The new Genera

Kayamuhakaia, Finsterwaldeia, Lichterfeldia

(Lepidoptera: Cossoidea: Metarbelidae Strand, 1909)

with thirty-six new species from lowland, submontane and montane areas of eastern, central and south-central Africa

(Afrotropical Region)

by

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with Plates by

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I dedicate my three new genera

Kayamuhakaia, Finsterwaldeia and Lichterfeldia

to Kenya,

the country, its people and biodiversity I love for almost 49 years of my life

as well as

to the Committee of Elders of

Kaya Muhaka, Kaya Kinondo and Kaya Diani.

The leadership of these committees successfully protected the Kayas in collaboration

with the Coastal Forest Conservation Unit (Ukunda)

during the period of my fieldwork in 1994 — 2007.

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The new Genera *Kayamuhakaia, Finsterwaldeia, Lichterfeldia* (Lepidoptera: Cossoidea: Metarbelidae Strand, 1909) with thirty-six new species from lowland, submontane and montane areas of eastern, central and south-central Africa (Afrotropical Region)

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Abstract

Based on autapomorphies and apomorphies, *Kayamuhakaia* **gen. nov.** is presented together with *Finsterwaldeia* **gen. nov.** and *Lichterfeldia* **gen. nov.** comprising 40 species at present. The differential diagnoses among species of these three genera are presented and suggest an ancestor only common to them. Based on two apomorphies as well as two "potential parsimony-informative characters" in the male genitalia the species of the first two genera are close to species of the *"Dimbelenge Group"* as well as *"coastal forest Group" sensu* Lehmann (2019b: 32). This suggests that the ancestors of the present species of *Kayamuhakaia* **gen. nov.** and *Finsterwaldeia* **gen. nov.** most probably first evolved in the tropical lowland rain forests as well as submontane rain forests on the Afro-Arabian continent. According to the author's results based on 46 weeks of extensive fieldwork in five lowland coastal forests of southeast Kenya and in its adjacent areas — 1994 to 2007 — as well as 15 weeks of fieldwork undertaken in three montane forest/bushland areas of central Kenya — 2015 to 2017 — as well as based on detailed studies on the morphology of more than 1000 species in more than 130 genera of Metarbelidae comprising more than 2700 drawings — 1994 to June 2024 — and occurring in the Afrotropical and Oriental Region, *Kayamuhakaia* **gen. nov.** is the only genus at present with species that occur from coastal

Somalia, Kenya and Tanzania westwards via high montane habitats into a lowland rain forest area located to the South as well as *ca.* 90 km to the East from the arc formed by the central Congo River as well as to the East from the *"Sangha River Interval"*. Southeastwards from the latter the species occur in forests and miombo woodlands towards areas close to the northwestern as well as southern shore of Lake Malawi extending southwards to Mount Mulanje. The *"Malawi Interval"* is shown herein for the first time in context with Metarbelidae as only one Afromontane species of *Kayamuhakaia* is known from Mount Mulanje based on a comprehensive collection of Metarbelidae from "168 well known areas" distributed throughout Malawi. In contrast, one undescribed genus comprising only endemic lowland species of the *"Zanzibar-Inhambane regional mosaic"* has been recorded in a lowland area of **Mkuwadzi Hill** adjacent to Nkhata Bay (northwest shore of Lake Malawi) — as well as in a still present relict patch of *"Zanzibar-Inhambane lowland rain forest"* in a submontane area of the **Ruo River Gorge** (Mount Mulanje). In conclusion, five characters are defined herein for microrefugia of forest and miombo in regard to Metarbelidae and Caesalpinioideae with the latter two areas presented together with ten additional areas as microrefugia, including: **Arabuko-Sokoke Forest** with forest and woodland patches nearby, the **Rabai Kayas** (Kenya, North Coast), **Kaya Muhaka** and a forest patch southwest of **Tiwi** village if still present (not Kaya Tiwi), **Gogoni Forest**, **Buda Forest** and the **Shimba Hills** (Kenya, South Coast), **Mogo Forest** near Dar Salam (destroyed), **Kimboza Forest** (lower eastern Uluguru Mountains), **Bokatola** (Congo Basin). In addition, the distribution range of species of *Kayamuhakaia* indicates, *e.g.* that coastal forests and coastal woodlands of Eastern Africa were once connected via continuous forest and woodland "bands" stretching from the coast of the Indian Ocean via the Lowlands — with links to upper montane and subalpine habitats in East Africa — further westwards to the Congolian lowland rain forests of the central Congo Basin. In regard to the shores of Lake Malawi, a new species of *Kayamuhakaia* from Mkuwadzi Hill is considered herein — in addition to one undescribed endemic genus of the Zanzibar-Inhambane region — as an indicator of a former *"Zanzibar-Inhambane lowland rain forest"* that most probably once occurred near the northwestern shore of the lake until well before the year 1970. This indicates a possible "northern link" for endemic species of the Zanzibar-Inhambane region as well as for species of *Kayamuhakaia*, to the coast of the Indian Ocean via southern Tanzania and a possible "southern link" via Mount Mulanje to the coast of Mozambique during 32.9 — 2.5 Ma. The 38 species of *Kayamuhakaia* **gen. nov.** comprise 34 species new to science including two new species for Somalia. The latter represent the first described species of Metarbelidae for the physiographic unit *"South Somalia Coastal Plain"* and the first new Metarbelidae for Somalia since the year 1916. One of those two lowland species occurs in Kismayu and is considered herein as *"linking species"* between the *"Swahilian regional centre of endemism"* and the *"Lake Victoria regional mosaic"* comprising areas such as Kakamega Forest (Kenya) and forests along the shore of Lake Nkuruba (Uganda). This *"linking species"* represents one example among seven groups of *"linking species"* that have been identified for this monophylum. The remaining eight lowland species of *Kayamuhakaia* **gen. nov.** (ten lowland species in total) occur in postulated major and minor Pleistocene lowland forest refuges, *e.g.* in the *"Eastern* [Pleistocene lowland forest] *Refuges with minor centers of endemism" sensu* Grubb (2001: Fig 6.3) and in minor centres not previously published as such like Mkuwadzi Hill and the Ruo River Gorge. The highest species diversity among lowland forest Sites occurs in Arabuko-Sokoke Forest (Kenya, North Coast) comprising three lowland species of *Kayamuhakaia* **gen. nov.** Submontane as well as montane forest areas in Kenya, Tanzania, Burundi and Rwanda appear to have high species diversities at present, *e.g.* including at least three species on Mount Kenya and at least two species in Nyungwe Forest (Rwanda). In contrast to the species of the Lowlands as well as of the submontane forests in Malawi, females appear to be more common and hence, more active than males in eleven Afromontane endemic species of *Kayamuhakaia* occurring in montane, upper montane and

subalpine forests of Kenya and Rwanda. Such a behavior of females is unknown in the great majority of Afrotropical Metarbelidae species including basal taxa. Almost certainly the rarity and large absence of montane species of *Kayamuhakaia* in Malawi is due to the *"Malawi Interval"* contributing to the fact that not a single female of any montane species of *Kayamuhakaia* is known from Malawi. Both other genera are monotypic with one new species to science. The two new genera *Kayamuhakaia* and *Lichterfeldia* comprise 12 species — including 11 species new to science — that are presented for 15 *Key Biodiversity Areas* of Kenya based on the UNDP (2021: 21 — 25) with minor Pleistocene lowland forest refuges presented herein in bold, namely: "**Arabuko-Sokoke Forest**", "Mount Elgon", "Mount Kenya", "**Shimba Hills**", "Taita Hills Forests", "**Kaya Muhaka**", "Kaya Tiwi" [or a forest patch southwest of Tiwi village], "**Buda Forest Reserve**", "**Gongoni Forest Reserve**" [called Gogoni Forest herein], "Kakamega forest", "**Kaya Rabai** [called Rabai Kayas herein]", "Mida Creek, Whale Island and the Malindi-Watamu coast", "Ol Ari Nyiro", "Aberdare Mountains" and "Kikuyu Escarpment forest". *Metarbela latifasciata* Gaede, 1929 was found to be a synonym of *Metarbela nubifera* (Bethune-Baker, 1909). *Metarbela vau-alba* Hampson, 1920, *Metarbela triangularis* Gaede, 1929 and *Metarbela haberlandorum* Lehmann, 1997 were found to be valid species. The latter four species are re-described and are transferred to *Kayamuhakaia* **gen. nov.**

Keywords: African mainland, autapomorphies, Caesalpinioideae, coastal forests of Eastern Africa, Congo Basin, dhesheegs, *Finsterwaldeia* **gen. nov.**, *haberlandorum* **comb. nov.**, *Kayamuhakaia* **gen. nov.**, Lake Malawi, *latifasciata* (synonym), *Lichterfeldia* **gen. nov.**, *"linking species"*, lowland refuges, *"Malawi Interval"*, Mkuwadzi Hill, *nubifera* **comb. nov.**, Ruo River Gorge, *"Sangha River Interval"*, Somalia, *triangularis* **comb. nov.**, *vau-alba* **comb. nov.**

INTRODUCTION

Origin of Metarbelidae and their phylogeny

The origin of Metarbelidae has been placed at about 100 — 90 Ma (Ma = million years ago) *cf.* Mutanen *et al.* (2010), Wahlberg *et al.* (2013). Recent genetic results confirmed their monophyletic status as a family (Mayer *et al.* 2021: 13, 16; Lehmann *et al.* 2023: 4) and additionally, suggesting also no close relationship to the Cossidae (Zahiri pers. comm. to I.L. in 2021 based on unpublished data). Results that are based on a morphological analysis, *e.g.* on 161 apomorphies, confirm for the first time — from the morphological point of view — their monophyletic status as a family and additionally, show that they first originated on the present African continent (Lehmann 2019b: 24, 25, 30 — 40, Figs 6a, 6c, 6d; Lehmann 2020). The latter result is also supported by genetic studies where no deep split has been found between various species in undescribed Afrotropical genera and the Oriental genera *Indarbela* Fletcher, T.B., 1922 and *Stueningeria* Lehmann 2019a (Lehmann *et al.* 2023: 5; Zahiri unpublished data).

All recent works utilizing either molecular or combined molecular and morphological analyses place Metarbelidae within Cossoidea (Regier *et al.* 2009; Mutanen *et al.* 2010; van Nieukerken *et al.* 2011; Heikkilä *et al.* 2015; Mayer *et al.* 2021; Lehmann *et al.* 2023).

The dataset of Heikkilä *et al.* (2015), which represents the largest morphological dataset (consisting of over 500 morphological characters) thus far, combined with considerable molecular evidence (one mitochondrial and seven nuclear protein-coding gene regions, 6172 bp), suggested that Metarbelidae are the sister group of Dudgeoneidae s. l. This arrangement is supported by two morphological synapomorphies (Lehmann 2019b: 24, 25).

Mayer *et al.* (2021: 16) found a low support within the superfamily Cossoidea, but stated that the Hypoptinae represent no sister group of Metarbelidae.

Diversity

Worldwide, 330 species of Metarbelidae are assigned to 46 described genera (*e.g.* Lehmann 2019a,b; Lehmann *et al.* 2023; Lehmann & Dalsgaard 2023; Yakovlev & Zolotuhin 2020; 2021 a, b, c, d, e; 2022; Yakovlev *et al.* 2022a, b, c; Yakovlev *et al.* 2023; Yakovlev & Hulsbosch 2024; Yen *et al.* 2025). De Prins & De Prins (2025) listed 261 species in 28 genera that are recorded from the Afrotropics, still omitting three new genera and 15 new species that have been added, namely for Madagascar as well as for areas close to the eastern and western coast of the African continent (Lehmann & Dalsgaard 2023).

Lehmann, abbreviated as I.L. herein, discussed the diversity of the family in the Afrotropical Region *sensu* Crosskey & White (1977) and in the Oriental Region *sensu* Wallace (1876) and revised and described 19 genera from both regions, including 16 genera new to science, with descriptions and re-descriptions of all their known 180 species comprising 154 species which are new to science from mainland Africa and Madagascar plus two new species from the Oriental Region (Lehmann 1997, 2007, 2008, 2009, 2010a, b, 2011, 2012, 2013, 2014, 2019a, b; Lehmann & Rajaei 2013; Lehmann *et al.* 2018; Lehmann *et al.* 2023; Lehmann & Dalsgaard 2023; Lehmann, Jenoh, Kioko and Koedam 2025 in prep.). Mey (2018) described one new genus and species from the Republic of South Africa and presented a checklist for 17 published species for Namibia including the presentation of one new species (Mey 2024).

Yakovlev & Zolotuhin (2020; 2021 a, b, c, d, e); Yakovlev & Zolotuhin (2022); Yakovlev *et al.* (2022a, b, c); Yakovlev *et al.* (2023) and Yakovlev & Hulsbosch (2024) revised 12 genera and 37 species from the Oriental Region, including descriptions for eight new genera and 22 species new to science. Noteworthy, their new genus *Tagoria* Yakovlev & Zolotuhin, 2021c represents a junior homonym (Hernández & Deshmukh 2022) and hence, an invalid genus name for Metarbelidae. The latter genus was re-named *Tagoriana* by Hernández & Deshmukh (2022).

Lehmann (2019b) defined 60 genera from both regions based on autapomorphies in his Doctoral Dissertation, and based exclusively on morphological traits he presented for the first time a list of 161 apomorphic characters found in 442 studied species of Metarbelidae. He also presented synapomorphies shared within each monophylum at genus-level, but without formal descriptions for 39 new genera and all their studied species. Meanwhile, seven of these new genera and their species were dealt with by Lehmann (2019a), Lehmann *et al.* (2023), Lehmann & Dalsgaard (2023), Lehmann, Jenoh, Kioko and Koedam (2025 in prep.). Here, *Kayamuhakaia* **gen. nov.**, *Finsterwaldeia* **gen. nov.** and *Lichterfeldia* **gen. nov.** are presented and were not dealt with by Lehmann (2019b) bringing the total of revised and published genera to 64 representing slightly less than 50% of all studied genera by I.L. up to this point (June 2024).

Metarbelidae represent a significant component of the Afrotropical fauna with the highest species richness on the African mainland with more than 1000 detailed studied species by I.L. up to this point (June 2024), but many more are yet to be discovered (Lehmann unpubl. data).

The species richness in the Oriental Region most probably was and still is much lower with 53 species in 15 genera that are published at present (Lehmann 2019a: 50 — 51); Yakovlev & Zolotuhin (2020; 2021 a, b, c, d, e); Yakovlev & Zolotuhin (2022); Yakovlev *et al.* (2022a, b, c); Yakovlev *et al.* (2023); Yakovlev & Hulsbosch (2024); Yen *et al.* (2025) and with additional 32 undescribed species in seven undescribed genera (Lehmann unpubl. data 2025). Hence, it is likely that the total number of species is somewhere between 100 and 200 for the Oriental Region. If this estimation is correct the number of species in the Oriental Region might represent (possibly in general) an additional 10% of the total number of species occurring in the Afrotropical Region at present (November 2025).

Based on morphology, the new genus and species *Vietarbela hopeavora* Heppner, 2024 (described on both sexes) is not yet included in the total number of genera and species of Metarbelidae for the Oriental Region. As the presentation of morphological characters for both sexes indicates, occur various significant morphological differences (five are mentioned herein) to the species in more than 130 genera of the family Metarbelidae studied by I.L. until June 2024 (*cf.* Lehmann 2019b: *e.g.* 24, 25; Lehmann in prep.), namely: First, the different venation between male and female in *V. hopeavora* were M_3 appears to be absent on the forewing of the male, but M_2 and M_3 appear to be present on the forewing of the female and are additionally stalked. In Metarbelidae M_1, M_2 and M_3 are present on the forewing in both sexes. Second, a different hindwing venation between male and female of the same species has not been found by I.L., *e.g.* Lehmann & Rajaei 2013: Fig 6 including species of genera from the Oriental Region, *e.g.* Lehmann 2019a: 71, 72. Third, absent from species of Metarbelidae is "… the [enlarged] bulging gena on the lower frons corners [next to each eye]…" (Heppner *et al.* 2024: 151, Fig 5c). Fourth, absent in all studied Metarbelidae is also the described and figured "juxta-anellar complex" in regard, *e.g.* to its shape. Fifth, a juxta that appears to be broadly attached to the sacculus is absent in all Metarbelidae species that are included in the comprehensive studied sample mentioned above.

Note: The “vertex tubercles (or possibly ocellar cornea) …” were treated by Lehmann (2019b: 379, character “37”) as homoplasy for the Metarbelidae and were figured in various shapes (*cf.* Lehmann 2013: Figs 11, 12; Lehmann *et al.* 2023: Figs 18.a., 18.b.; Lehmann & Dalsgaard 2023: Fig 16).

Distribution

In the Afrotropical Region, Metarbelidae occur on mainland Africa south of the Sahara (Lehmann 2019b), the Comoros Archipelago (Viette 1981; Lehmann, Jenoh, Kioko and Koedam 2025 in prep.), Madagascar (Saalmüller 1884; Lehmann 2019b, 2020; Lehmann & Dalsgaard 2023) and across the southwestern and southern Arabian Peninsula (Lehmann 2019b; Lehmann in prep.).

In the Oriental Region, they are known from Sri Lanka (Matthew Cock & Wade Jenner pers. comm. 2014; Yakovlev & Zolotuhin 2020, 2021a); India and the Andaman Islands (Yakovlev & Zolotuhin 2020, 2021a, b, c; Yakovlev *et al.* 2022c; Ahmad *et al.* 2023; Sondhi *et al.* 2025); Nepal, Bhutan, Bangladesh, Myanmar, Laos, Vietnam, southeastern China, Taiwan and Kinmen Island (Lehmann 2019a, b; Singh Irungbam 2021; Yakovlev & Zolotuhin 2020, 2021b, c, d, e, 2022; Yakovlev & Hulsbosch 2024, Yen *et al.* 2025); Thailand, Malaysia, Indonesia (Nias, Sumatra, Java, West Timor), Borneo and the Philippines (Holloway 1986; Lehmann 2009, 2013, 2019a, b; Yakovlev & Zolotuhin 2020; 2021b; Yakovlev *et al.* 2022a, b; Yakovlev *et al.* 2023). East of Borneo, only a single species is known, endemic to Sulawesi (Holloway 1986). Several New World *Indarbela* Fletcher, T.B., (1922) species were transferred to the cossid subfamily Hypoptinae (Edwards *et al.* 1999); and no Metarbelidae are known from South America.

Most species are micro-endemic, and only a few appear to have broader distributions (defined here as a range exceeding 50,000 km^2), *cf.* Lehmann (2019b: 325; Lehmann *et al.* 2023: 84).

Immature stages

The little knowledge about immature stages was first summarized by Lehmann (2008). Field observations for one undescribed species from coastal Kenya that belongs to an undescribed genus was presented by Jenoh *et al.* (2016, 2021) and by Jenoh (2022). More information on immature stages of the latter species as well as on this species-group including morphological similarities to species of *Squamura* Heylaerts, 1890 from the Oriental Region, will be presented by Lehmann, Jenoh, Kioko and Koedam (2025 in prep.).

A recent publication on a new species of *Stueningeria* Lehmann, 2019a from Kinmen Island (Taiwan) was presented by Yen *et al.* (2025) and suggests not only that there will be additional records of Metarbelidae for Taiwan in the future but also includes the first information on immature stages for one species of this genus.

MATERIAL AND METHODS

Fieldwork in Kenya and morphological studies on more than 1000 species of Metarbelidae in more than 130 genera comprising more than 2700 drawings

The material examined herein is housed in the following collections:

- **NHMO** the Natural History Museum, University of Oslo, Norway;
- **NHMUK** The Natural History Museum, London, UK (formerly BMNH);
- **NMK** the National Museums of Kenya, Nairobi;
- **NRM** the Swedish Natural History Museum, Stockholm;
- **Private collections** with specimens from Kenya, Uganda and Malawi of Ralf Fiebig (Roßleben, Germany), Hermann Staude (Magaliesburg, Republic of South Africa) as well as Ingo Lehmann (= I.L. herein, Hamburg, Germany).

  I.L. included some additional information that is based on his long-term fieldwork mainly in southeast coastal Kenya as well as in central Kenya (46 weeks in 1994 — 2007 and 15 weeks in 2015 — 2017) undertaken under various Research Clearance Permits, *e.g.* OP/13/001/23C 174A issued by the Office of the President (Kenya, Nairobi) on 17th August, 1995 and No NACOSTI/P/15/5928/901 issued by the National Commission for Science, Technology and Innovation (Nairobi) and ending on 31st July, 2017. A large amount of data is not yet published including in particular the years 2005 — 2007 for Kaya Muhaka, Gogoni Forest and Shimoni Forest as well as for the years 2015 — 2017 with data from Karura Forest, the Lolldaiga Hills and Mpala Research Center and hence, some data appears herein for the first time (*cf.* Lehmann & Kioko 2005 and Tables 1 — 7 herein).

  I.L. has also a comprehensive collection of Metarbelidae from more than 60 well distributed Sites in Malawi with nearly all specimens collected by Raymond James Murphy (Nkhorongo, Mzuzu, Malawi) during 1997 — 2017 under various Research Licences, *e.g.* No 30/8/2008/I issued by the Forestry Research Institute of Malawi (Zomba).
- **RMCA** the Royal Museum for Central Africa, Tervuren, Belgium;
- **RMNH** the Naturalis Biodiversity Center, Leiden, The Netherlands including the specimens from the Zoological Museum Amsterdam (ZMA);
- **SMNS** the State Museum of Natural History Stuttgart, Germany;
- **TMSA** Ditsong National Museum of Natural History, Pretoria, Republic of South Africa (formerly Transvaal Museum);
- **ZMH** the Zoological Museum, University of Hamburg and Leibniz Institute for Biodiversity Change, Germany;
- **ZMHU** the Natural History Museum and Leibniz Institute for Evolution and Biodiversity Research, Berlin (formerly ZMHB);
- **ZMUC** Zoological Museum, University of Copenhagen, Denmark;
- **ZSM** Zoological State Collection, Munich, Germany, including the specimens from the former Museum Witt, Munich (MWM).

Specimens were photographed at different institutions using available equipment and compared with all described and imaged Metarbelidae species (*e.g.* Lehmann 2019a, b; Lehmann unpublished data 2024). Genitalia were prepared as follows: 1) each abdomen was detached and macerated for one day in a glass tube containing a cold 10% solution of potassium hydroxide. 2) The genitalia were removed from the abdomen and every "fresh genitalia" was drawn in detail in a lateral view and in a not pressed condition on a piece of paper (*cf.* drawings herein; more than 2700 drawings are present for more than 1000 species) and then transferred to distilled water for cleaning and spreading. The prepared genitalia were submersed in isopropyl alcohol for 30 minutes before mounting in Euparal. Genitalia slides were photographed using a digital stereo-microscope.

Terminology and definitions

The terminology for external characters is based on Janse (1925), Scoble (1995), Edwards *et al.* (1999) and for internal features on Sibatani *et al.* (1954) and Klots (1970); colour nomenclature is based on Ridgway (1912).

Scientific names of plant species and their families are based on *"Plants of the World Online"* published by the Royal Botanic Gardens, Kew (UK) on: https://powo.science.kew.org Only the terminology in regard to the Leguminosae plant family (at present summarized in Fabaceae) and their species is based on White *et al.* (2001) who presented species of Leguminosae-Caesalpinioideae, the Leguminosae-Papilionoideae and Leguminosae-Mimosoideae. This older terminology is used herein to present in particular the species of Caesalpinioideae in a visible context with Metarbelidae as well as in context with refuge areas.

The definition for a large *"lowland forest refuge area"* or *"macrorefugia"* in regard to Africa is based on Maley (2001: 72, 73) comprising lowland rain forest regions that have been little affected, if at all, by arid phases, *e.g.* during the last maximum of the ice age (Last Glacial Maximun/ LGM) or arid phase 20,000 — 10,000 yr B.P. with its culmination 18,000 yr B.P. Hence, macrorefugia have high levels of species diversity as well as endemism in flora and fauna. Included here are also *"large riparian lowland forest refuge areas"* that have resulted not from regional climatic cooling but from conditions in their distant headwaters, *e.g.* the *"central* [macro]*refuge"* in the Congo Basin is associated with the Congo River and its main tributaries with their headwaters (*cf.* Grubb 2001: Figs 6.2, 6.3).

Of importance herein are also small patches of lowland forest (*cf.* Table 1, 2 and 3) that must have remained several times at the same locality during arid phases and hence, acting as *"small scale refuge areas"* or *"microrefugia" sensu* Leal (2001: 1077). Microrefugia are determined herein by the following approach:

First, by the dominance of Caesalpinioideae (including mainly species with a Guineo-Congolian affinity) and using their dominant tree species as "lowland forest refuge indicator species" based on the fact that they comprise slowly dispersing tree species with ballistic seed that travel only tens of meters and excluding dispersal along streams from hills — *e.g. ca.* 9 km from the Shimba Hills to Kaya Muhaka —

after extinction events in the lowlands occurred during arid phases. Consequently, an in-situ survival of all slow dispersing species during arid phases — including Metarbelidae — is most probably a fact and is assumed herein, *cf.* results of extensive fieldwork in central Gabon, *e.g.* by Leal (2004: 1, 42, 46, 50, 66) as well as in southeast coastal Kenya by Lehmann & Kioko (2005: 133, 134, 135). Second, if the dominance of Caesalpinioideae is present in any forest Site it is used in combination with a high number of species of Metarbelidae — defined as more than 5 species per forest Site based on Lehmann (2008: 70, number 5) and including at least one record of a species of *Kayamuhakaia* as well as at least one endemic genus of Metarbelidae of the *"Zanzibar-Inhambane regional mosaic"* (abbreviated as "Z-I" herein); the latter is based on morphological study results by I.L. until June 2024. This approach supports the view of Grubb (2001: 95) who suggested that the *"Eastern Refuges* [of East Africa] *with minor centers"* (*cf.* Grubb 2001: Fig 6.3) should be defined in more detail. This will be done herein (*cf.* habitat text for ten lowland species based on Table 1, 2 + 3 as well as "Discussion" herein).

The definition for elevations or altitudes in regard to Afrotropical Metarbelidae is as follows: The areas below an elevation of 600 m are defined as *"lowland"* based on White's *"Low Africa"* (1983: 18, 19); elevations between 600 and 1.300 m are referred to as *"submontane"* based on Lehmann (2019b: 21) and those above 1.300 m are considered *"montane" sensu* Keay (1959). Noteworthy, there are various other definitions available for the same terms in regard to Africa which consider sometimes a more regional scale, *e.g.* Richards (1996: 443 — 448), Grubb (2001: 92), Platts *et al.* (2011). However, the separation of *"submontane"* and *"montane"* areas in Africa is justified as various authors point out that generally above, *e.g.* 1.000 m or 1.200 m a fundamental biological barrier exists which is characterized by changes in flora and fauna as well as also commonly by physiognomical modifications, *e.g.* White (1983: 161), Maley (1991: 95). Lovett (1993: 36, 39) stated that his category *"Submontane forest* Altitude: 800 — 1.400 m*"* overlaps in floristic composition with montane and lowland forest in the Eastern Arc Mountains and hence, justifies his definition for *"submontane"*. This approach was also accepted for species of Metarbelidae by Lehmann, *e.g.* (2008: 63, 65, 71) and Lehmann *et al.* (2023: 5).

