as long as valva; straight, narrowest distally, bilobed with a deep cleft.

Habitat. Kasulu town (1266m a.s.l.) and its surroundings are a densely populated area in the Kigoma Region. The holotype was collected in a garden with *Psidium guajava* Linn. and a riparian forest patch dominated by *Syzygium guineense* (Willd.) DC subsp. *afromontanum* F. White. It was surrounded by a secondary woody bushland dominated by *Grewia bicolor* Juss. and *Combretum* spp. (Bjørnstad, pers. comm.).

Note. The garden where the holotype was collected might still exist. However, the surrounding woody habitats outside of the town were most probably largely destroyed due to the impact of the refugee influx from Rwanda and Burundi in Kasulu District and the impact of the relief operations during the Burundi and Rwanda refugee crisis of 1993 and 1994.

Distribution. *B. kasuluensis* is known only from Kasulu, northwest Tanzania.

Etymology. The species is named after the type locality Kasulu in Tanzania.

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re-classification of the Metarbelidae. This paper is a part of the PhD project of the author at the University of Bonn.

References

Aurivillius, C. 1910. Lepidoptera. *In*: Sjöstedt, Y. (Ed.), *Wissenschaftliche Ergebnisse der schwedischen zoologischen Expedition nach dem Kilimandjaro, dem Meru und den umgebenen Massaisteppen Deutsch-Ostafrikas 1905–06*. Part 9, 1–56, 2 pls.

Burgess, N., D'Amico Hales, J., Underwood, E., Dinerstein, E. Olson, D., Itoua, I., Schipper, J., Rickketts,T., and Newman, K. (Eds) 2004. *Terrestrial ecoregions of Africa and Madagascar: a conservation assessment.* World Wildlife Fund (United States), Island Press, Washington, xxiii + 499 pp.

De Prins, J. & De Prins, W. 2012. Afromoths, online database of Afrotropical moth species (Lepidoptera). Belgian Biodiversity Platform. [Available from http://www.afromoths.net]

Edwards, E.D., Gentili, P., Horak, M., Kristensen, N.P. &. Nielsen, E.S. 1998. The Cossoid/Sesioid Assemblage. *In*: Kristensen, N.P. (Ed.), *Lepidoptera, Moths and Butterflies.* Volume 1: *Evolution, Systematics, and Biogeography. Handbook of Zoology*, volume IV, part 35. Walter de Gruyter, Berlin, New York, pp. 181–197.

Holloway, J.D. 1986. The moths of Borneo. Part 1: Key to families; families Cossidae, Metarbelidae, Ratardidae, Dudgeoneidae, Epipyropidae and Limacodidae. *Malayan Nature Journal*, 40, 1–165, 9 pls.

Karsch, F. 1896. Die Hollandiiden oder die äthiopischen Arbeliden W.J. Holland's. *Entomologische Nachrichten* 22(9), 135–141.

Klots, A.B. 1970. Lepidoptera. *In*: Tuxen, S.L. (Ed.), *Taxonomist's Glossary of Genitalia in Insects*. Munksgaard, Copenhagen, pp. 115–130.

Lehmann, I. 1997. *Metarbela haberlandorum* spec. nov., a new moth from Kenya (Lepidoptera: Metarbelidae). *Nachrichten Entomologischer Verein Apollo*, 18(1), 45–53.

Lehmann, I. 2007. Metarbelidae. *In*: Mey, W. (Ed.), The Lepidoptera of the Brandberg Massif in Namibia. Part 2. *Esperiana Memoir*, 4, 169–185 + pl.17.

Lehmann, I. 2008a. Ten new species of Metarbelidae (Lepidoptera: Cossoidea) from the coastal forests and the Eastern Arc Mountains of Kenya and Tanzania, including one species from two upland forests. *Journal of East African Natural History* 97(1), 43–82.

Lehmann, I. 2008b. Six new species of Metarbelidae (Lepidoptera: Cossoidea) from the Eastern Arc Mountains of Tanzania, including one new species from Marenji Forest in southeast coastal Kenya. *Journal of East African Natural History*, 97(2), 187–206.

Lehmann, I. 2010a. A new genus of Metarbelidae (Lepidoptera: Cossoidea) from the Afrotropical Region with the description of seven new species. *Esperiana Memoir*, 5, 294–321 + pl. 21.

Lehmann, I. 2010b. *A revision of the genus* Arbelodes *Karsch (Lepidoptera:Cossoidea:Metarbelidae) from southeast- central and southern Africa with the description of thirteen new species.* Published by the author, Hamburg & Wismar, 82 pp., 8 b/w pls., 5 colour pls..