Hence, in regard to Metarbelidae a special attention was and is paid by I.L. to the altitudinal amplitude of each species and the location of the collecting Site, respectively (*e.g.* Lehmann 2019a, b; Table 1 — 7 herein). Any "lowland Metarbelidae species" and "submontane species" has narrow altitudinal amplitudes and survived, *e.g.* only in lowland or submontane refuges during cold and arid phases but not in montane habitats. In contrast, any "montane species" has broad altitudinal amplitudes and hence, survived in high as well as lowland elevations, *e.g.* during cold and arid phases. One example was found by I.L. in regard to the montane butterfly *Charaxes acuminatus* subsp. *shimbanus* van Someren (1963) in coastal forests of Kenya with the first record for Kenya below altitudes of 10 m (Kroon 2001: 82 + Back cover; Lehmann & Kioko 2005: 136, 138). Another example in regard to *Kayamuhakaia* is a species of the Taita Hills presented herein (*cf.* Discussion + Table 5). Hence, only the lowland and submontane species can be used as indicator species for lowland and submontane refuges (*cf.* Table 2).

An area that is termed as "well known area" herein (*e.g.* Table 2) is based on the definition for *"well known" sensu* Lemmens & Sosef (1998: 28). According to their definition, any tropical region that has a density of 2 [two collected plant] specimens per km^2 is regarded as being *"well known"*. This definition is slightly modified herein, *e.g.* the Dhesheeg Waamo Wildlife Reserve (Somalia) is considered as a region with "two well known areas" (*cf.* Table 3). This implies that at least two Metarbelidae species (instead of two specimens) with one specimen each were collected in an area of *ca.*1.0 km^2 and later studied morphologically by I.L. in detail. As there were six endemic species studied from two different collecting Sites *ca.* 2.0 km^2 can be considered as "two well known areas" within this Wildlife Reserve.

The biogeographic terminology used herein follows White (1983) and Burgess *et al.* (2004). The re-classification of White's (1983) *"Zanzibar-Inhambane regional mosaic"* (abbreviated as "Z-I") into two regions, namely the *"Swahilian / Maputaland regional transition zone"* and *"Swahilian regional centre of endemism" sensu* Clarke (1998) is dealt with here in regard to their endemic Metarbelidae of *Kayamuhakaia*.

An *"endemic"* taxon is entirely confined to a stated geographical area, *e.g.* a particular mountain, a particular hill or a particular forest. The term *"near-endemic"* follows the approach of BirdLife International and was used for Metarbelidae previously, *e.g.* Lehmann (2019a: 22; Lehmann *et al.* 2023: 6).

Additionally, there is a second approach presented herein for the delimitation of the distribution of a species based on the *"main phytochoria" sensu* White (1983: 38) to determine the potential ancestral area of a species *sensu* Lehmann (2019b: 20, Fig 6d). The latter approach uses herein only morphological characters based on the diagnosis of each species to determine within the same genus a *"linking species"* representing a link between two main phytochoria considering the first mentioned of these two as the possibly ancestral area. A *"linking species"* has a collecting Site in one main phytochoria that is close to (up to 1000 km) or adjacent to another main phytochoria that includes a collecting Site of another species. The latter species shares at least one morphological character that is close to a character in the former species based on a diagnosis. To use morphological characters to determine a *"linking species"* is necessary since there is no species among more than 1000 studied species of Metarbelidae (Lehmann in prep.) that occurs in two phytochoria and hence, would represent a *"linking species"* for both phytochoria.

If *"linking species"* of at least two genera (*e.g. Kayamuhakaia* **gen. nov.** and *Finsterwaldeia* **gen. nov.**) are compared — genera that were not dealt with by Lehmann (2019b) and including also monotypic genera — "potential parsimony-informative characters" are determined to present a possible ancestral area. The latter are based on "parsimony-informative characters" *sensu* Lehmann (2019b: 30 — 41 + Fig 6c).

The definition of any genus is based on autapomorphies (Wägele 2005: 129; Lehmann 2019b: *e.g.* 44) and the definition of any monophylum is based on the differential diagnosis in both sexes (if available) and follows the same method as presented by Lehmann (2019b: 18, 19).

RESULTS

Kayamuhakaia I. Lehmann Gen. nov.

Figs 1.a. — 12.a., 13.a. — 23.c., 26.a. — 29.c., 31.a. — 37.a.

Type species of genus: *Kayamuhakaia haberlandorum* (Lehmann, 1997) **comb. nov.** is designated as the type species.

Origin of species in genus (ancestral areas):

Based on the following two "potential parsimony-informative characters" (*cf.* 1. and 2. below) the species of *Kayamuhakaia* are close to the species of the *"Dimbelenge Group"* as well as *"coastal forest Group" sensu* Lehmann (2019b: 32). This is the nearest approach at present and indicates that the ancestors of species of *Kayamuhakaia* first evolved in the tropical lowland rain forests as well as submontane rain forests of the Afro-Arabian continent. This implies that all montane species presented herein — occurring on the Eastern Arc Mountains or nearby, on former volcanoes or on plateau areas in Kenya, Tanzania, Uganda, Rwanda and Burundi — derived from ancestors that first occurred in the Lowlands.

1. The "elongated uncus and tegumen" (Fig 13.b., b.1. and b.2.) that both are 1.8 — 2.1× as long as the basal width of valva — *cf.* the similar but different apomorphy as well as parsimony-informative character number "183" (closest approach) that is linked to Metarbelidae that first originated in lowland rain forests of West Africa and/or Central Africa (Lehmann 2019b: 38, 383, Fig 6c).

2. A "thinly sclerotized, medium broad band that connects both valva ventrally" (Fig 13.b., b.3.; *cf.* Fig 23.a., a.1. with a.2.) — *cf.* the similar but different apomorphies as well as parsimony-informative characters number "70" (closest approach), "71", "80", ("104" homoplasy), "121" that are linked to Metarbelidae that first originated in lowland rain forests of West Africa and/or Central Africa ("71", "121"), and/or in the Eastern Arc Mountains as well as the "*Zanzibar-Inhambane regional mosaic"* and *"Tongaland-Pondoland regional mosaic"* ("70"); and in montane areas for characters "80" and "121" (Lehmann 2019b: 32, 33, 386 — 387, Fig 4 + 6c).

Hence, the two closest approaches suggests that it is very likely that basal species of *Kayamuhakaia* evolved in the tropical lowland rain forests as well as submontane rain forests on the Afro-Arabian continent *ca.* 65 Ma — 59.9 Ma together with the earliest diversification events of the woody Leguminosae, *e.g.* Caesalpinioideae as one of the oldest groups of tropical tree species and close to basal Leguminosae (*cf.* Leal 2004: 1; Lehmann 2019b: 342, Figs 198a, 198b; Discussion herein) with the majority of caesalpinioids and all mimosoids that were diverse by mid Eocene *ca.* 40 Ma (*cf.* Lehmann 2019b: 32, 38, 324, 342 — 345).

Present species closest to the unknown basal species of genus:

Based on the age of the tropical lowland rain forest and their related types near the Indian Ocean coastline as well as based on submontane rain forest Sites that are presented herein, the following Sites are considered as the oldest:

1. The Lowlands, comprising legume-dominated lowland rain forest macrorefugia and microrefugia of the central Congo Basin (*cf.* Colyn *et al.* 1991: 404, 405; Robbrecht 1996: Fig 7; Leal 2001: 1073, Fig 1; Blom & Schipper 2004: 243; Leal 2004: Fig 1.5).

2. The lowland forest microrefugia in coastal areas just to the South of the Equator in Somalia (not yet identified herein), extending southwards along the Kenya coast to near Bagamoyo (Tanzania) as figured (for the second time) by Hamilton & Taylor (1991: 70, Fig 3). These areas were delimited to southern Kenya — including the Shimba Hills — and northern Tanzania by Robbrecht (1996: 567, 576, 579, Fig 7) but extended again by Couvreur *et al.* (2008: Fig 1). Lehmann & Kioko (2005: 140), Lehmann (2008: 70, number 5; unpublished data for 2005 — 2007) and Lehmann (2019b: 325) concluded for the Kenya South Coast and based on long-term field research data on forest structure, plant and Lepidoptera diversity and endemism that wetter legume-dominated coastal forests — such as Kaya Muhaka — are "forest … sites that survived under long-term stable ecological conditions, maybe since the Miocene …" and are situated not directly at the Indian Ocean but between 500 m up to *ca.* 25 km further inland; occurring mainly on sands of Upper Pliocene age or on a surface of a possible Miocene age.

3. The submontane as well as montane regions on Mount Mulanje (Malawi) represent the most ancient area with an age of at least 105 Ma (*cf.* Lehmann 2019b: 332 — 333). Hence, the still present lowland rain forest patches on its southern side — extending from the Lowlands into submontane areas — must be the most ancient ones regarding the habitats for species of *Kayamuhakaia.*

Based on these three latter facts as well as the two morphological results mentioned above, the following two lowland species as well as one submontane species are considered at present as descendant species that are the closest to the unknown basal ancestor species of *Kayamuhakaia*:

- The Lowlands, with *K. bokatolaensis* **sp. nov.** — that occurs in the *"South Central* [faunal] *region" sensu* Grubb (1982) to the South and to the East of the arc formed by the Congo River, *ca.* 80 km east of Lake Tumba as well as of the *"Sangha River Interval" sensu* White (1978: 261) as figured by Rietkerk *et al.* (1996: 619, Fig 1) and *ca.* 30 km to the East of a submontane area (elevation 700 — 1.000 m / Democratic Republic of the Congo, DRC) in *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) located at least in a *"small scale* [fluvial lowland forest] *refuge area" sensu* Leal (2001: 1073, 1077) suggesting an age of the **lowland rain forest at** the holotype collecting Site of **Bokatola** of at least 70,000 — 12,000 yr B.P. (*cf.* Sosef 1994: 3, 120; Grubb 2001: Fig 6.3; Blom & Schipper 2004: 243; Leal 2004: Fig 1.5).

- The Lowlands, with *K.haberlandorum* (Lehmann, 1997) **comb. nov.** — that occurs along the Kenyan coast in various Pleistocene lowland forest refuge areas or *"core areas" sensu* Hamilton & Taylor (1991: 70, Fig 3), *"postulated refuge areas" sensu* Robbrecht (1996: 579 + Fig 7) as well as *"Eastern refuges with minor centers" sensu* Grubb (2001: Fig 6.3) and *sensu* Couvreur *et al.* (2008: Fig 1 and Discussion) comprising herein in particular **Arabuko-Sokoke Forest** and nearby tiny forest or woodland patches, the **Rabai Kayas** (Kenya, North Coast that was excluded by Robbrecht 1996), **Kaya Muhaka**, **Gogoni Forest** [also known as Gongoni Forest], **Buda Forest** and the **Shimba Hills** (Kenya, South Coast; for the Shimba Hills *cf.* Lehmann & Dalsgaard 2023: 134, 137, 139, 140, 182) with *"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 197) including *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) dominated by caesalpiniaceous tree species.

- The submontane area, with *K. hilarysommerlatteae* **sp. nov.** — that occurs **along the (steep) banks of the Ruo River** (Ruo River Gorge, Mount Mulanje, Malawi) in a relict of *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) as well as *"Lowland rain forest" sensu* White *et al.* (2001: 60). This remaining habitat of only 200 ha in size is **defined herein as a Pleistocene microrefugium** — that once extended into the Lowlands at least to the present area of Lujeri Tea Estate. This view is supported additionally with data on one more undescribed genus comprising four more undescribed species of Metarbelidae that only occur in lowland forests of the *"Eastern refuges with minor centers of endemism" sensu* Grubb (2001: Fig 6.3) in the Southeast of coastal Kenya with the next locality of records on Mkuwadzi Hill (adjacent to Nkhata Bay and the northwestern lake-shore of Lake Malawi) as well as along the banks of the Ruo River based a comprehensive collection of Metarbelidae studied by I.L. with no other morphological similar species (Lehmann in prep.).

Note: At least since the year 1970 the original lowland and submontane forests on **Mkuwadzi Hill** (altitude range 567 — 785 m) as well as towards the Nkhata Bay lake-shore (altitude range 471 — 566 m) were completely destroyed by humans and almost certainly represented former relicts of *"Zanzibar-Inhambane* [Z-I] *lowland rain forest"* (*cf.* also Chapman & White 1970: 178; White *et al.* 2001: 60). The present old woodland relicts that replaced these former Z-I forests on Mkuwadzi Hill and in the Nkhata Bay lake-shore area are defined herein as a **Pleistocene miombo microrefuge area** with one relict Z-I indicator Metarbelidae genus (Lehmann in prep.) and two Z-I endemic species still present (Lehmann in prep.) — occurring both in a small patch of an old *Brachystegia* woodland sympatric with *K. mkuwadziensis* **sp. nov.** (*cf.* Table 2).

Autapomorphies — The genus is defined by the following combination of characters in both sexes.

Male, epiphyses on forelegs present and usually well developed, areole in forewing always present in combination with:

- a simple genitalia (Fig 13.b.) with a ventral edge of valva that is usually longer, or rarely as long as the basal width of valva — the latter is measured vertically from below the base of the small and reduced semi-transtilla to ventral edge of sacculus — and with a small, simple, never strongly sclerotized, lunule-like appendice on the valva ventral distally (Fig 13.b., b.4.). This appendice is usually reduced, rarely results in a short extension of the sacculus.

Female, epiphyses on forelegs usually absent, rarely rudimentary with up to 0.7 mm length, areole in forewing always present, in combination with:

- posterior apophyses are narrow, long, never shorter than anterior apophyses and 0.1 — 3.0× as long as the anterior apophyses in combination with the papillae anales that is, if not broken or not pressed below glass, bent outwards ventrally, similar to the belly of a pregnant woman (Fig 13.c., c.1.).

Differential diagnosis: characters shared with species of *Kayamuhakaia* gen. nov. and species of *Finsterwaldeia* gen. nov. (based on one male) and species of *Lichterfeldia* gen. nov. (based on one female)

Female, venation in forewing in combination with female antennae:

- In species of *Kayamuhakaia* and *Lichterfeldia* R_5 is separated or originates from near base of $R_3 + R_4$ and from top of an areole that is at least 30% the size of the upper discal cell, combined with female antennae that are unipectinated but with relicts of branches on up to one-third of flagellum — measured from base of flagellum towards tip. These relict branches are not longer than *ca.* 0.3× width of shaft near base of flagellum (sometimes branches are entirely absent; very rarely up to 0.8× width of shaft) but up to *ca.* 2.5× width of shaft on upper one-third of flagellum and near tip. Hence, the female antennae have relict branches that become significantly longer towards the tips of antennae.

Male, genitalia in combination with uncus and tegumen:

- In *Kayamuhakaia* and *Finsterwaldeia* the whole genitalia is simple and without any sclerotized appendices on uncus, tegumen and vinculum with uncus and tegumen always elongated (Fig 13.b., b.1. and b.2.).

An “elongated uncus and tegumen” means in this context that both are 1.8 — 2.1× as long as the basal width of valva (*cf.* different apomorphy number “183” in Lehmann 2019b: 383).

Male, genitalia as above and in combination with valvae:

- The valvae of *Kayamuhakaia* and *Finsterwaldeia* have a band ventrally that connects both valva. This band-like structure is thinly sclerotized and medium broad, namely only slightly broader than basal part of aedeagus (Fig 13.b., b.3. and b.5.; *cf.* Fig 23.a., a.1. with a.2.). In old genitalia preparations this band might be “absent” or difficult to see (*cf.* different but similar apomorphies number “70”, “71”, “80”, “104” and “121” in Lehmann 2019b: 386 — 387).

Diagnostic characters *sensu* Wägele (2005: 124) in females of *Kayamuhakaia*

- Females only slightly larger than males, or of an equal wingspan like the male in the same species, with a similar wing pattern on forewing dominated by a large rectangular band extending from above CuA_2 to at least basal half of R_3, rarely only to basal half of M_2 or only to CuA_1.
- Segment 8 without any sclerotized setae (*e.g.* Fig 2.d.).

- The sclerotized horizontal “T” represents the basal part of the posterior apophyses and is very long ventrally, extends to or close to the ventral edge of the papillae anales in lateral view.
- A ring-like band posteriorly on or adjacent to segment 8 is present (Fig 14.a., a.1.).
- Corpus bursae round, oval, broadly oval, pear-shaped or almost rectangular and as large as 0.5 — 3.5× as segment 8 in lateral view.
- Hindlegs usually with two pairs of tibial spurs with upper pair sometimes shorter than lower pair or equal in length with lower pair (*cf.* males).
- The scape of antenna is not broader than 1.5× width of flagellum (shaft), *cf.* species of *Lichterfeldia.*
- The apex of the forewing is never strongly rounded but pointed, *cf.* species of *Lichterfeldia.*

Diagnostic characters in males of *Kayamuhakaia*

- Near the central part of uncus occur two or three small holes that are separated by very narrow bands (*cf. K. haberlandorum*), but usually only one small hole is present (*cf. K. nubifera*, *K. triangularis*, *K. huchtemanni* **sp. nov.**, *K. hilarysommerlatteae* **sp. nov.**), often oval elongated (*cf. K. wellsi* **sp. nov.**), rarely a hole is absent (*cf. K. ngwenoae* **sp. nov.**).
- Uncus never as long as basal width of valva (*cf.* difference to species of *Finsterwaldeia*).
- The inner part of valva has always on its surface an oblique, thinly sclerotized appendice (sometimes lunule-like) with rows of tiny setae on its

upper surface. The appendice begins near the central basal part of valva and extends towards costa, but is still well below the base of semi-transtilla. In old genitalia preparations this structure might be "absent" or difficult to see.

- Valvae with a horizontal costal edge that is oblique towards outer edge of semi-transtilla.
- Hindlegs with two pairs of tibial spurs, very rarely with one pair, with upper pair usually longer than lower pair (*cf.* females).

Description of species in genus. *Head*: Rough-scaled; long hair-like scales of warm buff or buffy-olive or Isabella colour or tawny-olive mixed with deep olive-buff scales with a light golden glint (less visible in females) on fronto-clypeus; a pair of pits on lower fronto-clypeus is absent in male and female (*cf. K. haberlandorum, K. neemambeyuae* **sp. nov.**) or present in female (*cf. K. aberdarensis* **sp. nov.**) or rudimentary in both sexes (*cf. K. fontainei* **sp. nov.**); a pair of small conical projections usually absent on lower fronto-clypeus in both sexes, rarely present in females (*cf. K. hermanstaudei* **sp. nov.**); pits behind labial palpi are small oval-shaped or narrow slits in both sexes; a horizontal dorsal ridge on lower fronto-clypeus is usually absent, if present it is rudimentary in both sexes (*cf. K. fontainei* **sp. nov.**); labial palpi in both sexes short or medium long, half of eye-diameter in length, consisting of three segments (rarely two segments are present as in *K. nubifera, K. aberdarensis* **sp. nov.**, *K. hermannstaudei* **sp. nov.**, *K. lolgoriensis* **sp. nov.** and *K. bokatolaensis* **sp. nov.**) with usually 2nd segment longest, narrowly elongated oval or broadly rectangular, up to 0.5× longer than 1st (basal) segment (longest in *K. aberdarensis* **sp. nov.** and *K. juliusmathiui* **sp. nov.**), basal segment up to 1.2× broader than upper segment and rectangular, segment on top triangular or egg-shaped or elongated rectangular, small or up to 90% length of 2nd segment; only *K. nancycammae* **sp. nov.** has three segments of equal length. Antennae bipectinate in males, usually between 30 — 50% of forewing length, rarely very long with 60% of forewing length (*cf. K. wellsi* **sp. nov.**, *K. vau-alba*); in females the antennae are unipectinate, sometimes longer than in males in the same species (*cf. K. fontainei* **sp. nov.**), usually between 30 — 45% of forewing length, rarely very long with 46 — 50% (*cf. K. bokatolaensis* **sp. nov.**, *K. aberdarensis* **sp. nov.**, *K. stephanierobertsae* **sp. nov.**, *K. gitegaensis* **sp. nov.**, *K. tombutynskii* **sp.nov.**) or 55% (*cf. K. nubifera*) of forewing length; branches in males usually up to 3.5× longer, rarely 4.0× longer (*cf.* male of *K. fontainei* **sp. nov.**) or 5.0× longer (*cf. K. vau-alba*) than width of shaft; in females branches are often absent or less than *ca.* 0.3× length of width of shaft on lower one-third or on lower 40% of flagellum, but up to 2.5× longer than width of shaft towards tip of antenna (*cf. K. yiruchengae* **sp. nov.**, *K. aberdarensis* **sp. nov.**, *K. nubifera, K. hermannstaudei* **sp. nov.**), shorter in *K. stephanierobertsae* **sp. nov.**, *K. juliusmathiui* **sp. nov.**; branches are often laterally scaled cream or white, deep olive-buff or mummy brown and are not widely separated at base (*cf.* female of *K. haberlandorum*) or are widely separated at base (*cf.* females of *K. nubifera, K. nancycammae* **sp. nov.**) with at least 1.1× width of branch, in males up to 1.5× width of branch (*cf. K. wellsi* **sp. nov.**, *K. fontainei* **sp. nov.**); branches sometimes very flat (viewed laterally; *cf.* female of *K. nubifera*); dorsal and lateral sides of flagellum as well as scape are scaled cream, white, ivory-yellow, deep olive-buff or mummy brown in both sexes. The scape is not broader than 1.5× width of flagellum (shaft).

Thorax: Patagia and tegulae often with pronounced light golden glint, sometimes mixed with pale olive glint on hair-like scales in male and/or female (*cf. K. haberlandorum, K. neemambeyuae* **sp. nov.**, *K. bokatolaensis* **sp. nov.**); hair-like scales as well as medium broad scales with a broad tip, often decorative and more pronounced, with scales of white or dark olive-buff or Isabella colour with black or dark olive patches below tip; the scales on patagia forming sometimes a collar ring; females only with hair-like scales on patagia and tegulae of cream, pale olive-buff, deep olive-buff, dark olive and/or ivory-yellow with black, dark olive or mummy brown patches below tip of scale. Metathorax with long scale-crest in both sexes with long hair-like scales with a broad tip of Saccardo's umber, Isabella colour or dark olive-buff. Forelegs and midlegs are cream or dark olive-buff with long dense hair-like structures in both sexes. Epiphyses always present in male, tube-like or stick-like, sometimes flat towards tip, rudimentary to very long with 0.3 —1.6 mm (*e.g.* rudimentary in *K. wellsi* **sp. nov.**, very long in *K. haberlandorum, K. petermuriithii* **sp. nov.**, *K. aarviki* **sp. nov.**); epiphyses very rarely present in female, if present always rudimentary or short, 0.2 — 0.7 mm (*e.g. K. rupimangatae* **sp. nov.**, *K. juliusmathiui* **sp. nov.**, *K. karenae* **sp. nov.**). Hindlegs ivory-yellow, deep olive-buff or dark olive-buff with a glint on long hair-like structures in both sexes, with two pairs of narrow tibial spurs in both sexes, very rarely with one pair (*cf.* male of *K. triangularis,* female of *K. killmannae* **sp. nov.**), both pairs of spurs unequal in length, upper pair always longer in males with 0.5 — 1.4 mm (longest in *K. petermuriithii* **sp. nov.**), in females the lower pair is usually longer or equal in length with upper pair, 0.6 — 1.5 mm (equal in *K. haberlandorum*; longer in females of, *e.g. K. hermannstaudei* **sp. nov.**, *K. yiruchengae* **sp. nov.**, *K. gitegaensis* **sp. nov.**, *K. rupimangatae* **sp. nov.**); both pairs longest in male of *K. petermuriithii* **sp. nov.** and in females of *K. haberlandorum, K. nancycammae* **sp. nov.**, *K. lolgoriensis* **sp. nov.**, *K. yiruchengae* **sp. nov.**; all spurs with thorn-like tip. Wingspan is between 17.5 mm up to 43.5 mm with both sexes in the same species (if known) with a similar wingspan (*cf. K. haberlandorum, K. wellsi* **sp. nov.**, *K. fontainei* **sp. nov.**), the smallest species comprise *K. haberlandorum, K. neemambeyuae* **sp. nov.**, *K. kismayuensis* **sp. nov.**, *K. wellsi* **sp. nov.**, *K. kasikamwiuae* **sp. nov.** and the largest species include *K. killmannae* **sp. nov.**, *K. yiruchengae* **sp. nov.**, *K. rupimangatae* **sp. nov.**, *K. hermannstaudei* **sp. nov.** and *K. karenae* **sp. nov.** Forewing is broad with a pointed apex in both sexes and never strongly rounded.

Forewing upperside in both sexes with strong light golden or silvery glint (more pronounced in males if not worn), on ivory yellow, warm sepia, buffy olive, tawny-olive or old gold ground-colour; scale pattern in males and females is present and includes a broad dominant band of tawny-olive, Isabella colour, snuff brown or brownish olive (the latter colour occurs often in females) extending usually from CuA_2 to R_3, or to costal margin, often appearing like a large elongated rectangular patch; usually the end of lower median, the base of M_3 and the whole CuA_2 are narrowly marked white or ivory yellow, resembling sometimes (if the marking is reduced) a "V" or "Y" in horizontal position (*cf. K. haberlandorum, K. neemambeyuae* **sp. nov.**, *K. nubifera, K. fontainei* **sp. nov.**, *K. bokatolaensis* **sp. nov.**), rarely this marking is absent in males (*cf. K. wellsi* **sp. nov.**); below CuA_2 occur small patches in both sexes, *e.g.* of black, sepia, buffy olive, light cream, white or Isabella colour; lunules are usually absent, if present they are small, weak and of Saccardo's umber or sepia (*cf. K. fontainei* **sp. nov.**); below lower median occurs close to its base a patch of black or sepia that might be large and dominant in males (*cf. K. ngwenoae* **sp. nov.**) or small in males and absent in females (*cf. K. haberlandorum*) or absent in both sexes (*cf. K. wellsi* **sp. nov**., *K. fontainei* **sp. nov.**); costal margin with black or sepia striae or without striae; a broad subterminal band of buffy olive or warm sepia or Isabella colour is present from end of CuA_2 to near apex or extending only to M_2 (*cf. K. wellsi* **sp.nov.**). Any scales that are longer and hence, extend above the normal scale layer are absent in both sexes.

Hindwing is brownish olive, buffy olive, warm sepia or tawny-olive, rarely ivory-yellow, with a light golden glint in both sexes.

Forewing venation with 1A+2A forked at base in both sexes, fork sometimes weak or absent (*cf. K. petermuriithii* **sp. nov.**; *K. bokatolaensis* **sp. nov.**); CuP absent in both sexes; a continuous, not sclerotized, weak CuP fold also absent in both sexes; CuA_2 originating from two-thirds of lower median in both sexes, rarely near half of lower median; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell in both sexes; M_1 originating from distal margin of median cell in both sexes, always well separated from base of R_5; areole always present in both sexes, usually *ca.* 20 or 25% of upper discal cell in both sexes, rarely as large as 50% of upper discal cell in females (*e.g. K. karenae* **sp. nov.**) or 45% or more of length of upper discal cell (*K. haberlandorum*, *cf.* Fig 28.a. + 28.b.; *K. bokatolaensis* **sp. nov.**); very rarely as large as 60% of upper discal cell in males (*K. yvonnedejongae* **sp. nov.**); R_1 and R_2 separate; R_1 initiating from anterior margin of median cell and R_2 initiating from near anterior angle of areole in both sexes; $R_3+R_4+R_5$ are shortly stalked and originating from tip of areole (female of *K. wellsi* **sp. nov.** *cf.* Fig 28.d.; *K. aberdarensis* **sp. nov.**, *K. nancycammae* **sp. nov.**) or originating from the same basal point of posterior angle of areole (*K. haberlandorum cf.* Fig 28.a. + 28.b.; *K. neemambeyuae* **sp. nov.**, *K. wellsi* **sp. nov.** *cf.* Fig 28.c.; *K. triangularis cf.* Fig 29.c.), or R_5 is well separated at base from a relatively long stalked R_3+R_4 (*K. petermuriithii* **sp. nov.**, *K. gitegaensis* **sp. nov.** *cf.* Fig 29.a.; *K. bokatolaensis* **sp. nov.**); Sc more or less parallel to R_1.

Hindwing venation similar in both sexes with 3A always present, 1A+2A usually represents a sclerotized fold with a small fork at base, CuP usually present (*e.g. K. tombutynskii* **sp. nov.**, *K. petermuriithii* **sp. nov.**) or weak (*cf. K. haberlandorum*, *K. neemambeyuae* **sp. nov.**, *K. bokatolaensis* **sp. nov.**) or is represented by a not continuous fold; CuA_2 originating from two-thirds of posterior cell in both sexes; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated in both sexes; M_1 and Rs originating from apical angle of anterior cell, usually stalked in both sexes (*K. haberlandorum cf.* Fig 28.a.+28.b.; *K. wellsi* **sp. nov.** *cf.* Fig 28.c. + 28.d.; *K. triangularis cf.* Fig 29.c.; *K. bokatolaensis* **sp. nov.**), rarely very long stalked on *ca.* 45% of length (*cf. K. nancycammae* **sp. nov.**, *K. kismayuensis* **sp. nov.**) or separated (females of *K. fontainei* **sp. nov.**, *K. gitegaensis* **sp. nov.** *cf.* Fig 29.a.); usually with a bar from Rs to $Sc+R_1$ in both sexes; vein in discocellular cell on both fore- and hindwing is present in both sexes. Fringe scales usually long in both sexes with 0.6 — 1.3 mm length on forewing and hindwing, brownish olive, dark olive-buff, cream or pale olive-buff often with lighter tips, *e.g.* ivory yellow with a glint.

Retinaculum and frenulum are always absent in both sexes.

Abdomen: In males and females with dense hair-like scales of cream mixed with scales of pale olive-buff, dark olive-buff, brownish olive or Saccardo's umber with a light golden glint (more pronounced in males); abdominal tuft usually short or medium long with 15 — 25% of abdomen length in both sexes, rarely long with 30 — 35% (*cf.* female of *K. wellsi* **sp. nov.**, male of *K. huchtemanni* **sp. nov.**) coloured cream, tawny-olive or Saccardo's umber.

Male genitalia (*e.g.* Figs 13.a., 14.b., 15.b., 16.b., 20.a., 22.b.) with tegumen and vinculum fused, forming a firm narrow ring, with vinculum broadest, namely *ca.* 1.7 — 3.0× broader than basal part of tegumen. Saccus well developed, never rudimentary, broad with at least 1.3× broader than aedeagus, long with usually 60 — 100% length of ventral edge of valva, very rarely as short as 40% (*cf. K. mkuwadziensis* **sp. nov.**) or up to 25% longer than ventral edge of valva (*cf. K. aarviki* **sp. nov.**, *cf.* Fig 22.b.). Uncus broad, elongated, with two acuminate, truncate, mucronate or rectangular tips present, an emargination is usually V-shaped or U-shaped, rarely triangular, uncus never as long as basal width of valva, uncus and tegumen combined are 1.8 — 2.1× longer than the basal width of valva; dorsal part of uncus usually with one small hole, rarely two small holes are present (*cf. K. haberlandorum*) sometimes the hole is narrowly oval (*cf. K. wellsi* **sp. nov.**); uncus with tiny as well as long setae ventrally and along its vertical edges (viewed ventrally); basal edge of uncus thinly or thickly membranous and not bent at center (*cf. K. nubifera*, *K. haberlandorum*) or lunule-like bent at center (*cf. triangularis*, *yvonnedejongae* **sp. nov.**, *hilarysommerlatteae* **sp. nov.**) — basal edge best visible in fresh preparations. The gnathos is absent and never represented by a relict structure. The juxta is thinly sclerotized, small, narrowly rectangular and usually with a tiny elongated triangular appendice at each lateral side (viewed ventrally), usually 25 — 30% the size of saccus or up to 60% as large as saccus (*cf. K. yvonnedejongae* **sp. nov.**) or as large as saccus, the upper half of juxta is never broader or equal in width if compared to the basal width of the uncus in the same species. The valva is large rectangular with an horizontal costal margin that is more or less oblique near the base of semi-transtilla, usually 25 — 30% of valva thinly membranous and dorsally with a rounded end, distally with short setae; lower two-thirds of valva include an inner valva that is slightly sclerotized; a narrow thinly sclerotized band is dominant and connects both valva ventrally (valvae not separated ventrally). Transtilla always absent, semi-transtilla small triangular with a thinly membranous appendice (best visible in fresh preparations), this appendice is well developed (*cf. K. haberlandorum*, *K. yvonnedejongae* **sp. nov.**) or small (*cf. K. nubifera*); the sacculus is absent or narrow (often visible only in fresh preparations) and ends in one small lunule-like or small rectangular appendice ventral distally, this appendice is sclerotized, always hollow but rarely results in a short extension of the sacculus distal ventrally (*cf. K. nubifera*). On the inner surface of valva occurs an oblique row of tiny dense setae that begins near the central basal part of valva and extends towards costa but is still well below the base of semi-transtilla. Phallus always long, 1.8 — 2.0× longer than basal width of valva or 2.0 — 5.0× longer than saccus (*cf. K. wellsi* **sp. nov.**, *K. huchtemanni* **sp. nov.**), narrow and not broader than width of saccus (viewed ventrally), simple tube-like, broadest at base, not bent, with a rounded tip distally and without any appendice.

Female postabdominal structure and genitalia (*e.g.* Figs 13.c., 13.d., 21.a.) with papillae anales broad and at least as large as segment 8 in lateral view, dorsal part obliquely 8-shaped or elliptic in posterior view, covered with short and long setae, lobes of papillae anales are small, up to 20% longer as dorsal width of segment 8 or as long as dorsal width or only 30% length of the narrow dorsal width of segment 8 (viewed laterally) and as large as 6 — 30% of the papillae anales (largest papillae anales, *e.g. K. hermannstaudei* **sp. nov.**, *K. aberdarensis* **sp. nov.**, *K. lolgoriensis* **sp. nov.**, *K. yiruchengae* **sp. nov.**). Between the papillae anales and segment 8 occurs a large thinly membranous structure that is as large as segment 8 in lateral view (*cf. K. haberlandorum*, *K. neemambeyuae* **sp. nov.**) or smaller than segment 8 (*cf. K. nubifera*, *K. nanyukiensis* **sp. nov.**, *K. kismayuensis* **sp. nov.**) or up to 2.5× larger than segment 8 (*cf. K. nancycammae* **sp. nov.**). Segment 8 is often narrow rectangular (*cf. K. haberlandorum*, *K. neemambeyuae* **sp. nov.**, *K. bokatolaensis* **sp. nov.**) or rarely broadly rectangular (*cf. K. kismayuensis* **sp. nov.**, *K. aberdarensis* **sp. nov.**, *K. stephanierobertsae* **sp. nov.**) or triangular (*cf. K. karenae* **sp. nov.**, *K. killmannae* **sp. nov.**) and usually bent inwards dorsal anteriorly; segment 8 very narrow ventrally, rarely broader ventrally if compared to the dorsal width (*cf. K. nubifera*, *K. wellsi* **sp. nov.**, *K. aberdarensis* **sp. nov.**, *K. kismayuensis* **sp. nov.**), sclerotized or only thinly sclerotized and membranous ventrally; any sclerotized or membranous setae are absent on segment 8, rarely thinly membranous scale-like structures occur along the ventral part of the posterior margin (*cf. K. haberlandorum*, *K. neemambeyuae* **sp. nov.**); segment 8 has usually a ring-like band posteriorly that is more sclerotized on the lower half; the posterior apophyses are long, 0.1 — 3.0× as long as anterior apophyses, often twice as long as anterior apophyses, with a sclerotized base similar to a “T” in horizontal position that is very long ventrally and extends usually to the ventral edge of the papillae anales on each side (in lateral view) with both ventral ends of this T-like structure connected by a thinly membranous band ventrally (viewed posteriorly and visible in fresh preparations); the anterior apophyses are narrow and straight (*cf. K. haberlandorum*, *K. neemambeyuae* **sp. nov.**) or bent downwards (*cf. K. hermannstaudei* **sp. nov.**) or bent upwards (*cf. K. stephanierobertsae* **sp. nov.**) or they are S-shaped (*cf. K. killmannae* **sp. nov.**) with the base of one anterior apophysis smaller or larger than one lobe of papillae anales, with 0.1 — 3.0× the size of one lobe, with only four species with base of one anterior apophysis larger than one lobe (*K. hermannstaudei* **sp. nov.**, *K. philipokwaroi* **sp. nov.**, *K. bokatolaensis* **sp. nov.**, *K. mbalensis* **sp. nov.**). The distal narrower part of the anterior apophysis is long and never shorter than the sclerotized dorsal width of segment 8, namely 10 — 75% longer than the dorsal width or as long as the dorsal width of segment 8.

The ductus bursae is narrow and long, up to 2.0 mm in length, its length is 10 — 50% shorter or as long as the length of the posterior apophysis or 10 — 50% longer than the posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no sclerotized plate-like or bottleneck-shaped structure but often a thickly or thinly membranous triangular structure (*cf.* *K. mbalensis* **sp. nov.** with 0.7× the size of papillae anales in lateral view); corpus bursae is thinly membranous, without any structures, almost round (*cf.* *K. bokatolaensis* **sp. nov.**, *K. lolgoriensis* **sp. nov.**, *K. nanyukiensis* **sp. nov.**, *K. kilimanjaroensis* **sp. nov.**); oval (*cf.* *K. neemambeyuae* **sp. nov.**, *K. kismayuensis* **sp. nov.**, *K. karenae* **sp. nov.**); broadly oval (*cf.* *K. hermannstaudei* **sp. nov.**), pear-shaped (*cf.* *K. haberlandorum*, *K. wellsi* **sp. nov.**, *K. finchhattoni* **sp. nov.**, *K. yiruchengae* **sp. nov.**) or almost rectangular (*cf.* *K. gitegaensis* **sp. nov.**) and is, if not broken or not pressed below glas, 0.5 — 3.5× as large as segment 8 in lateral view (smallest in *K. lolgoriensis* **sp. nov.**, *K. stephanierobertsae* **sp. nov.**, *K. tombutynskii* **sp. nov.**, *K. yiruchengae* **sp. nov.**, *K. kismayuensis* **sp. nov.**; largest in *K. mbalensis* **sp. nov.**, *K. kilimanjaroensis* **sp. nov.**, *K. maasi* **sp. nov.**).

Species richness. Currently, 38 species are included in this new genus of which 34 species are described as new to science.

Distribution at present (Fig 1.a.). Species of *Kayamuhakaia* have a strong affinity to the Zanzibar-Inhambane (Z-I) phytochorion with a still visible affinity to the Guineo-Congolian (G-C) phytochorion (*cf.* Tables 1, 2, 3, 4, 5). Their strong affinity to the Afromontane (A-M) phytochorion is limited to East Africa (*cf.* Table 6).

They represent the only distribution among Metarbelidae that stretches from the eastern African coast to the central Congo Basin to the East of the *"Sangha River Interval"* as figured by Rietkerk *et al.* (1996: 619, Fig 1). Hence, their distribution at genus level is not separated by the *"Kingdon's Line"* and few endemics might occur locally some kilometers to the East as well as some kilometers to the West of the *"Kingdon's Line"* (*cf.* Grubb 2001: 91 + Fig 6.1), *e.g.* species occurring on the Karisia Hills such as *K. barrychappelli* **sp. nov.** as well as on the Aberdare Range such as *K. aberdarensis* **sp. nov.**

The distribution of species of *Kayamuhakaia* appears as a more or less continuous and broad horizontal band comprising a coast length of *ca.* 930 km extending from the Indian Ocean coastline of southern Somalia (just to the South of the Equator) along the coast of Kenya southwards to Dar es-Salaam in Tanzania (originally "Dar Salam", *cf.* Shaykh Al-Amin 1995: 20).

Westwards from this coast length, the species occur via lowland, submontane, montane, high montane and subalpine areas in southeastern, central and western Kenya, northern and east-central Tanzania to southwestern Uganda, southwestern Rwanda and central Burundi. Further westwards from these areas exists a single record from Bokatola (DRC) located in *"Congolia"* — a phytochorical region and sub-centre of endemism *sensu* White (1978: 258) — as well as in the Congo Basin as defined by Underwood & Olson (2004: Fig 4.15) and to the East as well as to the South of the arc formed by the central Congo River. No record exists from the *"Sangha River Interval" sensu* White (1978: 261), from areas to the West of the Congo River, *e.g.* from the two phytochorical regions and sub-centres of endemism *"Lower Guinea"* and *"Upper Guinea" sensu* White (1978: 258) and as figured, *e.g.* by Poorter *et al.* (2004: Fig 1.2.).

Species of *Kayamuhakaia* occur in the Rwenzori Mountains and are known from Ibanda and Fort Portal (*cf.* Fletcher 1968: 329; in contrast with Fletcher's work is *K. nubifera* considered as Nairobi endemic species herein). The montane forests of the Rwenzori Mountains were once connected with forests near Lake Nkuruba (*cf. K. maasi* **sp. nov.**) and the Kibale Forest (Hamilton *et al.* 2001: Fig 4.1; Tom Butynski pers. comm. to I.L. in 2024). Species extend from the areas mentioned above southwards, *e.g.* via northeastern Zambia (*cf. K. mbalensis* **sp. nov.**), northwestern Mozambique (records will be found in the future) and eastwards via northwestern Malawi (*cf.* species from areas near Nkhata Bay/Mkuwadzi Hill) and southern Malawi (*cf.* species from Zomba township and Mount Mulanje) to the northern and central coast of Mozambique (records will be found in the future).

Kismayu (southern Somalia, altitude *ca.* 1 — 19 m) is currently the most northeastern distribution limit; coastal areas at Dar Salam (Tanzania, altitude *ca.* 2 — 127 m) are the most southeastern limit; Bokatola (DRC, altitude *ca.* 344 — 350 m) is currently the most northwestern limit; the Ruo River Gorge (altitude up to *ca.* 1.200 m) on the south side of Mount Mulanje (2.968 m at its highest elevation, southeast Malawi) represents the most southwestern limit.

Species of *Kayamuhakaia* have a distribution range on the African mainland that extends within the following phytochoria:

- The *"Guineo-Congolian regional centre of endemism" sensu* White (1983: 71, 73) with Bokatola.
- The "*Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184) in particular its northern part extending southwards to Mozambique Island and renamed as *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61, 62) — herein from Kismayu (Somalia) via Malindi and the Rabai Hills (Kenya, North Coast) southwards to the Shimba Hills and nearby coastal Kaya forests (Kenya, South Coast) to forest patches in Dar Salam at 2.0 m, up to *ca.*145 km inland from Dar Salam to Kimboza Forest Reserve and most probably further southwards up to the northern coast of Mozambique. Noteworthy, some localities in coastal southern Somalia and southeast Kenya abut *"The Somalia-Masai regional centre of endemism"* and have a transitional character, *e.g.* Kismayu just south of the Jubba River (Somalia) was once fringed by riverine lowland forests (Burgess *et al.* 2000) and Friis & Vollesen (1989: 467) defined only the Kismayu coast and inland behind the coastal dunes as "*Zanzibar-Inhambane regional mosaic"*.
- The *"S* [South] *Somalia Coastal Plain" sensu* Friis (1992: 11) — herein from Kismayu (southern Somalia) via Lag Badana-Bushbush National Park and/or the Baddana River near Buulo Xaaji (southeastern Somalia) including a *"transition between Zanzibar-Inhambane undifferentiated forest, the Zanzibar-Inhambane scrub forest and the Zanzibar-Inhambane evergreen and semi-evergreen bushland and thicket (southern Somalia)" sensu* Friis (1992: 27).

- The *"Swahilian/ Maputaland regional transition zone" sensu* Clarke (1998: 61, 62) including the southern part of the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184) from Mozambique Island southwards to the mouth of the Limpopo River with a record from a wet submontane area on the south side of Mount Mulanje (*cf.* White *et al.* 2001: 639; collecting Site close to the Ruo River at 962 m in southern Malawi).
- The *"Somalia-Masai regional centre of endemism" sensu* White (1983) with a record from an lowland area at Kivuli Camp (Tsavo Conservancy, southeast Kenya) but only *ca.* 14 km northeast of Mount Kasigau (1.568 m) that belongs to the *"northern Eastern Arc Mountains" sensu* Lovett (1998: 62) and hence, to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983). Collecting Sites in central Kenya, *e.g.* Nairobi at 1.895 m (Loresho Ridge and Ngong Forest), Nanyuki at 2.170 m and Naro Moru at 1.948 m abut all the *"Afromontane archipelago-like regional centre of endemism"* or include remnants of Afromontane forest patches, often at higher altitudes.
- The *"northern Eastern Arc Mountains"* and *"central Eastern Arc Mountains" sensu* Lovett (1998: 62), *e.g.* with a record from Yale Forest at 1.804 m in the Taita Hills (Kenya) and potential records from submontane areas to the East of Morogoro that abut the Uluguru Mountains (Tanzania) and include forest remnants of the Eastern Arc type above 1.200 m on the Uluguru Mountains. Certainly, species of *Kayamuhakaia* occur in the East Usambara Mountains.
- The *"Afromontane archipelago-like regional centre of endemism"* with records from scattered high elevations, *e.g.* the Karisia Hills in northwest-central Kenya with a record from 2.135 m, further westwards from Mount Elgon National Park with the highest record of any species of *Kayamuhakaia* at present from 3.200 m near the Kimothon River (Kenya); followed by Mount Kenya National Park, *e.g.* near Lake Rutundu at 3.018 m; in the Lolldaiga Hills at 2.255 m; in the Aberdare Range at 2.087 m and in the Elgeyo Hills at 2.437 m. More western records exist from high elevations in Nyungwe National Park (southwestern Rwanda), *e.g.* from Pindua at 2.412 m. In northern Tanzania species are known from Mount Kilimanjaro occurring up to 1.900 m and from Mount Meru at 2.510 m. In the Rwenzori Mountains the highest record is from an elevation of 1.524 m (*cf.* Fletcher 1968: 329), species of *Kayamuhakaia* occur certainly also on much higher elevations in the Rwenzori Mountains. Some of these montane habitats are linked to the East African Rift System (EARS) *sensu* McConnell (1972), *e.g.* in Nyungwe National Park ("Western Branch" of EARS/ Rwanda) and in Mount Elgon National Park ("Eastern Branch" of EARS/ Kenya).
- The *"Zambezian regional centre of endemism" sensu* White (1983) with records from Morogoro town at 550 m (at the foot of the Uluguru Mountains, Tanzania) as well as from Mbala at 1.681 m (northeastern Zambia), Mkuwadzi Hill at 692 m (near Nkhata Bay / northwestern Lake Malawi) and Zomba township at 969 m from near the southern end of Lake Malawi. The southern areas are located *ca.* 892 km (Mbala) and *ca.* 403 km (Zomba) inland from the Indian Ocean coastline, respectively.

- The *"Lake Victoria regional mosaic" sensu* White (1983) with a record from Kakamega Forest at 1.619 m (western Kenya) and Lolgorien at 1.773 m (located less than *ca.*16 km from the "*Afromontane archipelago-like regional centre of endemism"* in southwestern Kenya); from the shore of Lake Nkuruba near Kibale National Park at 1.526 m and *ca.* 25 km to the East of the Rwenzori Mountains (southwest Uganda, near the eastern edge of the "Western Branch" of the EARS), as well as from Gitega at 1.685 m (central Burundi).

Habitats. Species of *Kayamuhakaia* were recorded in or close to the following main vegetation types:

- *"Zanzibar-Inhambane evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 189) occurring close to the shoreline and on coastal dunes or behind coastal dunes along the Indian Ocean.
- *"Zanzibar-Inhambane scrub forest" sensu* White (1983: 188).
- *"Special South Somalian Bur Vegetation" sensu* Friis & Gilbert (1984: 330).
- *"Zanzibar-Inhambane transition woodland" sensu* White (1983: 188), *e.g.* with *Brachystegia spiciformis* Benth. or *Paramacrolobium coeruleum* J. Léonard (Caesalpinioideae) including the *"open woodland" sensu* Britton & Zimmerman (1979: 3) as well as *"Brachystegia forest" sensu* Githitho (2021: Fig 1).
- *"Zanzibar-Inhambane secondary grassland and wooded grassland" sensu* White (1983: 189) dominated by *Hyphaene compressa* H. Wendl., *H. coriacea* Gaertn. (Arecaceae), *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae) and *Dichrostachys cinerea* Wight & Arn. (Mimosoideae), *e.g.* for forest edge habitats of coastal forests between Mombasa and Buda Forest (Kenya). Included in this habitat is often a mosaic of cultivation with various tree species, *e.g. Cocos nucifera* L. (Arecaceae), *Anacardium occidentale* L. (Anacardiaceae) and tiny patches of the original forest vegetation in large grassy areas.
- *"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 197) including *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) dominated by caesalpiniaceous tree species, *e.g. Julbernardia magnistipulata* Troupin and *Scorodophloeus fischeri* J. Léonard on the Kenya coast. Included here is the *"Mixed forest type" sensu* Githitho (2021: Fig 1) and the *"lowland rain forest" sensu* Britton & Zimmerman (1979: 3) as well as all forests of the *"Usaramo floristic area" sensu* Hawthorne (1984: 97) in Tanzania including Riparian forests occurring along rivers near the coast of Tanzania, Kenya and Somalia, *e.g.* in regard to Somalia in the *"Zona a bosco" sensu* Senni (1935: 12, 13).
- *"Cynometra-Manilkara forest" sensu* Britton & Zimmerman (1979: 3) including *"Cynometra forest" sensu* Githitho (2021: Fig 1).
- *"Afzelia forest" sensu* Britton & Zimmerman (1979: 3).
- *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) and including *"Coastal Mist Forest" sensu* Gillman (1949: 12 + Fig 3) as well as *"[Eastern Arc] Lowland forest" sensu* Lovett (1993: 39) dominated, *e.g.* by *Aningeria pseudoracemosa* J.H. Hemsl. (Sapotaceae), *Antiaris toxicaria* Lesch.

(Moraceae), *Cynometra ulugurensis* Harms (Caesalpinioideae); including *"Lowland rain forest" sensu* White *et al.* (2001: 60) for Malawi, *e.g.* Nkhata Bay with possibly no surviving forest of this type, and on Mount Mulanje with only 200 ha surviving, *e.g.* along the Ruo River.

- *"Afromontane rain forest" sensu* White (1983: 164) dominated, *e.g.* by *Xymalos monospora* Baill. (Monimiaceae) and *Tabernaemontana stapfiana* Britten (Apocynaceae) as well as various conifers and including the *"Moist Montane Forest" sensu* Lambrechts *et al.* (2003: 9).
- *"Lower montane wet forest" sensu* Zhou *et al.* (2018) including *"Ocotetalia usambarensis" sensu* Bussmann & Beck (1995: 488) as well as *"Submontane and Secondary Bushland"* dominated by the *"Pennisetum clandestinum – Cyperus rigidifolius community" sensu* Schmitt (1991: 72; *cf.* Edwards & Bogdan 1951: 104, 105).
- *"Dry transitional montane forest" sensu* White (1983: 166) including the Chagga home gardens on Mount Kilimanjaro below 1.700 m comprising *Albizia schimperiana* Oliv., *A. petersiana* Oliv. (Mimosoideae) and hence, montane forest types that are dominated locally by woody Leguminosae (*cf.* Hemp 2006b, Lehmann *et al.* 2023: 101 + Fig 24d.). Also included here are riverine forests, riverine woodlands and riverine thickets of this vegetation type. The riverine habitats are only sometimes dominated by woody Leguminosae.
- *"Single-dominant Afromontane forest" sensu* White (1983: 165), *e.g.* with *"Hagenia abyssinica forest"* including *"Hagenietalia abyssinicae" sensu* Bussmann & Beck (1995: 524).
- *"Myrsino africanae – Juniperetum procerae ekebergietosum capensis" sensu* Bussmann & Beck (1995: 512).
- *"Undifferentiated Afromontane forest" sensu* White (1983: 165) including *"Hagenio abyssinicae – Juniperion procerae" sensu* Bussmann & Beck (1995: 526) as well as *"Evergreen seasonal submontane forest" sensu* Schmitt (1991: 83) with the "*Cassipourea malosana – Setaria plicatilis* agg.*community"* and montane forest *sensu* Fischer & Killmann (2008: 13) above 1.500 m with woody Leguminosae below 2.100 m and a hard-leafed cloud forest above 2.600 m up to 2.900 m. The *"[Eastern Arc] Upper montane forest"*[altitude > 1.800 m], *"[Eastern Arc] montane forest"* [altitude 1.200 — 1.800 m] as well as the *"[Eastern Arc] submontane forest"* [altitude 800 — 1.400 m] *sensu* Lovett (1993: 37, 39) with Guineo-Congolian affinities.
- *"Afromontane bamboo" sensu* White (1983: 167) comprising a bamboo forest *"Podocarpo latifolii – Sinarundinarietum alpinae caricetosum chlorosacci" sensu* Bussmann & Beck (1995: 520) as well as *"Montane forest at middle altitudes"* of 2.100 m up to 2.600 m *sensu* Fischer & Killmann (2008: 13, 15).
- Subalpine vegetation including the *"Ericaceous Belt" sensu* Hedberg (1951: 178, 182) as well as the *"Hagenia-Hypericum Zone"* or relict patches of it *sensu* Hedberg (1951: 174, 176), including patches of *"Upper montane forest" sensu* Hitimana *et al.* (2010: Table 1) at altitudes above 3.000 m.
- *"Transitional rain forest" sensu* White (1983: 186, 187) including *"Mid-altitude rain forest"* ("mid-altitude" range 900 — 1.600 m) *sensu* White *et al.* (2001:

63) with a mixture of Guineo-Congolian, Afromontane and endemic tree species, *e.g. ca.* 1800 ha on Mount Mulanje (Malawi).