Lehmann, I. 2011. *The description of a new genus and twenty-three new species of Metarbelidae (Lepidoptera: Cossoidea) from the lowland tropical rain forests of the Guineo-Congolian Region with notes on habitats and biogeography.* Published by the author, Hamburg, 67 pp., 10 b/w pls., 6 colour pls., 1 coloured map.

Lehmann, I. & Kioko, E. 2000. Preliminary survey on butterflies and moths and their habitats in two Kaya forests of the Kenya coast. *Metamorphosis – Journal of the Lepidopterists' Society of Africa.* Occasional supplement 4, 1–52.

Lehmann, I. & Kioko, E. 2005. Lepidoptera diversity, floristic composition and structure of three Kaya forests on the south coast of Kenya. *Journal of East African Natural History*, 94, 121–163.

Mutanen, M., Wahlberg, N. & Kaila, L. 2010. Comprehensive gene and taxon coverage elucidates radiation patterns in moths and butterflies. *Proceedings of the Royal Society B*, 277, 2839–2848.

Plumptre, A.J., Davenport, T.R.B., Behangana, M., Kityo, R., Eilu, G., Ssegawa, P., Ewango, C., Meirte, D., Kahindo, C., Herremans, M., Kerbis Peterhans, J., Pilgrim, J.D., Wilson, M., Languy, M. and Moyer, D. 2007. The biodiversity of the Albertine Rift. *Biological Conservation* 134, 178–194.

Regier, J.C., Zwick, A., Cummings, M.P., Kawahara, A.Y., Cho, S., Weller, S., Roe, A., Baixeras, J., Brown, J.W., Parr, C., Davis, D.R., Epstein, M., Hallwachs, W., Hausmann, A., Janzen, D.H., Kitching, I.J., Solis, M.A., Yen, S.-H., Bazinet, A.L. & Mitter, C. 2009. Toward reconstructing the evolution of advanced moths and butterflies

(Lepidoptera: Ditrysia): an initial molecular study. *BMC Evolutionary Biology*, 9 (1), 280.

Ridgway, R. 1912. *Color Standards and Color Nomenclature*. Published by the author, Washington, 43 pp.+53 pls.

Scoble, M.J. 1995. *The Lepidoptera: form, function, and diversity.* The Natural History Museum in association with Oxford University Press, London, 404 pp.

Sibatani, A., Ogata, M., Okada, Y. & Okagaki, H. 1954. Male genitalia of Lepidoptera: Morphology and Nomenclature. I. Divisions of the valvae in Rhopalocera, Phalaenidae (= Noctuidae) and Geometridae. *Annals Entomological Society of America*, 47, 93–106.

Van Dyck, H. 2011. Habitat-use in butterflies: how to move from structural to functional ecology. *Abstracts of the XVIIth European Congress of Lepidopterology*, Luxembourg 9–13 May, 2011, 9.

van Nieukerken, E.J., Kaila, L., Kitching, I.J., Kristensen, N.P., Lees, D.C., Minet, J., Mitter, C., Mutanen, M., Regier, J.C., Simonsen, T.J., Wahlberg, N., Yen, S.-H., Zahiri, R., Adamski, D., Baixeras, J., Bartsch, D., Bengtsson, B.Å., Brown, J.W., Bucheli, S.R., Davis, D.R., De Prins, J., De Prins, W., Epstein, M.E., Gentili-Poole, P., Gielis, C., Hättenschwiler, P., Hausmann, A., Holloway, J.D., Kallies, A., Karsholt, O., Kawahara, A.Y., Koster, S., Kozlov, M.V., Lafontaine, J.D., Lamas, G., Landry, J.-F., Lee, S., Nuss, M., Park, K.-T., Penz, C., Rota, J., Schmidt, B.C., Schintlmeister, A., Sohn, J.-C., Solis, M.A., Tarmann, G.M., Warren, A.D., Weller, S., Yakovlev, R.V., Zolotuhin, V.V. & Zwick, A. 2011. Order Lepidoptera Linnaeus, 1758. In: Zhang, Z.Q. (Ed.), Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness. *Zootaxa* 3148, 212–221.

White, F. 1983. The Vegetation of Africa: a Descriptive Memoir to Accompany the Unesco/AETFAT/UNSO Vegetation Map of Africa. *Natural Resources Research* no. XX. Unesco, Paris, 356 pp.

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