- *"Dry peripheral semi-evergreen Guineo-Congolian transitional rain forest with Afromontane affinities" sensu* Fischer *et al.* (2010).
- *"Drier peripheral semi-evergreen Guineo-Congolian rain forest and similar forest in the transition zones" sensu* White (1983: 79, 172).
- *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) dominated by Caesalpinioideae and including wet evergreen levee forests on alluvial islands within rivers located at least in a *"small scale* [fluvial lowland forest] *refuge area" sensu* Leal (2001: 1073, 1077) to the South of the arc formed by the Congo River as well as to the East of the *"Sangha River Interval" sensu* White (1978: 261) and as figured by Rietkerk *et al.* (1996: 619 + Fig 1).
- *"Zambezian dry evergreen forest" sensu* White (1983: 89, 90) including dry forests with a markedly Guineo-Congolian affinity.
- *"Zambezian woodland" sensu* White (1983: 92, 93) including *"Zambezian miombo woodland"* of "wetter and drier types" *sensu* Chidumayo (1997: 8, 9) dominated by woody Leguminosae, in particular Caesalpinioideae.
- *"Zambezian transition woodland" sensu* White (1983: 91, 92) with Guineo-Congolian linking tree species and an appearance of a reversion to forest.
- *"Zambezian swamp forest and riparian forest" sensu* White (1983: 91) with Afromontane linking tree species as well as Guineo-Congolian linking tree species.
- *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115).
- *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113) dominated by tree species of *Acacia* Mill. (Mimosoideae), *e.g. A. nilotica* (L.) Willd., *A. bussei* Harms, *A. etbaica* Schweinf., *A. mellifera* Bosc and shrub species of *Grewia* L. (Malvaceae), *e.g. G. tephrodermis* K. Schum., *G. plagiophylla* K. Schum. On not yet degraded habitats tress of *Commiphora* Jacq. (Burseraceae) occur (*cf.* White 1983: 114), *e.g.C. baluensis* Engl. and *C. kataf* Engl. (synonym: *C. holtziana* Engl.).
- *"Somalia-Masai secondary grassland and wooded grassland" sensu* White (1983: 114) dominated by, *e.g.* species of *Acacia* Mill. (Mimosoideae) and *Commiphora* Jacq. (Burseraceae).

The habitats mentioned above are located in <u>or</u> near a range of climate types, *e.g.* Afroalpine climate (usually above 3.500 m where night frosts occur regularly *cf.* Hedberg 1964); Equatorial mountain climate; Warm temperate climate; Subtropical humid climate; Tropical wet and dry climate, *e.g.* Tropical rainforest climate, Tropical monsoon climate, Monsoon-influenced humid tropical climate, Tropical savanna climate.

The average annual rainfall in the habitats varies:

from at least 366 — 700 mm at Kismayu and the *"South Somalia Coastal Plain"* (Friis 1992: 42)/ Somalia; 600 — 1000 mm in Arabuko-Sokoke Forest (Britton & Zimmerman 1979: 3) and 1129 mm in Kaya Muhaka (Lehmann & Kioko 2005: 124); 762 — 1168 mm in the northeastern areas of Mount Kenya and 2146 mm in its southern areas (*cf.* Baker 1967: 6)/Kenya; 1475 mm in the Kibale National Park (Struhsaker 1997: 16) with increasing rainfall of up to 300 mm per year due to climate change and based until present on one of the very few long-term studies in Africa with two data sets (1970 — 1983, 1990 — 2002) on the fruiting phenology of common tree species by Chapman *et al.* (2005)/ Uganda; *ca.* 1300 mm at Mzuzu (Raymond James Murphy pers. comm. to I.L. in 2011); 1780 mm on Mkuwadzi Hill (Chapman & White 1970: 178)/ Malawi; 2000 mm in the central Congo Basin (Blom & Schipper 2004: 243); 2425 mm on Lujeri Tea Estate (Chapman & White 1970: 163)/Malawi, with the highest average rainfall of 1800 — 2500 mm from Nyungwe National Park (Ghehi *et al.* 2014)/ Rwanda.

Biological traits. The biology of species of *Kayamuhakaia* is unknown.

However, as several drops of resin on the abdomen of various species indicate, feed the larvae most probably on bark and/or in wood and pupation takes place in the latter. In combination with the habitat data of those specimens, bark and/or wood of the following tree species are potential food plants of the larvae:

- *Acacia tortilis* Hayne (Mimosoideae);
- Species of *Brachystegia* Benth., *e.g. B. bussei* Harms (Caesalpinioideae);
- *Cassipourea malosana* Alston (Rhizophoraceae);
- *Combretum hereroense* Schinz (Combretaceae);
- *Cordia somaliensis* Baker (Boraginaceae);
- *Croton megalocarpus* Hutch. (Euphorbiaceae);
- *Funtumia africana* Stapf (Apocynaceae);
- *Julbernardia magnistipulata* Troupin (Caesalpinioideae);
- *Kuloa usambarensis* Trofimov & Rohwer (synonym: *Ocotea usambarensis* Engl./ Lauraceae).

Etymology. The genus is named for the type locality of the type species, namely for Kaya Muhaka (4°19' — 4°20' S and 39°30' — 39°31' E; altitude 32 — 63 m) representing an isolated coastal lowland forest *ca.* 150 ha in size, located near Muhaka village, 32 km south of Mombasa (Kenya South Coast, Kwale County) and 5.5 km inland from the Indian Ocean.

This is a *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) and not only one of the postulated microrefugia presented herein but also one of Kenya's 121 *"Key Biodiversity Areas (KBAs)"* (UNDP 2021: 19, 20, 23).

According to the global standard for the identification of a *KBA* (IUCN 2016: 4), Kaya Muhaka is a *"… specific site …"* that *"… contributes significantly …"* to the *"… global persistence … of biodiversity …"*

Up to now Kaya Muhaka has preserved at least 127 endemic plant and Lepidoptera species (Lehmann & Kioko 2005: 140, Table 13) as well as at least 139 butterfly species (without larger moths!), based on a first as well as long-term study of the Lepidoptera diversity and endemism, floristic composition, endemic plant species as well as forest structure by Lehmann & Kioko (1994, 1998, 2000, 2003, 2005: 133, 135, 147 — 156; Lehmann unpubl. data of 2005, 2006, 2007; *cf.* also Lehmann 2020; Fungomeli *et al.* 2020: Table 2).

The sacred Kaya Muhaka is under the leadership of a Committee of Elders which is able to protect and conserve cultural as well as natural values in a symbiotic relationship. Additionally, *ca.* 70% of the forest have been leased from the County Council by the International Centre for Insect Physiology and Ecology (ICIPE, Nairobi) at least since the mid 1980s which helps to protect the Kaya. Noteworthy, Dale (1939: 17) mentioned that “Muhaka Forest” belongs to an area which does not appear to have ever been cultivated.

There are a variety of words and interpretations that are associated with the word “Kaya”, *e.g.* “... they do not normally appear as place names ...“(Walsh 1987: 22) but in the context of the power of old men (Willis 1993: 42; Lehmann & Kioko 2005: 122). More recently, the most common words were those that referred to culture (15% of responses) and the second most common words associated with the “Kayas” were in reference to them being sacred places (Shepheard-Walwyn 2014: 181, 223, 224).

Key to the species of *Kayamuhakaia*

The key is based primarily on characters of the head, legs and genitalia; hence, it cannot serve as a field identification key. For the majority of species, only a few specimens are available, so identifications obtained from this key should be cross-checked carefully with the description, distribution, and figures presented in this publication. The males of *Kayamuhakaia aberdarensis* **sp. nov.**, *K. barrychappelli* **sp. nov.**, *K. bokatolaensis* **sp. nov.**, *K. finchhattoni* **sp. nov.**, *K. gitegaensis* **sp. nov.**, *K. hermannstaudei* **sp. nov.**, *K. juliusmathiui* **sp. nov.**, *K. karenae* **sp. nov.**, *K. kilimanjaroensis* **sp. nov.**, *K. killmannae* **sp. nov.**, *K. kismayuensis* **sp. nov.**, *K.lolgoriensis* **sp. nov.**, *K. maasi* **sp. nov.**, *K. mbalensis* **sp. nov.**, *K. mountkenyaensis* **sp. nov.**, *K. nancycammae* **sp. nov.**, *K. nanyukiensis* **sp. nov.**, *K. neemambeyuae* **sp. nov.**, *K. philipokwaroi* **sp. nov.**, *K. rupimangatae* **sp. nov.**, *K. stephanierobertsae* **sp. nov.**, *K. tombutynskii* **sp. nov.** and *K. yiruchengae* **sp. nov.** are unknown.

1 Male 2

\- Female 13

2(1) Antennae very long, 0.60 or more length of forewing 3

\- Antennae not very long 4

3(2) .... *K. vau-alba*

4(2) Hindtibia with one pair of spurs .... *K. triangularis*

\- Not as above 5

5(2, 4) Hindtibia with two pairs of spurs 6

6(2, 4) Epiphysis rudimentary, less than 0.5 mm in length.......................... 7

\- Epiphysis not rudimentary 8

7(6) Antennae long, 0.44 to 0.59 length of forewing .... *K. wellsi* sp. nov.

\- Antennae very short, 0.33 or less length of forewing................................ .... *K. yvonnedejongae* sp. nov.

8(6) Tips of uncus are acuminate.. 9

\- Tips of uncus are mucronate 10

\- Tips of uncus are rectangular 11

9(8) Distal margin of valva slightly S-shaped and longer than ventral margin of valva.. .*K. kimbozensis* sp. nov.

\- Distal margin of valva strongly S-shaped and longer than ventral margin of valva...*K. petermuriithii* sp. nov.

\- Distal margin of valva C-shaped and shorter than ventral margin of valva ....*K. fontainei* sp. nov.

\- Distal margin of valva slightly C-shaped and as long as ventral margin or longer than ventral margin
....12

10(8) Distal margin of valva slightly S-shaped and longer than ventral margin of valva.. *K. aarviki* sp. nov.

\- Distal margin of valva strongly S-shaped and longer than ventral margin of valva.. *K. hilarysommerlatteae* sp. nov.

- Distal margin of valva slightly C-shaped and shorter than ventral margin of valva .... *K. haberlandorum*

- Distal margin of valva strongly C-shaped and as long as ventral margin of valva .... *K. nubifera*

11(8) Uncus with deep emargination with 25 to 40% of uncus length.............. .... *K. ngwenoae* sp. nov.

12(8, 9) Uncus with no deep emargination with 20% or less of uncus length, emargination also not wide with 25% or less than basal width of uncus

.... *K. huchtemanni* sp. nov.

- Uncus with no deep emargination with 20% or less of uncus length, but emargination is wide with 40% of basal width of uncus

.... *K. kasikamwiuae* sp. nov.

- Uncus with deep emargination with 25% or more of uncus length, emargination is very wide with 45% or more of basal width of uncus

.... *K. mkuwadziensis* sp. nov.

- **End of male IDkey** - Go to 13

13(1) Antennae very long, 0.45 or more length of forewing 14

- Antennae not very long and not very short..18

- Antennae very short, 0.33 or less length of forewing............................23

- Antennae unknown...28

14(13) Segment 8 broadly rectangular...15

- Segment 8 rectangular...16

- Segment 8 narrowly rectangular...17

15(13, 14) Ductus bursae very short, 40% shorter than posterior apophysis......... .... *K. stephanierobertsae* sp. nov.

- Ductus bursae short with 30% shorter than posterior apophysis......... .... *K. wellsi* sp. nov.

- Ductus bursae long, 50% longer than posterior apophysis…………………… ……………………………………………………………… .*K. aberdarensis* sp. nov.

16(13, 14) Ductus bursae as long as posterior apophysis and corpus bursae small oval with 70% the size of segment 8……………………………………………… …………………………………………………………………*K. tombutynskii* sp. nov.

- Ductus bursae 10% longer than posterior apophysis, corpus bursae pear-shaped with 90% the size of segment 8………………*K. finchhattoni* sp. nov.

17(13, 14) Corpus bursae very large, 50% larger than segment 8 in lateral view and elongated oval, ductus bursae short, 25% shorter than length of posterior apophysis… ………………………………………………………………*K. nubifera*

- Corpus bursae large, 20% larger than segment 8 in lateral view and broadly rounded, ductus bursae long, 30% longer than length of posterior apophysis. ………………………………………………………*K. fontainei* sp. nov.

- Corpus bursae 90% size of segment 8 and almost rectangular ………………………………………………………………*K. gitegaensis* sp. nov.

- Corpus bursae large, 20% larger than segment 8 in lateral view and broadly rounded, ductus bursae short, 10% shorter than length of posterior apophysis……………………………………*K. barrychappelli* sp. nov.

18(13) Segment 8 broadly rectangular………………………………………… ……..19

- Segment 8 narrowly triangular…………………………………………………..20

- Segment 8 narrowly rectangular, three labial palpi ………………………………………………………………………………………21

- Segment 8 narrowly rectangular, two labial palpi ………………………………………………………………………………………22

19(13, 18) Ductus bursae long, 20% longer than posterior apophysis, corpus bursae small oval, 80% size of segment 8 in lateral view…. ……………………………………………………………*K. kismayuensis* sp. nov.

20(13, 18) Anterior apophyses as long as dorsal width of segment 8, posterior apophyses very long, 40% longer than anterior apophyses …………………… ……………………………………………… …………*K. mountkenyaensis* sp. nov.

- Anterior apophyses very long, 30% longer than dorsal width of segment 8, posterior apophyses very long, 50% longer than anterior apophyses……… ……………………………………………………………*K. nancycammae* sp. nov.

21(13, 18) Ductus bursae very short, 50% shorter than length of posterior apophysis, corpus bursae elongated oval, 10% smaller as segment 8 in lateral view……………………………………………*K. rupimangatae* sp. nov.

- Not as above……………………………………………………………………21b

21b………..Ductus bursae very short, 30% shorter than length of posterior apophysis, corpus bursae rounded, very large, 2.5× as large as segment 8 in lateral view………………………………………*K. kilimanjaroensis* sp. nov.

- Not as above……………………………………………………………………21c

21c………..Ductus bursae as long as posterior apophysis, corpus bursae elongated oval, very large with 2.5× as large as segment 8 in lateral view, anterior apophyses very long, 50% longer than dorsal width of segment 8, length of posterior apophyses 30% longer than anterior apophyses……… ………………………………………………………………………*K. maasi* sp. nov.

- Not as above……………………………………………………………………21d

21d………….Ductus bursae as long as posterior apophysis, corpus bursae pear-shaped, very large with 2.0× as large as segment 8 in lateral view, anterior apophyses long, 30% longer than dorsal width of segment 8, length of posterior apophyses twice as long as anterior apophyses……… ………………………………………………………………………*K. haberlandorum*

- Not as above……………………………………………………………………21e

21e………….Ductus bursae as long as posterior apophysis, corpus bursae oval, very large with 2.0× as large as segment 8 in lateral view, anterior apophyses long, 40% longer than dorsal width of segment 8, length of posterior apophyses 20% longer than anterior apophyses…………………… ……………………………………………………………*K. neemambeyuae* sp. nov.

- Not as above……………………………………………………………………21f

21f………….Ductus bursae very long, 30% longer as posterior apophysis, corpus bursae rounded, 20% larger as segment 8 in lateral view, anterior apophyses very long, 70% longer than dorsal width of segment 8, length of posterior apophyses twice as long as anterior apophyses……………………… ……………………………………………………………*K. nanyukiensis* sp. nov.

22(13, 18) Anterior apophyses very long, 75% longer than dorsal width of segment 8, length of posterior apophysis very long, 60% longer than anterior apophysis, corpus bursae rounded, 40% larger than segment 8 in lateral view, ductus bursae very long, as long as posterior apophyses………………. …………………………………………………… ………..*K. bokatolaensis* sp. nov.

\- Not as above……………………………………………………………………….22b

22b……………Anterior apophyses very long, 50% longer as dorsal width of segment 8, posterior apophysis 60% longer than anterior apophysis, corpus bursae rounded, small with 50% size of segment 8 in lateral view, ductus bursae short, 30% shorter as posterior apophyses ……………………

…………………………………………………………………….*K. lolgoriensis* sp. nov.

23(13) Segment 8 broadly rectangular………………………………………………… 24

\- Segment 8 narrowly triangular, three labial palpi……………………………25

\- Segment 8 narrowly rectangular, two labial palpi……………………………26

\- Segment 8 narrowly rectangular, three labial palpi…………………………..27

24(13, 23) Anterior apophyses 15% longer than dorsal width of segment 8, length of posterior apophysis very long with 2.3× as long as anterior apophysis, corpus bursae almost rectangular, 50% larger than segment 8 in lateral view, ductus bursae long, 40% longer than posterior apophyses …………………………………………………………..*K. juliusmathiui* sp. nov.

25(13, 23) Anterior apophyses 70% longer than dorsal width of segment 8, length of posterior apophysis 2.1× as long as anterior apophyses …………………………………………………………………*K. karenae* sp. nov.

\- Not as above……………………………………………………………………….25b

25b………….Anterior apophyses S-shaped, as long as dorsal width of segment 8, posterior apophyses 3.0× as long as anterior apophyses ….

……………………………………………………………………*K. killmannae* sp. nov.

26(13, 23) Anterior apophyses 75% longer than dorsal width of segment 8, length of posterior apophysis very long with 2.0× as long as anterior apophysis, corpus bursae broadly oval, 50% larger than segment 8 in lateral view, ductus bursae as long as posterior apophyses

……………………………………………………………*K. hermannstaudei* sp. nov.

27(13, 23) Anterior apophyses 70% longer than dorsal width of segment 8, length of posterior apophysis very long with 2.0× as long as anterior apophysis, corpus bursae pear-shaped, small, 20% smaller than segment 8 in lateral view, ductus bursae almost as long as posterior apophyses

……………………………………………………………………*K. yiruchengae* sp. nov.

- Not as above……………………………………………………………………………27b

27b…………Anterior apophyses 50% longer than dorsal width of segment 8, posterior apophyses 2.0× as long as anterior apophyses, corpus bursae elongated oval, very large with 3.5× as large as segment 8 in lateral view, ductus bursae as long as posterior apophyses……… *K. mbalensis* sp. nov.

28(13) Segment 8 narrowly rectangular, anterior apophyses 70% longer than dorsal width of segment 8, posterior apophysis 2.1× as long as anterior apophysis, corpus bursae broadly oval, 70% larger than segment 8 in lateral view, ductus bursae almost as long as posterior apophyses

……………………………………………………………………*K. philipokwaroi* sp. nov.

- **End of key**

Kayamuhakaia haberlandorum (Lehmann, 1997) **comb. nov.**

Figs 2.a., 2.b., 2.c., 2.d., 2.e., 13.a., 13.b., 13.c., 28.a., 28.b., 31.a., 31.b., 31.c., 31.d., 31.e.; Lehmann (1997: Figs 1+2); Lehmann & Kioko (2000: Appendix III); one male incorrectly determined as "*Metarbela latifasciata* Gaede" in Lehmann & Kioko (2005: Appendix 3) representing instead also *K. haberlandorum*; Fig 3 in Lehmann (2020: 60) collected at Tiwi (Kenya, South Coast).

Type locality and repository: Kenya, the Natural History Museum, London, UK (NHMUK formerly BMNH).

Original combination: "*Metarbela haberlandorum* sp. nov." Lehmann, I.: *Nachrichten entomologischer Verein Apollo*, Vol. 18(1), 1997, Pp. 45 — 53: "Holotype 1 ♂ [deposited in BMNH]: Kenya — Coast, Kwale District [Kwale County], Kaya Muhaka [4°19'34"S 39°31'25"E], 45 m a.s.l., 16.II.1994, leg. I. Lehmann, genitalia slide no. 116496 L. Kobes [the late Professor Dr. Lutz Kobes, Göttingen].

Paratypes: 1 ♂, Kenya — Coast, Kilifi District [Kenya, North Coast, Kilifi County], Malindi, no date, leg. T.H.E. [Thomas Herbert Elliot] Jackson, BM 1935 — 203 (BMNH genitalia slide no. 38). 1 ♂ [deposited in NMK]: Kenya — Coast, Kwale District [Kwale County], Kaya Muhaka, 45 m a.s.l., 21.I.1996, leg. I. Lehmann."

Note: The collecting Site of holotype and paratype is the northwestern forest edge and near "*Drypetes* Site" located in Kaya Muhaka (*cf.* Fig 31.a.).

Additional material examined. Male, "Kenya [North Coast], Arabuko-Sokoke Forest [forest interior], 6 km W [West of] Gede 03°17'S 39°59'E, 70 m [correct are 40 m, in "lowland rain forest" *sensu* Britton & Zimmerman 1979], 27/03/2004, J. & W. De Prins leg. [Dr. Jurate De Prins & Willy De Prins]", genitalia slide number 13/022020 I. Lehmann (RMCA); "Kenya, [North Coast, Kilifi County], Watamu 10-III-1989 [10th March 1989], a.l. [= at light], R. Schouten leg. 108 [108?]", genitalia slide number 24/022020 I. Lehmann (originally from ZMA, now RMNH); same locality, date and collector, genitalia slide number 06/032020 I. Lehmann (originally from ZMA, now RMNH); male, "Kenya, [South] Coast, [Kwale County], Kaya Muhaka, [northwestern] forest edge near "*Drypetes* Site", 25/03/2002, Ingo Lehmann & Saidi Chidzinga leg.", genitalia slide number 15/052017 I. Lehmann (NMK; Figs 2.a. + 13.a. herein); male, same locality and date, genitalia slide number 05/022020 I. Lehmann (in private collection of I.L.); male, same locality and date, no genitalia dissection done (in private collection of I.L.); male, "Kenya, [South] Coast, [Kwale County], Gogoni Forest Reserve, forest interior near Site 1 [4°24'34"S 39°27'52"E with no further record, *e.g.* at forest edge 4°24'33"S 39°28'24"E], 27/01/2006, Ingo Lehmann, Saidi Chidzinga & Matano Abdulrahman leg.", no genitalia dissection done (in private collection of I.L.); male, "Kenya, [South Coast, Kwale County], Shimba Hills, Campsite [Site unknown since there are various potential campsites, *e.g.* 4°11'57"S 39°26'39"E ?], forest, [elevation] 350 m, 07/03/1989, at light, R. Schouten 99 [99?] leg.", genitalia slide number 10/032020 I. Lehmann (MWM); male, "Diani Mombasa [Kenya, South Coast, Kwale County, Diani: 4°18’56”S 39°34’01”E], Oct – Nov. 1951 [October — November], E. [Elliot] Pinhey [leg.]”, on second label: “Brit. Mus. [British Museum] 1953–293”, genitalia slide number 101999 Ingo Lehmann (BMNH); male, “Kenya Colony, Tiwi Mombasa [Kenya, South Coast, Kwale County, Tiwi: 4°15’20”S 39°35’52”E/probably not collected in Kaya Tiwi / see text below], April 1964, R. [Robert Herbert] Carcasson leg.”, genitalia slide number 01/012020 I. Lehmann (NMK), *cf.* Fig 3 in Lehmann (2020: 60); “Kenya, Südküste [= South Coast, Kwale County], Buda Forest [4°27’09”S 39°23’42”E], 13. — 17.4.1995, Dr. Politzar leg.”, genitalia slide number 31/122019 I. Lehmann (MWM); male, “Kenya Colony, Gazi Forest [Kenya, South Coast, Kwale County, Gasi Forest, Gasi: 4°24’59”S 39°30’20”E; the spelling of “Gasi” herein is based on Hollis 1901: 276; Willis 1993: 64], April 1964, R.H. [Robert Herbert] Carcasson leg.”, genitalia slide number 08/112020 I. Lehmann (NMK); male, first label: “van Someren [= V.G.L./Victor Gurney Logan], Rabai [3°56’06”S 39°35’41”E Kenya, North Coast, Kilifi County / probably one of the Rabai Kayas, see “Note” below], Nov. [November] 1933”, on second label: “van Someren collection 1959—468”, on third label: “BMNH drawer 18104”, genitalia slide number 26/032017 I. Lehmann (BMNH).

Female, first label: “van Someren [V.G.L.], Rabai [3°56’06”S 39°35’41”E Kenya, North Coast, Kilifi County], Nov. [November] 1933”, on second label: “van Someren collection 1959—468”, on third label: “BMNH drawer 18104”, genitalia slide number 28/032017 I. Lehmann (BMNH).

Note: Attached to the female was [now in coll. of I.L.] a very worn small piece of newspaper of Wednesday, June 28, 1933 with a worn handwriting — possibly written by van Someren — with a pencil as follows: “November 13-II-33 RABAI EMET ... [?] ... MKWADU ... MDINAMUGI... [?]”.

Willis (1996: 94) stated that one of the Rabai Kayas existed with the name “Mbwadu” and that this information was given to Ann Robertson in 1987. Willis neither found another written reference nor any proof that this Kaya indeed existed. Nevertheless, it is possible that the word “MKWADU” as written by van Someren is the name of the collecting Site as well as indeed a proof that one of the Rabai Kayas was named “Mbwadu” or “Mkwadu” and that this Kaya still existed in 1933. If this assumption of I.L. is correct than the piece of newspaper once fixed to *K.haberlandorum* is not only a proof that this Kaya once existed but also confirms that the informant of Ann Robertson was correct. Most probably this Kaya habitat does no longer exist.

Selection of type species. The species *K. haberlandorum* has been selected as type species of the new genus *Kayamuhakaia.* The reason is the comprehensive knowledge that is present on the floristic composition, forest structure, Lepidoptera diversity as well as plant and Lepidoptera endemism of Kaya Muhaka based on long-term field studies by I.L. in collaboration with the NMK (Dr. Esther Kioko / E.K. herein) and the Coastal Forest Conservation Unit (CFCU, Ukunda, *e.g.* Saidi Ali Chidzinga, Matano Abdulrahman) over a period of 14 years (1994 — 2007), with additional field studies in four coastal forests that are located from Kaya Muhaka in a distance between 6 — 20 km with a distance of the nearest forest edge to the Indian Ocean of *ca.* 100 m — 5.5 km (*cf.* Table 1), namely: to the Northeast (Kaya

Diani — no record of any species of *Kayamuhakaia* **gen. nov.**), to the Southwest (Gogoni Forest Reserve with one record) and to the Southeast (Kaya Kinondo and Shimoni Forest — no record of any species of *Kayamuhakaia* **gen. nov.**). These lowland forests (*cf.* Fungomeli *et al.* 2020; Ngumbau *et al.* 2020) are discussed in context with the habitats of other lowland species of *Kayamuhakaia* **gen. nov.** (*cf.* Table 1 + 2) and include additional first published data herein (*cf.* Lehmann & Kioko 2005; Lehmann 2020; Lehmann unpubl. data collected in 1989 in Malindi; in Diani Forest adjacent to *NOMAD* in 1998; in Gogoni Forest Reserve and Shimoni Forest in 2001 — 2007; in Kaya Muhaka, Kaya Kinondo, Kaya Diani, Ukunda and Diani villages in 2005 — 2007).

Re-Description, male. *Head*: rough-scaled, with dense, short hair-like scales of Isabella colour or ecru-olive, with a light golden glint between and around compound eyes; eyes black or buffy olive without spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small, narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.37 — 0.41 length of forewing (0.41 in holotype), bipectinate, with branches of 3.0× — 3.5× width of shaft, branches scaled laterally with scales of Isabella colour, branches at base widely separated with 1.2× width of branch, shaft densely scaled Isabella colour dorsally with a light golden glint; labial palpi Isabella colour or buffy olive with a light golden glint, half of eye-diameter in length, three-segmented, with segment on top egg-shaped, small with 20 — 25% as long as central segment, with central segment oval and 1.1× as long as basal segment or of equal length with basal segment, the latter is 1.2× broader than central segment and rectangular.

Thorax: Patagia with Isabella colour or buffy olive with a golden glint, not forming any collar ring; tegulae with longer hair-like scales of Isabella colour with a golden glint, some scales with pale olive tips. Metathorax with long hair-like scales of Isabella colour or buffy olive mixed with cream scales forming a pronounced scale-crest. Forelegs with epiphyses present, narrow, tube-like, 1.3 — 1.5 mm long. Hindlegs with fine hair-like scales of cream and Isabella colour with a light golden glint; two pairs of tibial spurs are *ca.* 1.1 mm / 1.0 mm (upper pair) and 0.7 mm / 0.9 mm (lower pair) in length; lower pair with slightly broader spurs. Forewing length ("Fwl") is 10.5 — 12.0 mm; wingspan 23.5 — 27.0 mm/25.0 mm in holotype.

Note: In Lehmann (1997: 48) occurred a misprint since 25.0 mm do not refer to the forewing length ("Fwl") but to the wingspan of the species *haberlandorum*.

Forewing (*cf.* Figs 2.a., 2.b., 2.e., 28.a.) elongated and visibly longer than hindwing, upper-side largely cream-buff or buffy olive with a light golden glint; termen and costa narrowly cream-buff, termen with triangular-shaped lunules of buffy olive, costa with small striae of sepia; a pronounced broad patch of Isabella colour from CuA_2 to near base of R_5, sometimes extending to near costa; lower median and upper part of CuA_2 narrowly white or ivory yellow, other veins not distinctly coloured; below lower median and CuA_2 between one and four small black patches, more or less rectangular-shaped; from near lower end of CuA_2 to near apex a medium broad cream-buff or buffy olive band that is edged on both sides dark olive or sepia; cilia long, 0.9 — 1.0 mm, cream-buff with a sepia tip, the sepia colour is more or less pronounced. Underside of forewing buffy olive with a light golden glint and mixed with scales of Saccardo's umber.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream-buff with a light golden glint mixed with hair-like scales of ivory-yellow; abdominal tuft with long scales of cream-buff, scales decorative with a long hair-like base and a medium broad tip, tuft long with 30 — 35% length of abdomen. Genitalia (Figs 13.a., 13.b.) with tegumen *ca.* 0.3 — 0.4× basal width of vinculum; saccus broad and long, *ca.* 0.7 — 0.9× length of ventral width of valva; uncus narrow and elongated with 15% longer than its basal width and basal part 25 — 30% broader than upper part of uncus, bifid at tip with tips usually mucronate, rarely pointed (*cf.* genitalia slide numbers 26/032017 and 31/122019). Uncus with a small and not deep lunule-like shape of the emargination between tips that is only 10 — 20% as deep as uncus length; uncus with two or three small holes dorsally. The thinly sclerotized juxta is rectangular with a very narrow sclerotized dorsal edge and as large as 30% of the saccus. The valva is large, *ca.* 5.0× larger than saccus, rectangular-shaped, horizontal costal margin is oblique near the base of the semi-transtilla and rounded distally with some long setae, semi-transtilla as large as 60% of juxta, with some long sclerotized setae; distal edge of valva 15% shorter than ventral edge (including in the latter the length of the lunule-like extension of valva ventral distally) and only slightly C-shaped; ventral edge with few short setae and a dominant lunule-like appendice distally; 25 — 30% of valva thinly membranous dorsally with a short lunule-like sclerotized oblique structure with few setae near the central basal part of valva — this structure is *ca.* 0.9 — 1.2× as long as length of horizontal base of semi-transtilla; lower two-thirds of inner valva strongly sclerotized. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long and narrow, 2.0 — 2.3× length of saccus and without any structures.

Description, female (Figs 2.d., 13.c., 28.b.). *Head*: rough-scaled, with dense hair-like scales of ecru-olive and Isabella colour towards scale tips mixed with scales of pale olive-buff between and around compound eyes; eyes buffy olive; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are narrow tiny slits; a horizontal ridge is rudimentary on lower fronto-clypeus; antennae 0.36 length of forewing with branches 0.3× width of shaft on lower 25% of antenna and up to 1.2× width of shaft towards tip, branches are not widely separated at base, scaled cream-buff laterally, shaft densely scaled cream-buff dorsally; labial palpi half of eye-diameter in length, ecru-olive, three-segmented with basal segment as long as 2nd segment, narrowly rectangular, 2nd segment narrowly oval, segment on tip small, 10% length of 2nd segment and triangular.

Thorax: Patagia with scales of ecru-olive and Isabella colour towards scale tips forming no collar ring; tegulae with same cloured scales. Metathorax has longer hair-like scales of cream forming a little pronounced scale-crest. Hindlegs with fine hair-like scales of cream with ecru-olive towards tip; two pairs of tibial spurs, upper pair 1.0 mm / 0.9 mm, lower pair 1.0 mm / 0.8 mm long. Forewing length 11.0 mm and wingspan 23.5 mm. Forewing faded, upperside cream-buff and cream with a light golden glint, costa cream-buff; forewing with an elongated rectangular patch of Isabella colour extending from CuA_2 to R_5; CuA_2 is narrowly marked ivory-yellow (in fresh females a reduced ivory-yellow "Y" in horizontal position is possibly present?); a narrow sub-terminal line occurs from near apex to the end of CuA_2 and is broadly edged ecru-olive; termen with triangular striae of ecru-olive; veins not distinctly coloured; cilia long, 1.0 mm, cream-buff. Underside of forewing is ecru-olive with a light golden glint.

Hindwing upperside is ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream mixed with ecru-olive hair-like scales; abdominal tuft short, tuft 20% length of abdomen, ecru-olive. Postabdominal structure and genitalia (Fig 13.c.) have papillae anales with short setae and small lobes, one lobe 50% length of narrow dorsal width of segment 8 (viewed laterally) and with one lobe as large as only 9% of the papillae anales (viewed ventrally). Segment 8 is narrow rectangular, thinly sclerotized; base of one anterior apophysis is 0.9× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is 0.3× longer than the dorsal width of segment 8 and without a broader end; the posterior apophyses are very long, twice as long as anterior apophyses, with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 40% of the whole length of posterior apophysis. The ductus bursae is long, as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a triangular-shaped membranous structure that is 2.0× as large as the broad basal part of the anterior apophyses; corpus bursae is thinly membranous, without any structures, pear-shaped with a rounded end, and if not pressed 2.0× as large as segment 8.

Diagnosis. *Kayamuhakaia haberlandorum* can be separated from all other congeners by the following character combination: First, antennae are medium long. Second, a narrowly elongated areole in the forewing of both sexes is present and as large as up to 50% (in males) and as long as 60% (in female) of upper discal cell. Third, a narrow elongated uncus is 15% longer than its basal width and only up to 25% broader than upper part of uncus with a small emargination between mucronate uncus tips. Fourth, the distal edge of valva is 15% shorter than its ventral edge and only slightly C-shaped (*cf.* differences in the diagnosis of *K. ngwenoae* **sp. nov.** and *K. yvonnedejongae* **sp. nov.**).

Note to the males: The genitalia preparations are slightly variable if pressed below glass, *e.g.* two males, namely from the Rabai Kayas (*cf.* Figs 13.a. with 13.b.) and Buda Forest (not figured), have pointed uncus tips. No further differences have been found if compared to the remaining genitalia of males presented herein and hence, both males have been included in the species *K. haberlandorum.* If more males will be collected in the future from various localities as mentioned above, *e.g.* from the Rabai Kayas and Buda Forest in particular, additional studies on this species might confirm the present decision of I.L. or might indicate that at least two other undescribed species are involved (*cf.* Table 2 herein).

The female from one of the Rabai Kayas is at present among the smallest females of *Kayamuhakaia*. Its genitalia has a long ductus bursae that is as long as one posterior apophysis in combination with a large pear-shaped corpus bursae that is 2.0× as large as segment 8 in lateral view.

At present, the closest related species from the morphological point of view is the female of *K.neemambeyuae* **sp. nov.**

Distribution. *Kayamuhakaia haberlandorum* is only known from scattered coastal lowland forest patches occurring along the Kenyan coastline from Malindi, Arabuko-Sokoke Forest and Watamu in the North, further southwards to the Rabai Kayas — located *ca.* 23 km further inland from Mombasa. To the South of Mombasa or along the “Kenya South Coast” respectively, this species occurs near Tiwi village (and Kaya Tiwi?), in Diani or nearby (collecting Site unknown), in Kaya Muhaka, in Gogoni Forest, near Gasi (the spelling of “Gasi” herein is based on Hollis 1901: 276 and Willis 1993: 64), in Buda Forest and *ca.* 25 km further inland from the coast in the Shimba Hills forests (*cf.* Table 1 with Table 2). All collecting Sites are located in the *“Zanzibar-Inhambane regional mosaic” sensu* White (1983: 184, 185) and *“Swahilian regional centre of endemism” sensu* Clarke (1998: 62).

Additionally, the coastal forests — including all habitats of *K. haberlandorum* — belong to the global biodiversity hotspot *“Coastal forests of Eastern Africa”* that is among the top ten priority ecosystems for biodiversity conservation on the African continent (Burgess 2000: 237).

Potential historical distribution: The only North-South distribution presented above for a species of *Kayamuhakaia* and for the Kenya coast is a scattered pattern in context to *K. haberlandorum* that is of interest in regard to past and present microrefugia. For example, the Mwachi and Chumvi rivers — with steep, very rocky slopes along the Mwachi River and “no good forest” (Dale 1939: 9) — divide the Shimba Hills in the South from the Rabai-Chonyi Hills in the North. In this so called *“Mombasa Gap” sensu* various mariners and fishermen of Mombasa (pers. comm. to I.L. in 1997), *K. haberlandorum* was not yet recorded. If later fieldwork confirms that this species does not occur in the *“Mombasa Gap”*, it indicates that *K. haberlandorum* used at least one ancient continuous forest band for its present distribution that once occurred near Mombasa, namely extending from Arabuko-Sokoke to the Rabai-Chonyi Hills — and to the West of present Ras Hodi and Bombo Creek (Mombasa) — southwards via Kaya Muhaka, Gogoni Forest and Buda Forest to the Shimba Hills. Such a possible continuous coastal forest “band” that was almost certainly edged on the landward side (further inland from the Indian Ocean) with *Brachystegia*-woodland is more or less confirmed by Dale (1939: Map 1 + Map 2). This “band” was certainly of Pre-Pleistocene age suggesting a similar age for *K. haberlandorum* (*cf.* Discussion).

Rarity: *Kayamuhakaia haberlandorum* is rare within its distribution range, *e.g.* in Kaya Muhaka only nine male records on two Sample Sites during 46 weeks of fieldwork by I.L. in 1994 — 2007 were recorded (without any female record!); in Gogoni Forest only one male was found during 28 weeks of fieldwork by I.L. in 2001 — 2007 (without any female record!).

Noteworthy, the species was never recorded by I.L. and E.K. during 14 years of extensive fieldwork in Ukunda and Diani villages, Kaya Diani, in Diani Forest adjacent to *NOMAD* in 1998, in Kaya Kinondo, in Shimoni village and Shimoni Forest (Kenya South Coast). These results are astonishing and support the view of I.L. that many species of Metarbelidae are sedentary as well as absent from relatively geologically young Sites, *e.g.* coastal forests occurring less than 500 m away from the shoreline of the Indian Ocean. In the latter forests, Caesalpinioideae are also largely absent and if present, they are represented by different species that are never dominant (Lehmann & Kioko 2000: Fig 4 with profile diagram + Fig 6; Lehmann & Kioko 2005: 135 + Fig 1 representing a profile diagram of a possibly very rare primary forest patch on coral rag in Kaya Kinondo, Fig 2 representing a profile diagram done in Kaya Diani; Lehmann 2019b: 325, 342 + Fig 199; Lehmann 2020: Fig 1; Table 1 herein).

Based on its distribution as well as diagnosis, *K. haberlandorum* is classified as *Kenya coast endemic* as well as endemic species to the "*Swahilian regional centre of endemism*" and "*Zanzibar-Inhambane regional mosaic*", respectively.

Habitats of type species of genus (*cf.* Figs 31.a. — 31.e.; 32.a.?). Along the South Coast there is an altitude range of 6 m at Tiwi — 350 m in the Shimba Hills; in the North Coast from 11 m at Malindi and 7 m at Watamu —192 m at Rabai.

Based on the dominance of the Caesalpinioideae (Lehmann & Kioko 2000: Fig 3; Lehmann & Kioko 2005: Table 9; Lehmann unpublished data 2005 — 2007; Table 1 herein), the high number of at least 127 endemic plant and Lepidoptera species in Kaya Muhaka (Lehmann & Kioko 2005: 140) with a higher number in Gogoni Forest (Lehmann unpublished data 2005 — 2007) as well as based on the high number of Metarbelidae genera and species including *K. haberlandorum* (*cf.* Table 1), Kaya Muhaka as well as Gogoni Forest are considered herein as *"Postulated micro-refugia"*.

This is also done for Buda Forest and above all for the Shimba Hills forests based on the dominance of the Caesalpinioideae, *e.g.* with the *"Paramacrolobium coeruleum* community*" sensu* Schmidt (1991: 73 — 75) covering the largest forest area on the Shimba Hills (total forest area is 253 km^2) as well as based on the highest number of indigenous plant species for Kenya, comprising 1396 species in 686 genera in 143 families (Luke 2005: 5) and based on at least ten genera of Metarbelidae — the highest number of genera for any Kenyan locality at present (Lehmann in prep.) — including two Z-I endemic genera (*cf.* Table 2)

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A) Sample Sites in Postulated Microrefugia Kaya Muhaka and Gogoni Forest

(*cf.* Dale 1939: 10, 17; Moomaw 1960: 18; Luke & Robertson 1993: 4:16 — 4:17; Luke 1999: 28 — 42; Lehmann & Kioko 2000: Fig 1 + 3 with profile diagram; Lehmann & Kioko 2005; Lehmann unpublished data 2001 — 2007).

The two Sample Sites (25 m x 25 m in size) in Kaya Muhaka as well as one Sample Site in Gogoni Forest Reserve (824 ha in size) were *K. haberlandorum* was recorded are located in a *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) and are very similar in plant species composition: First, dominance of large and old trees — possibly older than 160 years — of *Julbernardia magnistipulata* Troupin, *Gigasiphon macrosiphon* Brenan and *Cynometra suaheliensis* Baker f. (Caesalpinioideae). Second, in the lower tree canopy and understory occur, *e.g. Craibia brevicaudata* (Vatke) Dunn (Papilionoideae), *Dialium holtzii* Harms (Caesalpinioideae), *Drypetes reticulata* Pax, *D. natalensis* Hutch. var. *leiogyna* Brenan (Putranjivaceae), *Ficus exasperata* Vahl (Moraceae), *Blighia unijugata* Baker (Sapindaceae), *Rinorea ilicifolia* Kuntze (Violaceae), *Dorstenia kameruniana* Engl. and *Sloetiopsis usambarensis* Engl. (synonym: *Streblus usambarensis* C.C. Berg/ Moraceae). In Gogoni Forest, the rare liana *Ancistrocladus robertsoniorum* J.Léonard (Ancistrocladaceae) is common on and near several Sample Sites (*cf.* Figs 31.d., 31.e.).

Third, the habitat of paratypes collected in less than 10 m from the northwestern forest edge of Kaya Muhaka is located in *"Zanzibar-Inhambane secondary grassland and wooded grassland" sensu* White (1983: 189) dominated by *Hyphaene compressa* H. Wendl., *H. coriacea* Gaertn. (Arecaceae), *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae) and *Dichrostachys cinerea* Wight & Arn. (Mimosoideae) including shrub species, *e.g. Lantana camara* L. (Verbenaceae) and *Grewia plagiophylla* K. Schum. (Malvaceae) occurring adjacent to large and old trees of *Julbernardia magnistipulata* Troupin (Caesalpinioideae), *cf.* Lehmann & Kioko (2000: 9 + Fig 5 + Front cover and Back cover; Fig 31.a. herein).

In all habitats of Kaya Muhaka no significant disturbance, neither by humans nor by fire, was recorded in the forest during 1994 — 2007. Low fires occurred every year, *e.g.* in February, but only near the forest edge, never in the forest and not on the habitat Site of the paratypes. Dale (1939: 17) stated that "... Areas which do not appear to have ever been cultivated are ... Gogoni, and Muhaka Forests ..."

Gogoni Forest was locally heavily exploited with sawmillers in the 1980s extracting in particular *Cynometra suaheliensis* Baker f. (Caesalpinioideae) and by cutting logging tracks to each individual tree with no regard to forest structure until 1990/1991 (CFCU pers. comm. to I.L. in 2006; also Luke & Robertson 1993: 4:17). During 2001 — 2007 no significant disturbance was observed by I.L./CFCU staff in the central and northern forest part where ten Sample Sites and one Transect Site of I.L. are located.

B) Postulated microrefugia Gogoni and Buda forests (Buda Mafisini Forest Reserve)

(*cf.* Dale 1939: 10, 17; Luke & Robertson 1993: 4:18; Robertson 1993: 1:11; Luke 1999: 28 — 42; Lehmann & Dalsgaard 2023: 142; Lehmann unpublished data).

The northwestern half of Gogoni Forest is "very similar" to Buda Forest (Luke & Robertson 1993: 4:18). The latter is located *ca.* 3 km southwest of Gogoni Forest and 6 km inland from the Indian Ocean. Both forests can be classified as *"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 187) with Gogoni and Buda forests as a "wetter type" that receive 1300 mm average annual rainfall (Robertson 1993: 1:11). Buda Forest and Gogoni Forest are classified herein as *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126); the latter is dominated largely by Caesalpinioideae in the Sample Area based on unpublished data collected by I.L./CFCU staff 2001 — 2007 (Table 1 + 2). In both forests occur at least 534 plant species comprising 24 Kenyan endemics, 161 regional endemics and 16 species of Caesalpinioideae, *e.g. Cordyla africana* Lour., *Julbernardia magnistipulata* Troupin, *Gigasiphon macrosiphon* Brenan and *Cynometra suaheliensis* Baker f. (Luke 1999: Appendix 2). The Metarbelidae species *Shimbania budaensis* Lehmann & Dalsgaard, 2023 (Fig 1.b. + 142) is most probably endemic to Buda Forest.

In Buda Forest, selective logging occurred in particular on *Newtonia paucijuga* Brenan (Mimosoideae) resulting in numerous lorry tracks and camp sites of sawmillers until 1991 (Luke & Robertson 1993: 4:18).

C) Postulated Microrefugium Shimba Hills

The very diverse vegetation with 1396 plant taxa (Luke 2005: 5; *cf.* also "Habitats of type species of genus" above) and forest types, largely dominated by Caesalpinioideae, were dealt with in detail by Schmidt (1991: 19 — 211) and Luke (2005: 5 — 120). A summarized habitat information was presented by Lehmann & Dalsgaard (2023: 139 — 140) in context with Kaya Muhaka and Gogoni Forest for the description of *Shimbania baginerichardi* Lehmann & Dalsgaard, 2023. The latter species is most probably a Shimba Hills endemic Metarbelidae of the genus *Shimbania* Lehmann & Dalsgaard, 2023 (134 — 137, Fig 1.a.) that belongs to the group of Z-I-A-G genera (*cf.* Table 2 herein; Lehmann in prep.) and represents the only African-Madagascan sister genus-group with *Morondavania* Lehmann & Dalsgaard, 2023 (155 — 164) in Metarbelidae among more than 130 genera.

Striking similarities have been found by Lehmann & Kioko (2005: 137, 138) in a comparison of the butterfly faunas of the Shimba Hills (Sample Size 246 species) and Kaya Muhaka (Sample Size 127 species) in regard to biogeographical elements based on Larsen (1991: 58 — 74).

In conclusion, the main reason for the outstanding plant as well as Metarbelidae diversity and endemism, *e.g.* in regard to the number of genera (*cf.* Table 2) is the fact that the Shimba Hills represent a microrefugium. The proximity to the East Usambara Mountains as stated by Luke (2005: 11) might be a second reason, although the Metarbelidae Sample of the East Usambara Mountains differs significantly with the one from the Shimba Hills (Lehmann in prep. and based on data until June 2024).

D) Pinhey's specimen of 1951 and potential collecting Sites in Ukunda and Diani villages, Kaya Diani, Diani Forest (Jadini Forest) including Kaya Ukunda

(*cf.* Dale 1939: 9; Birch 1963: 608, 609; Robertson 1984: 155; Robertson 1987: 15, 23 / pages counted by I.L.; Luke & Robertson 1993: 6:9, 7:8, 7:9, 7:20; Lehmann & Kioko 2005: 126, 129, 135; Lehmann unpubl. data of 2005, 2006, 2007).

Species of *Kayamuhakaia* were not recorded by I.L. in Kaya Diani and its adjacent areas; in *NOMAD* and its adjacent parts of Diani Forest in 1998; in various other places in Diani and Ukunda villages during 2001 — 2007 (Table 1).

Kaya Diani (20 ha) is located *ca.* 500 m inland from the Indian Ocean and behind Diani Beach Hospital. Robertson (1987: 23) included Kaya Diani with her note "? Sacred forest" into her map but was not sure about its name. Kaya Diani was classified as *"Maritime scrub forest" sensu* Lehmann & Kioko (2005: 126, 129) with one transect figured. Caesalpinioideae are only represented by a single tree of *Tamarindus indica* L. in the Sample Area (Lehmann & Kioko 2005: 150). Near the Sample Area occurs only one additional large tree of *Afzelia quanzensis* Welw. close to the eastern forest edge.

Diani Forest (also known as Jadini Forest, *e.g.* Birch 1963: 603) was described by Robertson (1987: 15, 16) incorrectly as "KAYA DIANI". Diani Forest is a drier type of forest on coral rag and was cleared and gradually destroyed on areas developed for tourism since 1972 (forest size at least 350 ha by then). Only *ca.* 85 ha remained in 1989 (Luke & Robertson 1993: 7:8, 7:20) with possibly further reductions until present. This forest area was located until 2007, *e.g.* adjacent to and opposite of *NOMAD* as well as opposite of the "Two Fishes Hotel". Further forest degradations were observed by I.L. during 2001 — 2007. Trees of Caesalpinioideae are largely absent with only scattered trees present of *Afzelia quanzensis* Welw. and *Piliostigma thonningii* Milne-Redh. — also planted, *e.g.* few trees occurred along a road in Diani village until 2007 (I.L. pers. observations). Common and almost certainly dominant tree species of Diani Forest comprise, *e.g. Lecaniodiscus fraxinifolius* Bak. (Sapindaceae), *Lannea welwitschii* Engl. as well as *L.schweinfurthii* Engl. (Anacardiaceae / I.L. pers. observations). Additionally, Robertson (1987: Appendix) mentioned small trees, *e.g. Acacia adenocalyx* (Mimosoideae) and *Erythrina sacleuxii* Hua (Papilionoideae); Birch (1963: 608) mentioned *Cassipourea euryoides* Alston (Rhizophoraceae) as understorey tree.

Kaya Ukunda — incorrectly mentioned by Robertson (1984: 155) as "Kaya Diani" — was a drier type of coral rag forest with a size of *ca.* 20 ha and was once located within Diani Forest *ca.*1.5 km west of the "Two Fishes Hotel". All trees were cut down probably well before 1991 (CFCU pers. comm. to I.L. in 2005; also Luke & Robertson 1993: 6).

Due to many hotel and private house building activities mainly linked to tourism in the Diani area, the habitat where *K. haberlandorum* was collected in 1951 is almost certainly completely destroyed at present. However, it is unlikely that this species was collected in a drier forest type on coral rag, *e.g.* Diani Forest or Kaya Ukunda; certainly it was not collected in Kaya Diani or nearby.

Dale (1939: 9) mentioned "… few forested patches near Diani [of Lowland Evergreen Rain-forest]" and since "… they occur on private land I have not visited them [*e.g.* patches near Tiwi or Kaya Tiwi?]." If such patches were still present in 1951 they represent the most likely habitat for *K. haberlandorum*.

E) Carcasson's specimen of 1964 and potential collecting Sites near Tiwi village or in Kaya Tiwi

(*cf.* Dale 1939: 9; Robertson 1984: 155; Robertson 1987: 15, 23 (pages counted by I.L.); Luke & Robertson 1993: 6:9, 7:8, 7:9, 7:20; Lehmann & Kioko 2005: 126, 129, 135; Lehmann unpubl. data of 2005, 2006, 2007).

On a map published by the Directorate of Overseas Surveys (1958a: Sheet 201/I) Tiwi village is located in a mosaic of an cultivated area with "Palms" and "Mango" including a small patch marked as "Forest" *ca.* 700 m to the Southwest of the village and surrounded by "Palms" and "Huts". The Mwachema River is located *ca.*1 km further to the South. This patch is of interest and might represent the habitat as well as might be one of the patches mentioned by Dale (1939: 9) as "Lowland Evergreen Rain-forest … patches … near Diani …" If these assumptions of I.L. are correct this patch is considered herein as microrefugium that was almost certainly once connected with Kaya Muhaka.

Kaya Tiwi is less than 10 ha in size and located on private land (Robertson 1987: 18) adjacent to the northern bank of the mouth of the Mwachema River and adjacent to the coastline of the Indian Ocean and close to Ras Mwachema. The Kongo Mosque is located *ca.* 500 m to the Southwest of Kaya Tiwi and the forest patch near Tiwi village mentioned above lies *ca.* 3.5 km to the Northwest from Kaya Tiwi. It was at least until 1983 an active Kaya where the Elders did not allow any entrance by scientists (*cf.* Robertson 1984: 155). Based on sight records it looked fairly intact to I.L. until 2007 and might represent a relict of a former riverine forest. Some of the tree species recorded in Kaya Tiwi by Robertson (1987: 25) support this view, *e.g. Tamarindus indica* L. (Caesalpinioideae), *Sorindeia madagascariensis* DC. (Anacardiaceae), *Drypetes natalensis* Hutch. (Putranjivaceae) and *Ludia mauritiana* J. F. Gmelin (Salicaceae). Tree species that indicate drier Sites include, *e.g. Haplocoelum inoploeum* Radlk. (synonym: *H. trigonocarpum* Radkl. /Sapindaceae), *Afzelia quanzensis* Welw. (Caesalpinioideae), *Cassipourea euryoides* Alston (Rhizophoraceae), *Zanthoxylum holtzianum* P.G.Waterman (Rutaceae) with *Erythroxylum emarginatum* Thonn. (Erythroxylaceae) in the shrub layer.

A similar tree and shrub species composition was found on Sample Sites in Kaya Diani (located *ca.* 3 km further to the South), Kaya Kinondo and in Shimoni Forest by I.L. but without any record of a species of *Kayamuhakaia*. Hence, it is unlikely that Carcasson collected his specimen in Kaya Tiwi but most probably in a forest patch located further inland and close to Tiwi village.

Kaya Tiwi is not defined herein as microrefugium.

F) Carcasson's specimen of 1964 and potential collecting Sites in Gasi Forest and near Gasi village

Gasi village is located *ca.* 2 km to the East of Gogoni Forest. Between Makongeni village and Gasi occurs a large mangrove forest along Gasi Bay south to the Mukurumudzi River where all nine mangrove tree species that occur in Kenya are present (Jenoh *et al.* 2021: 3, Fig 1; Jenoh 2022: 64, 65). Neither Dale (1939: Map 2) nor Moomaw (1960) mention any coastal forest type in this area. On a map published by the Directorate of Overseas Surveys (1958b: Sheet 200/IV) Gogoni is marked as "Forest" while a large area to the West and South of Gasi is marked with "Light Forest" suggesting almost certainly a *"Zanzibar-Inhambane secondary grassland and wooded grassland" sensu* White (1983: 189) where scattered trees occur comprising mainly non-forest tree species that appear in a mosaic of cultivation with trees, *e.g. Mangifera indica* L. (Mango/Anacardiaceae), *Anacardium occidentale* L. (Cashew Nut/Anacardiaceae) and small plantations of *Cocos nucifera* L.(Coconut Palm /Arecaceae) as well as large grassy areas with very scattered tiny fragments of the original forest vegetation. Such a mosaic is still present between the northeastern part of Gogoni Forest and Gasi dominated in the open grassy areas by scattered small trees, *e.g. Catunaregam nilotica* Tirvengadum (Rubiaceae), *Strychnos madagascariensis* Poir. (Loganiaceae), *Sclerocarya birrea* Hochst. (Anacardiaceae) and *Hyphaene coriacea* Gaertn. (Arecaceae) (I.L. unpublished data).

One forest fragment close to Gasi village was visited by I.L. and Matano Abdulrahman (CFCU) in 2006. The few trees that were still recorded included no Caesalpinioideae but *Harungana madagascariensis* Lam. (Hypericaceae), *Pycnocoma littoralis* Pax (Euphorbiaceae), *Mimusops obtusifolia* Lam. (Sapotaceae), *Ficus scassellatii* Pamp. (Moraceae) and the liana *Hugonia castaneifolia* Engl. (Linaceae).

Riverine forests occur as narrow but often not continuous bands (I.L. pers. observation until 2007) and in one of them, Dale collected at Gasi in 1936 the tree *Homalium abdessammadii* Aschers. & Schweinf. (Salicaceae/ formerly in Flacourtiaceae, *cf.* Sleumer 1975: 43).

It is very unlikely that *K. haberlandorum* was collected in the large mangrove forest at Gasi. More likely the species still occurs in one of the scattered tiny forest fragments in the wooded grassland or in a riverine forest patch located to the West or to the South from Gasi.

G) Postulated microrefugia in the Rabai Kayas

(Krapf 1860: 202; Dale 1939: 8, 9; Moomaw 1960: 18, 37; Robertson 1984: 154; Hawthorne 1984: 247; Robertson 1987: 10 + Appendix; Luke & Robertson 1993: 6:13, 6:14; Willis 1996: 93, 94; Fungomeli *et al.* 2025: 14, 15).

Hawthorne (1984: 247) mentioned that "The Rabai forest [possibly refers only to Kaya Mriale, *cf.* Robertson 1984: 154] today is the best-preserved of all the kayas, and the largest.” In contrast and noteworthy in this context is that Krapf already stated on 25th December 1848 that the elders of “Kaya Rabai” had permitted to cut down trees for ship-building for “Sheikh [or Shaykh] Gabiri of Mombaz” and that “… a number of Wanika collected [wood] in the Kaya [Rabai], to call the chief to account, … to cut down more trees for ship-building than had been allowed by the elders…”(Krapf 1860: 202 with possibly incorrect spelling for “Sheikh Jabiri of Mombas”, *cf.* Willis 1993: 60). These statements of Krapf indicate local forest disturbance in Kaya Rabai, or Kaya Mriale respectively. Additionally, they suggest a possible local forest disturbance that occurred several times in the Kaya Rabai forests since at least the Busaidi rule in Mombasa (1837 — 1895). More recent studies on land use and land cover changes in the Rabai area show a great loss of forest within the historical boundary of Kaya Rabai (= Kaya Mriale?) of 895.7 ha between the years 1992 and 2022 (Fungomeli *et al.* 2025: 14, 15). Nevertheless, the “Critically Endangered” tree species *Combretum tenuipetiolatum* Wickens (Combretaceae) is still known from the Rabai Kayas in forest habitats (*cf.* Beentje 1994: 136; Ngumbau *et al.* 2020: 63).

Van Someren, who collected *K. haberlandorum* collected also plant species in the Rabai Kayas, *e.g. Barringtonia racemosa* Spreng. (Lecythidaceae), *cf.* Sangai (1971: 4) as well as in coastal wooded grassland at Mombasa, *e.g. Philenoptera bussei* Schrire (synonym: *Lonchocarpus bussei* Harms/ Papilionoideae), *cf.* Gillett *et al.* (1971: 70). This suggests that *K. haberlandorum* was either collected in the forest or outside of forest by van Someren in *“Zanzibar-Inhambane transition woodland”* or *“Zanzibar-Inhambane secondary grassland and wooded grassland”* (for the latter habitat, *cf.* holotype locality).

Robertson (1987: 10) stated that Kaya Rabai comprises “9 [Kayas] in Rabai Location and 2 in Ruruma Location”. Luke & Robertson (1993: 6:13) found that “Kaya Rabai” consists of nine separate Kayas. Willis (1996: 93, 94) mentioned with important details only the following separate six Kayas: *“Mriale”* (today called Benyagundo Hill) comprising *“Mudzi Mwiru”* and *“Mudzi Mudide”* representing the first two settlements of Rabai; *“Vokera/Bomu”* representing the third settlement at Rabai; *“Chang’ombe/Fimboni”* represents one of the five settlements that existed already before the year 1847; *“Rabai Mpya”* possibly established in the 1840s within an area of dense bushland; *“Chijembeni/Kijembeni”* appeared on a map on 1852. The other six Kaya names that were mentioned by an informant (not named) to Ann Robertson in 1987 comprise: *“Mwakonde Mwarai”*, *“Mbwadu”*, *“Mwakatama”*, *“Mbura”*, *“Ivuni”* and *“Bendeji”* but Willis (1996: 94) found no written reference to any of them; *cf.* “Note” of I.L. to *“Mbwadu”* below the collecting data above, suggesting the most likely habitat where van Someren collected *K. haberlandorum* was Kaya Mbwadu.

Hence, the collecting Site “Rabai” for *K. haberlandorum*, including the only known female for this species, represents in fact locations with very different habitat types occurring in at least seven Kayas (including “Mbwadu”) in 1933. Based on the plant list presented by Robertson (1987: Appendix) the following species were mainly collected by van Someren and a few by ‘Joanna’ in the 1930s; the records of Hawthorne presented by Robertson are excluded here since

Hawthorne stated that he did not obtain permission to enter Kaya Rabai (*cf.* Hawthorne 1984: 247):

Tree species records by van Someren and 'Joanna' comprise in drier forest margins, bushland and wooded grassland, *e.g. Maerua triphylla* A. Rich. (Capparaceae), *Harrisonia abyssinica* Oliv. (Rutaceae), *Catunaregam nilotica* Tirvengadum (Rubiaceae), *Adenium obesum* Roem. & Schult. (Apocynaceae), *Philenoptera bussei* Schrire (Papilionoideae) and *Boscia salicifolia* Oliv. (Capparaceae). Riverine habitats are indicated by, *e.g. Psychotria capensis* Vatke subsp. *riparia* Verdc. (Rubiaceae), *Ziziphus mucronata* Willd. (Rhamnaceae), *Homalium longistylum* Mast. (Salicaceae) and *Antidesma venosum* E. Mey. (Phyllanthaceae).

The most likely collecting Site of *K. haberlandorum* in 1933 is located in the following habitats that are defined herein as "microrefugia": First, Dale (1939: 8, 9) found "Lowland Evergreen Rain-Forest" in "The kayas along the Rabai-Chooni Hills ..." and Moomaw (1960: 18, 37) stated that "Kaya Rabai" is "Lowland evergreen rain forest". Collected plant species that support this view comprise: First, in *"wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) *Julbernardia magnistipulata* Troupin (Caesalpinioideae), *Dracaena aletriformis* Bos (Asparagaceae), *Gardenia posoquerioides* S. Moore and *Coffea sessiliflora* Bridson (Rubiaceae), the liana *Uvaria faulknerae* Verdc. (Annonaceae) and the shrub *Acalypha neptunica* Müll. Arg. (Euphorbiaceae). Second, in *Cynometra*-forest and *Brachystegia*-woodland — both are dominated by trees of Caesalpinioideae — with *Heinsia crinita* G. Taylor (Rubiaceae), *cf.* Beentje (1994: 516) and *Drypetes natalensis* Hutch. var. *leiogyna* Brenan (Putranjivaceae).

Heinsia crinita is defined by Hubau *et al.* (2013: 336) as a "... significant indicator for regenerating forest ..." in regard to burnt Sites in the Mayumbe Forest — one of the forest refuges (*e.g.* Maley 2001: 72 "Mayombe mountains") in *"Lower Guinea" sensu* White (1978: 258) — with a Sample of Metarbelidae studied by I.L. This Sample from Mayumbe Forest does not include any species of *Kayamuhakaia.*

H) Postulated microrefugium Arabuko-Sokoke Forest but excluding herein former or much modified relict patches of "Lowland rain forest ... near Malindi ..." *sensu* Moomaw (1960: 37) and the destroyed natural forests near Watamu including the "Mida Creek *Trachylobium* forest" *sensu* Moomaw (1960: 33)

(Dale 1939: 14, 15 + Map 1; Moomaw 1960: 33, 37; Britton & Zimmerman 1979: 2, 3, 4)

The Arabuko-Sokoke and Mida-Gede forests are described in detail and in context with *K.ngwenoae* **sp. nov.**

In regard to Malindi, the following statements are of importance:

Dale (1939: 14) mentioned "... a large [Evergreen Dry-forest] running from ... near Milindi [misprint of Malindi] to Sokoke [Forest]" in the 1930s. Possibly this forest covered large parts of the Giriama Hills that extend from *ca.* 8 km to the North of Rabai just to the North of the Sabaki River and *ca.* 14 km inland from Malindi including Mount Mangea, Mount Chonyi and Mount Jibana (Naval Intelligence Division 1920: 29) but extended most probably in patches eastwards to Malindi. This former forest and woodland "band" (*cf.* Dale 1939: Map 1) is also of interest herein in regard to the distribution of species of *Kayamuhakaia* from areas near Malindi southwards to the Shimba Hills and westwards to the Taita Hills (*cf.* Discussion).

In regard to one paratype of *K. haberlandorum* that was collected at or near Malindi earlier than 1935 — almost certainly only in or near a remaining patch of this once large forest and woodland as figured and described by Dale (1939: 14, 15, Map 1) — it is very likely, that the habitat does no longer exist today.

Bradley Martin (1973: 57) stated that by October 1861 "… fifty Arabs … were clearing the land for several kilometres around the town [Malindi] with the help of a thousand slaves. They planted mainly millet and maize along with coconuts, bananas and mangos."

These clearings of the original vegetation around Malindi until 1866 when its population — including the adjacent plantations — was at least 10.000 people (*cf.* Bradley Martin 1973: 57, 58) almost certainly comprised forest and woodland areas with small patches left standing, *e.g.* at Kaya Malindi (*cf.* Robertson 1984: 153 + Fig 1; I.L. pers. observations in and near Malindi in September 1989 + February 1995).

The following tree species suggest and based on Dale's examples for the 1930s (*cf.* also Moomaw 1960: 37, 38) that the forest towards the coast of Malindi was probably similar to the "*Afzelia* forest" as described by Britton & Zimmerman (1979: 3) for the "Mida-Gede forest" dominated by *Afzelia quanzensis* Welw. and *Hymenaea verrucosa* Gaertn. (Caesalpinioideae, *cf.* Fig 31.c. herein).

Further inland from Malindi it is very likely that still a "*Brachystegia* savanna" occurred as described by Dale (1939: Map 1) dominated by "*Brachystegia oliveri*" Taub. (synonym of *Brachystegia spiciformis* Benth./Caesalpinioideae). *Brachystegia*-woodlands occurred possibly adjacent to as well as within the large forest "band" of the Malindi-Sokoke-Mangea-Arabuko forest (*cf.* Dale 1939: 14, 15, 16, Map 1). This large *"Brachystegia-Afzelia Lowland Woodland" sensu* Moomaw (1960: 30) was reduced to scattered remnants until the late 1950s.

Hence, almost certainly the collecting Site of one paratype of *K. haberlandorum* found before the year 1935 at or near Malindi was close to a patch of forest or woodland where trees of Caesalpinioideae were common or dominant.

The specimen from Watamu most probably is also a part of this "*Brachystegia-Afzelia* community" *sensu* Moomaw (1960: 33) since he still mentioned a wetter forest type at Mida Creek that he named "Mida Creek *Trachylobium* forest" — located *ca.* 3 km to the East of Watamu but possibly extended towards the latter locality. This forest was dominated by various Caesalpinioideae, *e.g. Brachystegia spiciformis* Benth., *Afzelia quanzensis* Welw.

and "*Trachylobium verrucosum*" Oliv. (synonym of *Hymenaea verrucosa* Gaertn./ Caesalpinioideae). Moomaw noted the removal of *Afzelia* trees and the high number of damaged *Hymenaea* trees on his Sample Site during his studies suggesting a change in the tree species composition of forests near Mida Creek until the late 1950s. Britton & Zimmerman (1979: 2, 4) did not figure any forest remnant in the area between Mida Creek and Watamu but stated for Arabuko-Sokoke, Gede and adjacent areas that "… felled trees are an increasingly common sight in all forest habitats." Hence, it is possible that on the collecting Site of the specimen found in or near Watamu in 1989 still several relict trees of *Afzelia quanzensis* Welw. and *Hymenaea verrucosa* Gaertn. occurred in a highly developed area for tourism mixed with introduced tree species, *e.g.* plantings of *Casuarina equisetifolia* L. (Casuarinaceae/ I.L. pers. observations in Watamu and in nearby areas in September 1989 and January 1995).

Biological traits. The biology of *K. haberlandorum* is unknown. However, since this species is absent from, *e.g.* Kaya Diani, Kaya Kinondo and Shimoni Forest (Lehmann & Kioko 2005; Lehmann unpubl. data collected in Shimoni Forest in 2001—2007) where Caesalpinioideae are largely absent (*cf.* Table 1), it is very likely that the larvae of *K. haberlandorum* feed mainly on bark and in wood of Caesalpinioideae with a Guineo-Congolian affinity.

Etymology. The type species was named by Lehmann (1997: 48) for the beloved grandparents of I.L., namely Willi Eduard Hermann Haberland — who passed away on 10th June 1982 in Finsterwalde/ Niederlausitz/ federal state Brandenburg — and to his wife Charlotte Marie Johanna Haberland, ne Quitter — who died on 26th December 2010 in Kirchen/ federal state Rhineland-Palatinate (Germany).

***Kayamuhakaia neemambeyuae* sp. nov.**

Figs 2.f., 13.d.

Type locality and repository: Somalia, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Somalia m. [Somali Republic, m.= meridionalis = south], Lake [misprint of Lag?] Baddana [Jubaland federal state, Jubbada Hoose administrative devision, today in Lag Badana-Bushbush National Park with an elevation up to 62 m, *ca.* 1°15'20"S 41°30'11"E and *e.g.* possibly collected along the banks of the Lach Buscbusc, *cf.* Friis 1992: Photo 27.] or — rather unlikely — *ca.* 40 km further northeast along the banks of the Baddana River, *e.g.* near or south of Buulo Xaaji, elevation 0 — 6 m, where the river widens significantly towards the Indian Ocean and maybe did look like a "lake" for the collector, *ca.* 0°38'10"S 41°58'23"E or 0°46'16"S 41°59'50"E; "1.2.89 [1st February 1989], leg. Dr. Politzar", genitalia slide number 24/102020 I. Lehmann (MWM).

Description, female. *Head*: rough-scaled, with dense hair-like scales of dark olive-buff and cream towards scale bases mixed with scales of pale olive-buff between and around compound eyes; eyes sorghum-brown with narrow black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small oval; a horizontal ridge is well developed on lower fronto-clypeus; antennae medium long with 0.43 length of forewing with branches 0.3× width of shaft on lower 25% of antenna and up to 1.5× width of shaft towards tip, branches are not widely separated at base, scaled cream laterally, shaft densely scaled cream dorsally; labial palpi half of eye-diameter in length, cream-buff, three-segmented with basal segment as long as 2nd segment, broadly rectangular, 2nd segment broadly oval, segment on tip small, narrow, 25% length of 2nd segment and egg-shaped.

Thorax: Patagia with scales of cream with dark olive tips forming no collar ring; tegulae with same coloured scales. Metathorax has longer hair-like scales of cream forming a little pronounced scale-crest. Hindlegs with fine hair-like scales of cream with a dark olive patch below tip and with two pairs of tibial spurs, upper pair 1.0 mm/0.8 mm, lower pair 0.8 mm/0.6 mm in length. Forewing length 8.0 mm and wingspan 17.5 mm. Forewing faded, upperside cream-buff and cream with a light golden glint, costa cream-buff; forewing with an elongated rectangular patch of Isabella colour extending from CuA_2 to R_5; CuA_2 is narrowly marked ivory-yellow (in fresh females a reduced ivory-yellow "Y" in horizontal position is possibly present); termen with no visible striae (or faded); veins not distinctly coloured; cilia long, 0.6 mm, cream-buff with ecru-olive tips. Underside of forewing ecru-olive with a light golden glint.

Hindwing is upperside ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream mixed with ecru-olive hair-like scales; abdominal tuft short, tuft 15% length of abdomen, ecru-olive. Postabdominal structure and genitalia (Fig 13.d.) have papillae anales with short setae and small lobes, one lobe 60% length of narrow dorsal width of segment 8 (viewed laterally) and with one lobe as large as only 10% of the papillae anales (viewed ventrally). Segment 8 is narrow rectangular, thinly sclerotized; base of one anterior apophysis is 1.4× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); distal part of anterior apophysis is 40% longer than the dorsal width of segment 8 and with a slightly broader end; the posterior apophyses are *ca.* 20% longer than anterior apophyses, with a T-shaped base that occurs on a large intersegmental membrane that is slightly broader than segment 8, extending ventrally to base of papillae anales, the length of the T-shaped base is 70% of the whole length of posterior apophysis. The ductus bursae is long, as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a small triangular-shaped membranous structure that is 1.4× as large as the broad basal part of the anterior apophyses; corpus bursae is thinly membranous, without any structures, nicely oval-shaped with a rounded end and if not pressed 2.0× as large as segment 8.

Male: unknown.

Diagnosis. *Kayamuhakaia neemambeyuae* **sp. nov.** can be separated from all other congeners by the short wingspan combined with a long ductus bursae that is as long as one posterior apophysis. The length of the ductus bursae is shared with *K. haberlandorum* that represents a larger species. A character that occurs also in *K. maasi* **sp. nov.** is the size of the intact corpus bursae that is at least 2.0× as large as segment 8 and largest in *K. maasi* **sp. nov.** In contrast, the shape of the corpus bursae is different as it is pear-shaped in *K. haberlandorum* but oval-shaped in *K. neemambeyuae* **sp. nov.** and *K. maasi* **sp. nov.**

Distribution. *Kayamuhakaia neemambeyuae* **sp. nov.** is one of two species described herein that represent the first published records of Metarbelidae for the physiographic unit *"S* [South] *Somalia Coastal Plain" sensu* Friis (1992: Fig 2.).

It is only known from a lowland habitat in southeastern Somalia located on the *"S* [South] *Somalia Coastal Plain" sensu* Friis (1992: 11) occurring at altitudes up to *ca.* 62 m with an average annual rainfall of *ca.* 700 mm and located mainly in the *Zanzibar-Inhambane regional mosaic sensu* White (1983: 184, 185) or *Swahilian regional centre of endemism sensu* Clarke (1998: 62), respectively.

Kayamuhakaia neemambeyuae **sp. nov.** is classified as an endemic species to the *"Swahilian regional centre of endemism"*, *"Zanzibar-Inhambane regional mosaic"* as well as to the *"South Somalia Coastal Plain"*, respectively. The species possibly occurs in extreme northeastern coastal Kenya, *e.g.* near Raas Kaambooni and in adjacent areas of the *KBA* "Boni National Reserve".

Furthermore, it might be a relic species of *Kayamuhakaia* that indicates for its habitat a wetter environment or an additional groundwater supply (*cf.* habitat description below).

Habitat. Friis & Vollesen (1989: 466) stated that *"Zanzibar-Inhambane scrub forest"* is "very common" in the area between Bad Daada and Raas Kaambooni, representing a part of the large area of the Lag Badana-Bushbush National Park — possibly named after the two temporary streams "Lach Buscbusc", *cf.* Friis & Vollesen 1989: 467 and "Lach Baddana". The National Park is *ca.* 3.340 km^2 in size (Sayer *et al.* 1992: 151) and comprises tree species such as *Afzelia quanzensis* Welw., *Dialium orientale* Bak. f. (Caesalpinioideae), *cf.* Friis (1992: Photo 26.), *Craibia brevicaudata* Dunn (Papilionoideae), *Croton megalocarpoides* Friis & M. Gilbert (Euphorbiaceae), *Newtonia erlangeri* Brenan (Mimosoideae) and *Zanthoxylum holtzianum* P.G. Waterman (Rutaceae), including shrub species, *e.g. Allophylus rubifolius* Engl. (Sapindaceae), *Bullockia mombazensis* Razafino., Lantz & B. Bremer (synonym: *Canthium mombazense* Baill.), *Coffea rhamnifolia* Bridson, *Feretia apodanthera* Delile subsp. *keniensis* Bridson, *Tennantia sennii* Verdc. & Bridson (Rubiaceae) and *Markhamia zanzibarica* K. Schum. (Bignoniaceae).

Patches of *"Zanzibar-Inhambane undifferentiated forest" sensu White* (1983: 187, 188) as well as Riparian forest occur in the same area, *e.g.* the former forest type along the "Lach Buscbusc" representing "… very tall [Z-I] forest … "(Friis 1992: 43 + Photo 27.) and are dominated (if still present) by large trees of *Parkia filicoidea* Welw. (Papilionoideae), species of *Albizia* Durazz. (Mimosoideae) and in the lower canopy with *Mimusops obtusifolia* Lam. (synonym: *M. fruticosa* Bojer/Sapotaceae), *Cordia goetzei* Gürke (Boraginaceae), *Garcinia livingstonei* T. Anderson (Clusiaceae), *Acacia elatior* Brenan (Mimosoideae), *Thespesia danis* Oliv. (Malvaceae) as well as with records of *Diospyros greenwayi* F.White (Ebenaceae), *Drypetes parvifolia* Pax & K. Hoffm. (Putranjivaceae) and *Uvaria acuminata* Oliv. (Annonaceae), Friis & Vollesen (1989: 466, 467); Friis (1992: Photo 26. + 27.).

Senni (1935: 12 — 13, 190, 244) additionally mentioned, *e.g.* for "Lak Badana", *Sideroxylon inerme* L. (Sapotaceae) and *Oldfieldia somalensis* Milne-Redh. (Picrodendraceae) for *"Zona a bosco"* (= "Forest zone" including Riparian forest/ Galery forest).

Riparian forest types might still occur along the Baddana River near or south of Buulo Xaaji.

In contrast, semi-deciduous bushland occurs close to the Indian Ocean dominated by *Combretum hereroense* Schinz (Combretaceae); on the coastal dunes by *Acacia tortilis* Hayne (Mimosoideae) and *Ephippiocarpa orientalis* Markgr. (synonym: *Callichilia orientalis* S. Moore/Apocynaceae), Friis & Vollesen (1989: 460, 463, 467, 468, 469).

Friis & Gilbert (1984: 330) reported of the occurrence of a *"special S Somalian Bur vegetation"* that has been found at the foot of a "Bur" or "buur" where additional water run-off creates a wetter environment (also Friis 1992: 51). The "Bur" is a large isolated "inselberg" of granite, gneiss or dorite and represents a common landscape feature in southern Somalia and in adjacent parts of Kenya comprising much moister semi-evergreen coastal vegetation species at its foot which explains why, *e.g.* Z-I species, occur far inland in drier parts of southern Somalia. Local Sites with "favoured water supply" and "supporting post-climax relics" in regard to plant species that indicate a once wetter climate in semi-desert areas of eastern "British Somaliland" were also reported by Gilliland (1952: 93, *cf.* also his photograph 2).

It is very likely that *K. neemambeyuae* **sp. nov.** represents a coastal forest relic species of *Kayamuhakaia* that is linked to "Somalian buur vegetation" and to *"Zanzibar-Inhambane undifferentiated forest" sensu White* (1983: 187, 188) occurring along the "Lach Buscbusc" as described above and hence, indicates a wetter environment.

Biological traits. The biology of *K. neemambeyuae* **sp. nov.** is unknown.

Etymology. The species is named for the Kenyan Lady Neema Mbeyu Hamisi (born in Mombasa in June 1982) in remembrance of our love and pure happiness among avenues, in flowering gardens, in forests and in towns of various parts in Kenya during 2007 as well as 2008.

Neema holds a special place that nobody can replace in the heart of I.L.

Kayamuhakaia kismayuensis sp. nov.

Figs 3.a., 14.a.

Type locality and repository: Somalia, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, “Somalia m. [Somali Republic, m.= meridionalis = south], Kisimayo [mispelling of Kisimayu or Kismaayo or Chisimaio or Kismayu, Jubaland federal state, Jubbada Hoose administrative devision 0°18’44”S 42°34’30”E], 29.3.89 [29th March 1989], leg. Dr. Politzar”, genitalia slide number 11/102020 I. Lehmann (MWM).

Description, female. *Head*: rough-scaled, with dense hair-like scales of dark olive-buff, cream towards scale bases and tips mixed with slightly broader scales of cream around compound eyes; eyes sorghum-brown with sepia patches; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are small elongated slits; a horizontal ridge is present on lower fronto-clypeus; antennae 0.38 length of forewing with branches 0.4× width of shaft on lower 30% of antenna and up to 1.0× width of shaft towards tip, branches are not widely separated at base, scaled cream laterally, shaft densely scaled cream dorsally with a light golden glint; labial palpi half of eye-diameter in length, deep olive-buff, three-segmented with basal segment slightly longer and broader as 2nd segment, broadly rectangular, 2nd segment broadly rectangular, segment on tip small, narrow, 30% length of 2nd segment and egg-shaped.

Thorax: Patagia with drops of honey-yellow resin(!) on hair-like scales of dark olive-buff with cream bases and tips forming no collar ring; tegulae also with drops of honey-yellow resin(!) and same coloured scales. Metathorax has longer hair-like scales of dark olive-buff with cream tips forming a little pronounced scale-crest. Hindlegs with fine hair-like scales of dark olive-buff with cream tips; two pairs of tibial spurs are present, upper pair 0.8 mm/0.8 mm, lower pair 1.0 mm/0.8 mm in length. Forewing length 8.5 mm and wingspan 18.5 mm. Forewing upperside deep olive-buff with a light golden glint, costa of same colour; forewing with an elongated rectangular patch of dark olive-buff extending from CuA_2 to R_5; CuA_2 is narrowly marked white, the white extends onto lower median and forms a reduced white “Y” in horizontal position; other veins not distinctly coloured; termen without striae; cilia very long for such a small species with 1.0 mm, cream at base and at tip in between dark olive-buff. Underside of forewing is deep olive-buff with a light golden glint.

Hindwing upperside is dark olive-buff with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream mixed with deep olive-buff hair-like scales; abdominal tuft short, tuft 15% length of abdomen, deep olive-buff. Postabdominal structure and genitalia (Fig 14.a.) have papillae anales with short setae and small lobes, one lobe 40% length of broad dorsal width of segment 8 (viewed laterally) and with one lobe as large as only 12% of the papillae anales (viewed ventrally). Segment 8 is broad rectangular, ventrally slightly broader than dorsally, thinly sclerotized; base of one anterior apophysis is 2.0× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); distal part of anterior apophysis is only 10% (= 0.1×) longer than the dorsal width of segment 8 and with a slightly broader end; the posterior apophyses are long, but only *ca.* 10% longer than anterior apophyses, with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane that is narrower than segment 8, extending ventrally to base of papillae anales, the length of the T-shaped base is 70% of the whole length of posterior apophysis; ventrally, this T-shaped base is connected by a thin band-like membrane with the base of the other posterior apophysis. The ductus bursae is very long, *ca.* 20% longer than one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a small triangular-shaped membranous structure that is 1.4× as large as the broad basal part of the anterior apophyses; corpus bursae is thinly membranous, without any structures, small oval-shaped with a rounded end and if not pressed only 0.8× as large as segment 8.

Male: unknown.

Diagnosis. *Kayamuhakaia kismayuensis* **sp. nov.** can be separated from all other congeners by the short wingspan combined with a very long ductus bursae that is *ca.* 20% longer than one posterior apophysis as well as by the broader ventral part of segment 8 if compared to the slightly narrower dorsal part. Segment 8 is broadly rectangular. These characters separate *K. kismayuensis* **sp. nov.** from *K. haberlandorum* as well as *K. neemambeyuae* **sp. nov.**, respectively that both have a narrowly rectangular segment 8 as well as a ductus bursae that is as long as one posterior apophysis. Another character that is different to the latter two species is the much smaller corpus bursae that is, if intact, only 0.8× as large as segment 8 but 2.0× as large as segment 8 in *K. haberlandorum* as well as *K. neemambeyuae* **sp. nov.** A common character shared between *K. kismayuensis* **sp. nov.** and *K. neemambeyuae* **sp. nov.** is the oval shape of the corpus bursae. The antennae are longest in the latter species with 0.43 length of forewing comprising also the longest branches on the upper one third of antennae with 1.5× width of shaft. Both characters are similar in *K. haberlandorum* and *K. kismayuensis* **sp. nov.** The large areole on the forewing in *K. kismayuensis* **sp. nov.** is 40% of the size of the upper discal cell but only 25% of the size of upper discal cell in *K. neemambeyuae* **sp. nov.** and 60% in the female of *K. haberlandorum.* Noteworthy, three characters are shared with *K. juliusmathiui* **sp. nov.** (*cf.* diagnosis of the latter species).

Distribution. *Kayamuhakaia kismayuensis* **sp. nov.** is one of two species described herein that represent the first published records of Metarbelidae for the physiographic unit of the *"South Somalia Coastal Plain" sensu* Friis (1992: Fig 2.).

The species is only known from the Kismayu area (altitude 1 m — 19 m; average annual rainfall 366 mm) and was almost certainly collected behind the dunes. Kismayu is located *ca.* 175 km northeast of the Kenya border and *ca.* 10 km south from the Jubba River on the *"S* [South] *Somalia Coastal Plain" sensu* Friis

(1992: 11). The area of Kismayu that is located behind the dunes belongs to the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184), *cf.* Friis & Vollesen (1989: 467, 468).

Kayamuhakaia kismayuensis **sp. nov.** is classified as *"Zanzibar-Inhambane /Lake Victoria linking"* as well as endemic species to the "*South Somalia Coastal Plain"*.

Noteworthy, Kismayu was not included by Burgess *et al.* (1998: Fig 3) in the *"Swahilian regional centre of endemism" sensu* Clarke (in press by then) which is incorrect since it was later included by Clarke (1998: Fig 7) based on White (1983: 184). Hence, *K. kismayuensis* **sp. nov.** is also an endemic species of the *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61 + Fig 7).

Habitat. Friis & Vollesen (1989: 465, 467, 468) stated that *"Zanzibar-Inhambane evergreen and semi-evergreen bushland and thicket"* occurs at Kismayu behind the dunes and is dominated locally by pure stands of *Cordia somaliensis* Baker (Boraginaceae). To the North of Kismayu occurs "... a dry open bushland with much *Combretum hereroense ..."* Schinz (Combretaceae) and on the coastal dunes with *Acacia tortilis* Hayne (Mimosoideae).

Biological traits. The biology of *K. kismayuensis* **sp. nov.** is unknown. However, as several drops of resin on the holotype indicate feed the larvae most probably on bark and/or in wood and their pupation takes place in wood including possibly *Cordia somaliensis*, *Combretum hereroense* and/or *Acacia tortilis*.

Etymology. The species is named for the type locality, namely for the town of "Kismayu" located at the southern coast of the Somali Republic. The spelling of "Kismayu" herein is based on Andrzejewski & Lewis (1964: 14) who have done extensive studies on the dialects and poetry among the Northern Somali tribes as well as Southern Somali tribes. Friis & Vollesen (1989: 456) as well as the Ministry of Defense, UK (1982) used the spellings "Kismaayo" and "Chisimaio" for the same town. The origin of the word might be linked — according to the opinion of I.L. — to the "Cismaan Machamuud lineage" meaning something like "waayo" for "not satisfied" with reference to their submission of a stronger group along the Somali coast resulting in their reduced power and prestige (*cf.* Andrzejewski & Lewis 1964: 130 — 135).

***Kayamuhakaia ngwenoae* sp. nov.**

Figs 3.b., 14.b., 14.c.

Type locality and repository: Kenya, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Male, holotype, "Kenya, [North Coast, Kilifi County], Arabuko-Sokoke Forest, 10.5 km W [West of] Gede 03°16'S 39°58'E [forest interior], 80 m [correct are: *ca.* 5 km northwest of Gede and *ca.* 10 km northwest of Watamu, elevation 68 m, in "*Cynometra-Manilkara* forest" *sensu* Britton & Zimmerman 1979: 3], 20/03/2004, J. & W. De Prins leg. [Dr. Jurate De Prins and Willy De Prins]", genitalia slide number 01/022020 I. Lehmann (RMCA).

Paratypes: Male, "Kenya [North Coast, Kilifi County], near Watamu, Mida Creek, O m, 03°22'S 39°56'E [incorrect locality and altitude; correct are: 3°22'08"S 39°56'00"E, *ca.* 3 km north of Matsangoni at 13 m and *ca.* 4 km to the South of a large "*Afzelia* forest" *sensu* Britton & Zimmerman 1979: 3], 07/04/2004, J.De Prins leg. [Dr. Jurate De Prins]", genitalia slide number 15/022020 I. Lehmann (RMCA); male, "Kenya [North Coast, Kilifi County] Sokoke Forest [Arabuko-Sokoke Forest], 8 miles S [South of] Malindi, *Brachystegia* ["*Brachystegia* forest", *cf.* Githitho 2021: 15, 16; "*Brachystegia* woodland", *cf.* Britton & Zimmerman 1979: 3; herein Fig 32.a.], April 1969, M.P. Clifton leg. [Mike Peter Clifton]", genitalia slide number 01/092005 I. Lehmann (NMK).

Description, male. *Head*: rough-scaled, with dense, short hair-like scales of warm-buff and cream, with a light golden glint between and around compound eyes; eyes sorghum brown with large black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small, narrowly oval, a horizontal dorsal ridge is absent; antennae long, in holotype with 0.43, in paratypes up to 0.48 length of forewing (antennae very long with 6.0 mm in paratype from near Matsangoni with gen. no. 15/022020), bipectinate, with branches of 3.0× — 3.5× width of shaft, branches scaled laterally with scales of deep olive-buff, branches at base widely separated with 1.5× width of branch, shaft densely scaled deep olive-buff dorsally with a light golden glint; labial palpi deep olive-buff mixed with scales of dark olive-buff with a light golden glint, three-segmented with central segment 1.5× longer than basal segment, the latter is 1.3× broader as 2nd segment, broadly rectangular, 2nd segment narrowly oval, segment on tip small, narrow, 25% length of 2nd segment and egg-shaped.

Thorax: Patagia with scales of deep olive-buff with a light golden glint, not forming any collar ring; tegulae with longer hair-like scales of deep olive-buff with a dark olive-buff patch below tip with a light golden glint, some scales with pale olive tips. Metathorax has long hair-like scales of cream and deep olive-buff forming a pronounced scale-crest. Forelegs with flat epiphysis that is 1.1 mm in length. Hindlegs with fine hair-like scales of cream and deep olive-buff with a light golden glint; two long pairs of tibial spurs are present with 1.3 mm/1.0 mm (upper pair) and 1.1 mm /1.0 mm (lower pair); lower pair with broader spurs. Forewing length in holotype 11.5 mm, in paratypes 11.5 — 12.5 mm and wingspan 26.0 mm in holotype, in paratypes 26.0 — 27.0 mm. Forewing upperside largely chamois in holotype, in paratypes also buffy-olive, with a light golden glint; termen and costa chamois, termen with weak triangular-shaped lunules of buffy olive or lunules are absent, costa with small striae of buffy olive; a pronounced broad patch of Isabella colour in holotype or Dresden brown in paratypes occurs from CuA_2 to near base of R_3, sometimes extending to costa; the end of lower median and CuA_2 narrowly white, other veins not distinctly coloured; from near base of lower median to near end of lower median an elongated and dominant large black rectangular patch occurs, below CuA_2 occur between two and three smaller black patches, more or less rectangular-shaped and edged ecru-olive towards dorsum; from near lower end of CuA_2 to near apex a medium broad ecru-olive band that is edged on both sides by a broader band of light brownish-olive is present; cilia short, 0.6 — 0.7 mm, ecru-olive. Underside of forewing is ecru-olive with a light golden glint and mixed with scales of light brownish-olive.

Hindwing upperside is light brownish-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly ecru-olive mixed with hair-like scales of ivory-yellow with some scales with a light brownish-olive patch below cream tips; abdominal tuft with long scales of cream-buff and ecru-olive, scales decorative with a long hair-like base and a medium broad tip, tuft short with 20 — 25% length of abdomen. Genitalia (Figs 14.b., 14.c.) with tegumen *ca.* 0.6× basal width of vinculum (in lateral view); saccus large, broad and long with a slightly rectangular tip, *ca.* 0.9× length of ventral width or as long as ventral width of valva; uncus broad with basal part 10 — 15% broader than upper part of uncus and hence, upper part width up to *ca.* 0.9× as long as basal width of valva, bifid at tip, tips rectangular, uncus with a large and wide lunule-like shape of emargination that is as deep as 25 — 40% of uncus length, without any holes dorsally. The thinly sclerotized juxta is large, almost rectangular, with a very narrow sclerotized dorsal edge and as large as the saccus. The valva is large, *ca.* 4.0× larger than saccus, rectangular-shaped, horizontal costal margin is only slightly oblique near the base of the semi-transtilla and rounded distally with some long setae, semi-transtilla is small for such a large valva and narrow with its base only 30% the width of basal part of saccus or only 50% the size of juxta and has an acuminate end, ventral edge with many short setae; only 10% or less of valva thinly membranous along the dorsal edge with a lunule-like sclerotized oblique structure with few setae near the central part of basal width of valva — this structure is as long as the horizontal base of semi-transtilla and hence, short; a large part (*ca.* 90%) of inner valva strongly sclerotized. The distal margin of valva is straight or only slightly C-shaped and 15% longer than ventral edge of valva. The sacculus is very narrow and ends in the slightly extended lunule-like appendice ventral distally. Phallus long and narrow, 2.0× length of saccus and without any structures.

Female. Unknown.

Diagnosis. *Kayamuhakaia ngwenoae* **sp. nov.** can be separated from all other congeners by its very long antennae in combination with broad, short forewings that are only slightly longer than the hindwings as well as the flat epiphysis that is 1.1 mm in length. Remarkable differences are also present in the male genitalia with a broad uncus in its lower and upper part, the latter has a large lunule-like emargination that is as deep as 40% if compared to the whole uncus length and occurs between rectangular uncus tips. The superficially similar looking *K. haberlandorum* has a narrow uncus with only 35% width at its upper part if compared to the basal part of uncus comprising a small emargination that is as deep as 20% between mucronate uncus tips. In *K. ngwenoae* **sp. nov.** the width of the upper part of uncus is between 60% and 80% if compared to its basal part. Furthermore, *K. haberlandorum* has shorter antennae and more narrow elongated forewings that are visibly longer than the hindwings in males.

Distribution. *Kayamuhakaia ngwenoae* **sp. nov.** is only known from Arabuko-Sokoke Forest Reserve (3°12' — 3°30'S and 39°47' — 40°00'E) as well as from adjacent more or less cultivated areas, *e.g.* Matsangoni and Watamu. The forest is located *ca.*70 km northeast of Mombasa and *ca.*2 km inland from the Indian Ocean at its southern end. All areas belong to the "*Zanzibar-Inhambane regional mosaic*" and "*Swahilian regional centre of endemism*", respectively.

Kayamuhakaia ngwenoae **sp. nov.** is classified as endemic to the "*Swahilian regional centre of endemism*" *sensu* Clarke (1998: 61 + Fig 7). It is an endemic species of *Arabuko-Sokoke Forest* and its adjacent areas.

Noteworthy, the new species was never recorded by I.L. during fieldwork in cultivated areas of Malindi and Gede in September 1989 and January 1995. In contrast, *K. haberlandorum* is known from Malindi and occurs sympatric with *K. ngwenoae* **sp. nov.** in Arabuko-Sokoke Forest as well as near Watamu.

Habitat. Arabuko-Sokoke Forest represents the highest diversity of species of *Kayamuhakaia* for any lowland forest at present and is considered herein as microrefugium (*cf.* Table 2). Hence, this forest is described in detail (*cf.* Fig 32.a.):

Arabuko-Sokoke — also known as "Shikoku" or "Sekoki" (*cf.* "soki" below) — was early occupied and especially used for hunting by the Wata tribe ("Wa-Atha" — their name given by themselves or "Wa-Liangulu" their Mijikenda name or "Wa-Sanye" their Ki-Swahili name) as suggested by the place name "Arabuko" that was given to the forest by the Wata and derived from the Oromo language (Parker 2001: 95). "Arabuko" derives from "araba" (an elephant) and "Huko" (a man's name). Thus the word "arabuko" means "Huko's elephant" (Ian Parker pers. comm. to I.L. in December 2020). The word "Sokoke" derives from the Wata term "soki" for the red soil that occurs locally in the forest (*cf.* description of woodland type below). An extra syllable was added by Bantu speakers (Ian Parker pers. comm. to I.L. in December 2020). Noteworthy, "araba" is the name for *Cordia monoica* Roxb. (Boraginaceae) and *Ficus capreifolia* Delile (Moraceae) in the Orma language but both tree species do rarely occur in forest (Beentje 1994: 680).

Arabuko-Sokoke Forest (average annual rainfall 600 — 1100 mm) was among the first eleven *"principal proclaimed forest reserves"* in East Africa Protectorate and was named by then as *"Arabuko-Sekoki"* in the *"Forests Ordinance of 1911"* (Naval Intelligence Division 1920: 199). Githitho (2021: 15) cites a later Proclamation No. 4 of the year 1914 comprising a "forest reserve" of "132 square miles" (= 341.88 km^2).

The forest was used by the Bajuns from Mambrui (near Malindi) before 1896 for tapping of rubber (Bradley Martin 1973: 87, citing various times Fitzgerald 1898, *e.g.* 63) from the liana *Landolphia kirkii* Dyer (Apocynaceae) and by Giryama since 1890 to around 1902 for trade of gum copal (Bradley Martin 1973: 75, 76, 77) collected from *Hymenaea verrucosa* Gaertn. (Caesalpinioideae, *cf.* Fig 31.c.).

Today, the Forest Reserve is 417.64 km^2 in size (*cf.* Bennun & Njoroge 1999: 82; Githitho 2021: 15) and comprises the largest continuous coastal lowland forest in Eastern Africa. The forest is internationally renowned for its rare endemic bird species (six endemics among 261 bird species) and hence, is designated as an *"Important Bird and Biodiversity Area /IBA"* (*cf.* Bennun & Njoroge 1999: 82) as well as one of Kenya's *KBAs* (UNDP 2021: 21). Together with "Mida Creek, Whale Island and the Malindi-Watamu Coast" it forms part of a UNESCO Biosphere Reserve while the latter three areas represent also one of Kenya's *KBAs* (UNDP 2021: 24). There are many people who help to protect the forest, *e.g.* 50 beekeeping groups and 26 butterfly farming groups (**Nature***Kenya* 2017; *cf.* the following species).

The forest habitats have an altitude range of *ca.* 10 m at Watamu — 206 m in the southwestern part of Arabuko-Sokoke. They belong to the global biodiversity hotspot*"Coastal forests of Eastern Africa"* that are among the top ten most important sites on the African continent with Arabuko-Sokoke as one of their *"priority sites for vascular plants, birds, mammals and reptiles"* (Burgess 2000: Table 4.9.4).

Arabuko-Sokoke comprises four different indigenous forest and woodland types largely dominated by woody legumes representing also the largest family Fabaceae with 62 species out of 605 vascular plant species that occur in the forest (Githitho 2021). The forest comprises the following types *sensu* Britton & Zimmerman (1979: 3) as well as *sensu* Githitho (2021: 15, 16):

First, the driest part with average rainfall of *ca.* 600 mm comprises 53 — 66% of Arabuko-Sokoke forest and is dominated by *"Cynometra-Manilkara forest" sensu* Britton & Zimmerman (1979: 3) or *"Cynometra forest" sensu* Githitho (2021: Fig 1) comprising *Cynometra webberi* Baker f. (Caesalpinioideae), *Brachylaena huillensis* O. Hoffm. (Asteraceae; rare species today due to logging after 1979), *Euphorbia murielii* N.E.Br. (synonym: *Euphorbia candelabrum* Trémaux /Euphorbiaceae), *Oldfieldia somalensis* Milne-Redh. (Picrodendraceae) and *Manilkara sulcata* Dubard (Sapotaceae), the latter grows up to 15 m height in the South but only up to 4 m in the Northwest.

Second, the central and southern part is *"open woodland"* (*cf.* Fig 32.a.) dominated by *Brachystegia spiciformis* Benth. and *Julbernardia magnistipulata* Troupin (Caesalpinioideae) growing on reddish-yellow to white, loose, sand to loamy sand defined as Albic Arenosols and Orthic Ferrasols (Kenya Soil Survey 1982).

Third, some parts of the north-central and southeastern forest were called *"Afzelia forest"* by Britton & Zimmerman (1979: 3) dominated by *Afzelia quanzensis* Welw., *Julbernardia magnistipulata* Troupin, *Hymenaea verrucosa* Gaertn., *Dialium orientale* Baker f. (Caesalpinioideae) and *Drypetes reticulata* Pax (Putranjivaceae) as well as *Encephalartos hildebrandtii* A. Braun & C. D. Bouché (Zamiaceae) in the lower tree canopy.

Fourth, a *"mixed wetter semi-deciduous forest"* (*cf.* Githitho 2021: Fig 1) on coral rag that receives more than 1000 mm (or *ca.* 1100 mm?) of average annual rainfall and is called *“lowland rain forest”* by Britton & Zimmerman (1979: 3). It is closely located to Gede Forest Station referred to as the “Mida-Gede forest” by Britton & Zimmerman (1979: 3). The “Mida-Gede forest” was first described in context to other similar forests by Moomaw (1960: 37) and is still figured by Githitho (2021: Fig 1). The former authors stated that less than 20 km^2 remain of this *“lowland rain forest type”* and that it is “systematically destroyed”. Dominant tree species comprise, *e.g.* *Sterculia appendiculata* K. Schum. (Malvaceae), *Combretum schumannii* Engl. (Combretaceae), *Lannea schweinfurthii* Engl. var. *stuhlmannii* Kokwaro, *Sorindeia madagascariensis* DC. (Anacardiaceae) and *Lecaniodiscus fraxinifolius* Bak. (Sapindaceae).

Githitho (2021: Fig 1) did not separate the third and fourth forest type but treated both as a *“Mixed forest type”*. According to the opinion of I.L. it is likely that there was further modification in tree species dominance due to selective logging and absence of natural regeneration of valuable timber trees in the “Mida-Gede forest” during the past 60 to 100 years, *e.g.* of *Sterculia appendiculata* K. Schum. (Malvaceae) and *Milicia excelsa* C.C. Berg (Moraceae). This assumption of I.L. is supported by Britton & Zimmerman (1979: 3) who stated that sawmills at Arabuko, Dida and Kararacha ceased operations for valuable timber long time ago.

Biological traits. The biology of *K. ngwenoae* **sp. nov.** is unknown.

Etymology. The new species is named for Fleur Ng’weno to honour her significant contributions to the growth of conservation strategies as well as growing number of naturalists in Kenya since 1963, *e.g.* as the Honorary Secretary of the East Africa Natural History Society/**Nature***Kenya*, as a member of the Board of Directors of the National Museums of Kenya (NMK) and as co-editor of the first *Kenya National Environment Action Plan* in 1994.

Fleur was born on 3rd June 1938 in Beirut (Lebanon) where her father was working as an administrator in the French lycée. In 1971, she founded the “Wednesday Morning Birdwalks” in Nairobi for the East Africa Natural History Society and led most of them for 49 years, introducing and fascinating many of today’s naturalists and bird guides into the amazing life of nature. As a very active naturalist until present (June 2025), Fleur was part of a team that discovered the first breeding ground for one of the world’s rarest species of birds, the Clarke’s Weaver, *Ploceus golandi* (Clarke, 1913) in 2013, found only in Arabuko-Sokoke Forest and nearby Dakatcha Woodlands.

She was the editor of *Rainbow* Children’s Magazine for 19 years and the lead author of *Learning for Sustainable Living in Kenya*, a teacher’s guide to the environment produced by **Nature***Kenya*. Furthermore, she is the author of the chapter *Sound, Sight, Stories and Science: Avoiding Pitfalls in Ethno-ornithological Research, with Examples from Kenya* in the book *Ethno-ornithology: Birds, Indigenous Peoples, Culture and Society* (Tidemann & Gosler 2010). Fleur received for her hard work the “BirdLife International Conservation Achievement Award” at the BirdLife100 World Congress in London in September 2022 (Fleur Ng’weno pers. comm. to I.L. in 2023).

Kayamuhakaia kasikamwiuae sp. nov.

Figs 3.c., 14.d.

Type locality and repository: Kenya, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Male, holotype, "Kenya [North Coast, Kilifi County], Arabuko-Sokoke Forest [forest interior], 6 km W [West of] Gede 03°17'S 39°59'E, 70 m [correct are 40 m, collecting Site in *"lowland rain forest" sensu* Britton & Zimmerman 1979: 3], 27/03/2004, J. & W. [Dr. Jurate & Willy] De Prins leg.", genitalia slide number 18/022020 I. Lehmann (RMCA).

Description, male. *Head*: rough-scaled, with dense, short hair-like scales of cream and ivory-yellow, with a light golden glint between and around compound eyes; eyes light brownish-olive with black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are large oval, a horizontal dorsal ridge is absent; antennae medium long, 0.40 length of forewing, bipectinate, with branches of 3.5× width of shaft, branches scaled laterally with scales of cream, branches at base widely separated with 1.2× width of branch, shaft densely scaled cream with a light golden glint; labial palpi three-segmented with a narrowly rectangular basal segment, central segment narrowly oval and 1.2× length of basal segment, segment on tip is very small, egg-shaped, 15% length of central segment; labial palpi deep olive-buff with a light golden glint.

Thorax: Patagia with long hair-like scales of cream with a light golden glint, not forming any collar ring; tegulae with hair-like scales of cream mixed with ivory-yellow. Metathorax has long hair-like scales of cream forming a small scale-crest. Forelegs with long and flat epiphysis that is 1.0 mm in length. Hindlegs with fine hair-like scales of cream with a light golden glint; two pairs of tibial spurs are 1.1 mm/1.0 mm (upper pair) and 0.8 mm/0.7 mm (lower pair). Forewing length is 10.0 mm and wingspan 22.0 mm. The forewing is short and does only slightly extend beyond hindwing. Both forewings are largely worn; but have possibly a pronounced broad patch of Isabella colour from CuA_2 to near base of R_3 or extending to costa.

Hindwing upperside is light brownish-olive with a light golden glint.

Abdomen: Mainly cream mixed with hair-like scales of ivory-yellow; abdominal tuft with long scales of cream-buff, tuft short with 20% length of abdomen. Genitalia (Fig 14.d.) with tegumen *ca.* 0.3× basal width of vinculum; saccus large, broad and long with a rounded tip, as long as ventral width of valva; uncus broad with basal part 60% broader than upper part of uncus and hence, upper part up to *ca.* 0.4× as long as basal width of valva, bifid at tip, tips acuminate, uncus with wide lunule-like shape of emargination that is only as deep as 20% of uncus length but as wide as 40% of basal width of uncus, with two small oval holes dorsally. The valva is large, *ca.* 5.0× larger than saccus, rectangular-shaped, horizontal costal margin is only slightly oblique near the base of semi-transtilla and rounded distally with some long setae, semi-transtilla is extremely small and narrow with its base only 20% the width of basal part of saccus, tip acuminate, ventral edge with few short setae; near upper basal edge of valva with a lunule-like sclerotized oblique structure with few setae — this short structure is 80% longer as the horizontal base of semi-transtilla. The distal margin of valva is C-shaped and 20% longer than the ventral edge. The sacculus is very narrow and ends in the slightly extended lunule-like appendice ventral distally. Phallus long, narrow, 2.0× length of saccus and without any structures.

Female. Unknown.

Diagnosis. *Kayamuhakaia kasikamwiuae* **sp. nov.** can be separated from all other congeners by the following combination of characters: First, the forewings are short and do only slightly extend beyond the hindwings. Second, the antennae are medium long. The former character is shared with *K. ngwenoae* **sp. nov.** but not with *K. haberlandorum* that has elongated forewings which extend well beyond the hindwings. *Kayamuhakaia ngwenoae* **sp. nov.** can be visibly separated from both other species as it has very long antennae as well as a larger forewing size. Third, the distal margin of valva is C-shaped in *K. kasikamwiuae* **sp. nov.** but not C-shaped in both other species. Fourth, further differences in the male genitalia comprise the shape of uncus: in *K. ngwenoae* **sp. nov.** occurs a broad uncus in its lower and upper part, the latter has a large lunule-like emargination that is as deep as 40% if compared to the whole uncus length, additionally rectangular uncus tips are present. In contrast, the uncus tips are acuminate in *K. kasikamwiuae* **sp. nov.** and mucronate in *K. haberlandorum*. In both latter species is the lunule-like emargination between both uncus tips as deep as 20% or less if compared to the whole uncus length. Hence, *K. haberlandorum* shares more characters with *K. kasikamwiuae* **sp. nov.** as *K. ngwenoae* **sp. nov.** (*cf.* diagnosis of *K. mkuwadziensis* **sp. nov.**).

Distribution. *Kayamuhakaia kasikamwiuae* **sp. nov.** is only known from Arabuko-Sokoke Forest Reserve (*cf. K. ngwenoae* **sp. nov.**) and is classified as endemic to the "*Swahilian regional centre of endemism*" *sensu* Clarke (1998: 61 + Fig 7) as well as *Arabuko-Sokoke Forest endemic* species.

Kayamuhakaia kasikamwiuae **sp. nov.** occurs sympatric with *K. haberlandorum* and *K. ngwenoae* **sp. nov.**, contributing to the highest diversity of lowland species of *Kayamuhakaia* in Arabuko-Sokoke Forest at present.

Habitat. See detailed information in context with *K. ngwenoae* **sp. nov.**

Biological traits. The biology of *K. kasikamwiuae* **sp. nov.** is unknown.

Etymology. The new species is named in honour of Alice Kasika Mwiu (Matano Mane, Kilifi County) who activily helps to protect Arabuko–Sokoke Forest from illegal activities and who successfully manages more than 200 bee hives in the forest that produce, *e.g.* more than two tonnes of honey per year. She represents one of the members of an impressive community-driven forest conservation project — comprising more than 50 beekeeping and 26 butterfly farming groups — that aims to draw a livelihood from this precious ecosystem without destroying it, supported by *“Integrating Livelihoods and Conservation — People Partner with Nature for Sustainable Living”* developed by BirdLife Denmark, **Nature***Kenya*, **Nature***Uganda* as well as Bird Conservation Nepal (**Nature***Kenya* 2017: 1, 2).

***Kayamuhakaia petermuriithii* sp. nov.**

Figs 3.d., 15.a.

Type locality and repository: Kenya, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Male, holotype: “Coll. [Collection] Museum Tervuren, Kenya, Taita Hills [Taita-Taveta County], Yale indigenous forest (L4) [= southeastern part of Yale Forest: 3°24’26”S 38°18’19”E /elevation is 1.804 m] 14 – 03–1999, U.Dall’Asta [Dr. Ugo Dall’Asta leg.]”; on second label: “Hg+Hal.[?]”; genitalia slide number 27/012020 I. Lehmann (RMCA).

Paratype: Male, “Kenya, Tsavo – ca. 30 km S Voi [correct are *ca.* 40 km southeast of Voi], Taita Discovery Centre [today Kivuli Camp, Rukinga Wildlife Sanctuary, Tsavo Conservancy, Taita-Taveta County] 1 km west TDC [= Taita Discovery Centre], 475 m [484 m], 3°43’S 038°46’E [correct are: 3°42’19”S 38°46’33”E], 23.III.2004 [23rd March 2004], leg. J. & W. [Dr. Jurate & Willy] De Prins”, genitalia slide number 13/032020 I. Lehmann (MWM).

Description, male. *Head*: rough-scaled, with dense, short hair-like scales of cream and ecru-olive, with a light golden glint between and around compound eyes; eyes brownish-olive with many small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small, narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.39 — 0.41 length of forewing (0.39 in holotype), bipectinate, with long branches of 3.5× — 4.0× width of shaft, branches scaled laterally with scales of dark olive-buff, branches at base widely separated with 1.5× width of branch, shaft densely scaled dark olive-buff dorsally with a light golden glint; labial palpi three-segmented with a broad rectangular basal segment that is 1.5× as broad as the central segment, the latter is narrowly oval and as long as the basal segment, segment on tip long and egg-shaped, 30% length of central segment; labial palpi brownish-olive mixed with cream.

Thorax: Patagia with cream coloured scales with dark olive-buff towards tip, not forming any collar ring; tegulae with longer hair-like scales of cream with dark olive-buff towards tip with a light golden glint, some scales with pale olive tips. Metathorax has long hair-like scales of cream forming a scale-crest. Forelegs with needle-like epiphysis that is 0.6 mm in length. Hindlegs with fine hair-like scales of cream and dark olive with a light golden glint; two pairs of tibial spurs are very long with 1.4 mm/1.2 mm (upper pair) and 1.0 mm/0.8 mm (lower pair) in holotype, 1.3 mm/1.1 mm (upper pair) and 1.0 mm/0.9 mm (lower pair) in paratype; lower pair with slightly broader spurs. Forewing length is 11.5 — 12.0 mm and wingspan 25.5

— 26.5 mm (26.5 mm in holotype). Forewing elongated and visibly longer than hindwing in holotype, upper-side largely brownish olive with a light golden glint; costa broadly cream-buff with small brownish olive spots, termen broadly buffy olive with small lunules of brownish olive; a pronounced broad patch of Isabella colour from CuA_2 to near base of R_2; lower median and upper part of CuA_2 in holotype and paratype not distinctly white or ivory yellow, other veins also not distinctly coloured; below lower median and CuA_2 are black patches absent; from near lower end of CuA_2 to near apex a broad buffy olive band; cilia long, 0.7 — 0.9 mm, cream-buff with buffy-olive at tip. Underside of forewing buffy olive with a light golden glint and mixed with scales of cream.

Hindwing upperside buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream-buff with a light golden glint mixed with hair-like scales of buffy olive and brownish olive; abdominal tuft with long scales of cream-buff, tuft medium long with 20 — 25% length of abdomen. Genitalia (Fig 15.a.) with tegumen *ca.* 0.4× basal width of vinculum; saccus broad, twice as broad as basal width of aedeagus and medium long, namely 15% shorter than ventral width of valva; uncus broad and not elongated, 15% shorter in length as its basal width, basal part of uncus *ca.* 35% broader than upper part, bifid at tip, emargination wide with 60% of uncus basal width, lunule-like in shape, only as deep as 15 — 20% of uncus length, tips of uncus acuminate, uncus without any holes dorsally. The thinly sclerotized juxta is *ca.* 0.8× as large as saccus, almost rectangular, with a very narrow sclerotized dorsal edge and two long thorn-like appendices. The valva is large, *ca.* 4.5× larger than saccus, rectangular-shaped, horizontal costal margin is only slightly oblique (almost rectangular) near the base of the semi-transtilla and rounded distally with some long setae; semi-transtilla is broad and with its base as broad as basal part of saccus, 90% the size of juxta, and its posterior margin has a vertical position of 90°, tiny tip is acuminate, ventral edge with many short setae; *ca.* 30% or less of valva thinly membranous along the dorsal edge with a short lunule-like sclerotized oblique structure with few setae near the central part of basal width of valva — this structure is as long as the horizontal base of semi-transtilla and hence, short; a large part (*ca.* 90%) of inner valva sclerotized. The distal margin of valva is S-shaped and 10% longer than the ventral margin. The sacculus is very narrow and ends in the slightly extended lunule-like appendice ventral distally. Phallus long, narrow with 3.0× length of saccus, without any structures.

Diagnosis. *Kayamuhakaia petermuriithii* **sp. nov.** can be separated from all other congeners by the following characters: First, the distal margin of valva is S-shaped and 10% longer than the ventral margin (*cf.* diagnosis of *K. triangularis*) in combination with an almost rectangular-shaped semi-transtilla. Second, an uncus with a large but not deep lunule-like emargination that is as wide as 60% of the basal width and located between acuminate uncus tips. Similar characters occur in *K. kasikamwiuae* **sp. nov.** with an emargination that is as wide as 40% of the uncus basal width. The latter species can be separated from *K. petermuriithii* **sp. nov.** as its distal margin of valva is C-shaped. The superficially similar looking species *K. haberlandorum* has a slightly C-shaped distal margin of valva and a narrow elongated uncus that is 20% broader on the basal part if compared to the upper part as well as 15% longer than its basal width while in *K. petermuriithii* **sp. nov.** the basal part of uncus is 35% broader and the uncus length is 15% shorter than its basal width. Two characters shared with *K. haberlandorum* comprise the medium long antennae and the forewings that are longer than the hindwings. However, the forewings of the latter species are more contrasting coloured and without a broad cream costal margin, with several black patches below lower median as well as with a narrowly white lower median and CuA_2 (*cf.* diagnosis of *K. aarviki* **sp. nov.**).

Distribution. *Kayamuhakaia petermuriithii* **sp. nov.** is known from two areas west and southeast of Voi (southeast Kenya) located in two different phytochoria, namely from a montane forest patch in the Taita Hills/*"northern Eastern Arc Mountains"* that belong to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161) as well as from a lowland area southwest of Kivuli Camp located *ca.* 50 km southeast from the Taita Hills in the *"Somalia – Masai regional centre of endemism" sensu* White (1983: 110).

Due to these contrasting records in regard to the altitude as well as based on morphological similarities to three Zanzibar-Inhambane endemics, *K. petermuriithii* **sp. nov.** is classified as *Afromontane/ Zanzibar-Inhambane linking* as well as *Taita Hills near-endemic* species including the *"Eastern Arc Forests"* ecoregion as well as the adjacent *"Northern Acacia-Commiphora Bushlands and Thickets"* ecoregion *sensu* Burgess *et al.* (2004: Fig 2.2, 250, 298). The species might also occur on the Sagalla Hills, Maungu Hills and/or Mount Kasigau. Its present range occurs in a montane forest and a nearby lowland bushland and/or woodland area located in the Tsavo Conservancy. This represents almost certainly a relict distribution in a lowland area that was once covered by Afromontane forest (*cf.* Discussion).

Noteworthy, there is no other record among six Lepidoptera samples taken in Yale Forest (*cf.* Fig 32.b.) by scientists of the Taita Hills Biodiversity Project (THBP). Hence, *K. petermuriithii* **sp. nov.** is rare within its distribution range and on the Taita Hills in particular with only one record among 55 Lepidoptera samples taken by the THBP on six hills, namely Mbololo, Ngangao, Chawia, Mwacha, Mwachora and Yale during November 1996 to July 2000 (Dall'Asta 2004 and Ugo Dall'Asta pers. comm. to I.L. in 2007). This is supported by the fact, that I.L. also checked all the available boxes including Lepidoptera collected by the THBP with not yet spread specimens in the RMCA (Tervuren) in September 2007.

Based on this comprehensive collection of Lepidoptera taken during long-term field surveys, this is in regard to the rarity of this new species a similar pattern as for *K. haberlandorum* in Kaya Muhaka as well as in Gogoni Forest Reserve (*cf.* "Rarity" of *K. haberlandorum*).

Habitat. The Eastern Arc Mountains comprising 13 isolated mountain blocks and have gone through cycles of erosion and uplifting since 290 Ma with most recent uplifting 30 Ma — 25 Ma as well as during the last 7 Ma in eastern Tanzania and southeast Kenya (Lovett 1985; Griffiths 1993: 15; Newmark 2002: 7). The Taita

Hills, together with Maktau Hill, Sagalla Hills, Maungu Hills as well as Mount Kasigau, form the only *"northern Eastern Arc Mountains"* in Kenya by using a 500 m (instead of 600 m) elevation contour line *sensu* Platts *et al.* (2011: 317, 321). The Taita Hills (*ca.* 250 km^2/Vuria representing the highest point at 2.208 m), comprise only 6 km^2 of natural forest (Newmark 1998: 10). Hence, these forests are among the most endangered in Kenya (Beentje 1988) with the greatest forest loss among the 13 blocks mainly during the last 250 years, namely 98% (Newmark 1998: 70). Due to human activities the remaining natural forest in the Taita Hills is highly fragmented and threatened comprising 13 small patches of 185 ha (Mbololo Forest) to 0.5 ha (Kichuchenyi Forest) with 184 woody plant species including four Taita endemics (Thijs *et al.* 2013: 1, 12). All 13 patches belong to the *"Eastern Afromontane Biodiversity Hot Spot"* (Brooks *et al.* 2004) and represent one of Kenya's *KBAs* (UNDP 2021: 21).

Yale Forest — also known as Iyale Forest (*cf.* Gacheru *et al.* 2024: 18; Fig 32.b.) — is an *"Undifferentiated Afromontane forest" sensu* White (1983: 165) located *ca.* 3 km south of Wundanyi (*cf.* map in Bennun & Njoroge 1999: 122) and comprises two patches that are together between 1 hectare (ha) and 2 ha in size (Bennun & Njoroge 1999: 121; Chege & Bytebier 2005: 232). The collecting Site of the holotype is located on an elevation of 1.804 m and inside of one indigenous forest patch that occurs below but adjacent to the rocky outcrop of a hill culminating at 2.104 m (Dall'Asta 2004: 193; Ugo Dall'Asta pers. comm. to I.L. in 2007). The two forest patches have with 1000 trees per ha, including 50 buttressed trees per ha, a high tree density with a closed canopy and many old trees based on data collected on four plots of 20 m x 20 m in size and surveyed in March 2000. According to the field data, *Xymalos monospora* Baill. (Monimiaceae) is among the most common tree species in Yale Forest. Other tree species comprise *Albizia gummifera* C.A.Sm. (Mimosoideae), *Tabernaemontana stapfiana* Britten (Apocynaceae) and *Phoenix reclinata* Jacq. (Arecaceae) with understorey tree, shrub and liana species such as *Dracaena steudneri* Engl. (Asparagaceae), species of *Psychotria* L. (Rubiaceae) and *Agelaea pentagyna* Baill. (Connaraceae), Chege & Bytebier (2005: 233). Thijs *et al.* (2013: 10) stated that both forest patches of Yale are "disturbed" but unfortunately did not provide any detailed data on disturbance.

Of interest is the record of the paratype found in a lowland area at 484 m near Kivuli Camp. This camp and its surrounding habitats are located in the Tsavo Conservancy and belong to the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110) but are located only *ca.* 14 km northeast of Mount Kasigau (1.568 m) that belongs to the Eastern Arc Mountains (Medley & Kalibo 2007: 151; Medley & Maingi 2014: 1, 3). The semi-deciduous bushland and/or woodland habitat near Kivuli Camp can be classified as *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket"* and *"Somalia-Masai secondary grassland and wooded grassland" sensu* White (1983: 113, 114). The paratype locality is dominated by tree species of *Acacia* Mill. (Mimosoideae), *e.g. A. nilotica* (L.) Willd., *A. bussei* Harms, *A. etbaica* Schweinf., *A. mellifera* Bosc and shrub species of *Grewia* L. (Malvaceae), *e.g. G. tephrodermis* K. Schum. and *G. plagiophylla* K. Schum. (Ugo Dall'Asta pers. comm. to I.L. in 2007).

The paratype of *K. petermuriithii* **sp. nov.** indicates that this habitat was once covered by Afromontane forest extending from Mount Kasigau into the Lowlands during arid phases (*cf.* Discussion).

Between Mount Kasigau and the paratype collecting Site tree species such as *Melia volkensii* Gürke (Meliaceae), *Commiphora baluensis* Engl., *C. kataf* Engl. (synonym: *C. holtziana* Engl./ Burseraceae), *Combretum hereroense* Schinz, *Terminalia spinosa* Engl., *T. brownii* Fresen. (Combretaceae), *Manilkara mochisia* Dubard, *M. sulcata* Dubard (Sapotaceae), *Newtonia hildebrandtii* Torre and *Tamarindus indica* L. (Caesal-pinioideae) are common. On and near Mount Kasigau a diverse semi-deciduous bushland as well as an *Acacia-Commiphora* bushland and woodland dominated by *Euphorbia quinquecostata* Volkens (Euphorbiaceae) occur in an altitude range of 520 to 955 m. Montane woodland occurs above 650 m as well as evergreen forest (altitude range 1086 to 1380 m) with Afromontane and coastal (forest) affinities have been found based on 338 woody plant species including several Taita endemic species (Medley & Kalibo 2007: 149, 155, 156, 157; Medley & Maingi 2014: Table 2).

Rainfall is variable between 247 mm and 744 mm. Both habitats receive an average annual rainfall of *ca.* 500 mm in the Lowlands and up to 1300 mm towards the hill tops (*cf.* Bennun & Njoroge 1999: 121; Medley & Kalibo 2007: 151).

Biological traits. The biology of *K. petermuriithii* **sp. nov.** is unknown.

Etymology. The species is named for the Kenyan conservationist Peter Kinyua Muriithi (Kiambu / Nairobi) for his always save driving to various research Sites of I.L. located in and near Nairobi, *e.g.* Karura Forest, Oloolua Forest, as well as to Lake Bogoria and nearby areas during the years 2015 to 2019.

Peter was born on the southern slopes of Mount Kenya in Gichugu Division (northwest of Embu) at Kirima in Gachigi Sub-location (Kirinya District) in July 1978. He is a keen and knowledgeable ornithologist, an active member of **Nature***Kenya* since 2007 and responsible for Membership Marketing at present.

Kayamuhakaia nubifera (Bethune-Baker, 1909) **comb. nov.**

Figs 3.e., 3.f., 3.g., 15.b., 15.c., 15.d., 15.e.; Fletcher (1968: Fig 12)

Type locality and repository: Kenya, the Natural History Museum, London, UK (NHMUK formerly BMNH).

Original combination: "*Marshalliana nubifera,* sp. n." Bethune-Baker, G.T. (1909): *Annals and Magazine of Natural History*, Ser. 8, Vol. iii, May 1909, p. 425: "Type 1 ♂: [Kenya] — Nairobi, April, [wingspan] 32 mm." Based on data collected by I.L. in the BMNH the holotype represents a female and not a male comprising the label data: “Nairobi 12 April 1907”, on second label “BMNH genital slide Cossid no. 22” [incorrectly considered as Cossidae].

<u>Synonym</u>: “*Metarbela latifasciata* n. sp.” Gaede, M. (1929): *21. Family: Metarbelidae.* In: *Seitz, A. (ed.) The Macrolepidoptera of the World*, Vol. 14, p. 508: “Type 1 ♀ [deposited in BMNH]: [Kenya] — East Africa, [wingspan] 28 mm”, *cf.* Figs 3.f. and 15.d. herein. Based on data and comparison of genitalia slides by I.L. in the BMNH the holotype represents a female of *M. nubifera* and hence, is considered herein as synonym of *M. nubifera*, comprising the label data: “Nairobi [Kenya] April 1920, W.N.[?] van Someren 5.600 ft.”, on second label “BMNH genital slide Cossid no. 21” [incorrectly considered as Cossidae].

<u>Notes</u>: Hampson (1910) transferred the type of “… nubifera, B.-Baker” to the genus *Metarbela* Holland, 1893. Hampson, G.F.: *Annals and Magazine of Natural History*, Ser. 8, Vol. vi, July 1910, p. 124.

This species was also transferred to *Metarbela* by Aurivillius, C. (1910): *Lepidoptera.* Arbelidae. In: Sjöstedt, Y. (ed.) *Wissenschaftliche Ergebnisse der schwedischen zoologischen Expedition nach dem Kilimandjaro, dem Meru und den umgebenden Massaisteppen Deutsch-Ostafrikas 1905—1906*, Part 9, p. 49.

The female specimens that Aurivillius (1910) published as „Metarbela nubifera BAKER?” are described herein as *Kayamuhakaia tombutynskii* **sp. nov.** (see below).

Fletcher (1968: 329) presented two females (not figured by him) from “Ruwenzori: Ibanda, 4,700 ft., [1.433 m, average annual rainfall 1679 mm] …” and “Uganda: Fort Portal, 5,000 ft., [1.524 m, average annual rainfall 1623 mm] …” Both females were not studied by I.L. but certainly represent at least one undescribed species of *Kayamuhakaia.* Hence, they are not considered herein as “Metarbela nubifera (Bethune-Baker)” as the latter species is endemic to Nairobi and perhaps to its adjacent areas in central Kenya.

Additional material examined. Female, “Dr. van Someren [V.G.L. van Someren leg.] Nairobi [Kenya, Nairobi City County], Oct [October] 1927, [deposited in BMNH]”; on second label: “van Someren collection 1959 — 468”; on third label: “Metarbela nubifera B.-Bk. W.H.T. Tams det.”; on fourth label: “BMNH drw. [ex drawer] 18104”; genitalia slide number 15/032020 I. Lehmann (BMNH). Female, “Loresho Ridge Nairobi [1°14’48”S 36°46’06”E], Kenya, Mar [March] 1976, M.P. [Mike Peter] Clifton [leg.]”, genitalia slide number 01/032020 I. Lehmann (NMK).

Male, “Nairobi Kenya April 1960 R.H. Carcasson [Robert Herbert Carcasson leg.]”, genitalia slide number 02/082005 I. Lehmann (NMK), *cf.* Figs 3.g. + 15.b. herein; male, “Kenya: Nairobi: 28.IX.1927 [28th September 1927] D.M. Hopkins [leg.]”; on second label: “J.J. Joicey Coll. [collection] B.M. [= British Museum] 1927 — 538”, on third label: “ex drawer 32613”; genitalia slide number 18/112007 I. Lehmann (BMNH).

Re-Description, female (based on two females). *Head*: rough-scaled, with dense, short and long hair-like scales of deep olive-buff with dark olive below scale tips and a light golden glint between and around compound eyes; eyes sorghum brown or ecru-olive with black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are rudimentary or small narrow slits, a horizontal dorsal ridge is absent; antennae very long, 0.45 — 0.55 length of forewing with branches 0.3× width of shaft on lower 25% of antenna and 1.7× up to 2.0× width of shaft towards tip, branches are flat (viewed laterally), widely separated at base with 1.4× width of branch, scaled cream-buff laterally, shaft densely scaled cream-buff dorsally mixed with scales of dark olive; labial palpi half of eye-diameter in length, dark olive-buff, only two-segmented with basal segment short, narrowly rectangular, 2nd segment narrowly oval but slightly broader and 1.3× longer than basal segment.

Thorax: Patagia with scales of deep olive-buff and ecru-olive towards scale tips forming no collar ring; tegulae with same coloured scales. Metathorax has longer hair-like scales of cream forming a little pronounced scale-crest with scales of ecru-olive below scale tips. Forelegs are without epiphyses. Hindlegs with fine hair-like scales of deep olive-buff with ecru-olive towards tip; two pairs of tibial spurs are present, upper pair 0.9 mm/0.8 mm in both females, lower pair 1.3 mm/ 1.0 mm in length (1.1 mm/0.8 mm in gen. no. 15/032020). Forewing length 12.5 mm (in gen. no. 15/032020) and 14.0 mm, wingspan 28.0 mm and 31.0 mm. Forewing upperside deep olive-buff with a light golden glint and with an elongated dominant rectangular patch of Isabella colour or of buffy olive extending from CuA_2 to costa; costa not distinctly coloured; CuA_2 is not distinctly marked (in fresh females a reduced ivory-yellow "Y" in horizontal position is possibly present?); a medium broad sub-terminal line occurs from near apex to the end of CuA_2 and is broadly edged buffy olive; termen Isabella colour or buffy olive mixed with deep olive-buff with triangular striae of buffy olive; veins not distinctly coloured; cilia very long, 1.3 mm (in both females), deep olive-buff with tips of buffy olive. Underside of forewing is ecru-olive with a light golden glint.

Hindwing upperside deep olive buff with scale tips of buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly buffy olive mixed with cream and deep olive-buff hair-like scales; abdominal tuft short, tuft 20% length of abdomen, buffy olive. Postabdominal structure and genitalia (Figs 15.c., 15.d., 15.e.) have papillae anales with short setae and small lobes, one lobe 40% or 50% length of narrow dorsal width of segment 8 (viewed laterally/ viewed dorsally in gen. no. 21 BMNH) and with one lobe as large as only 8% or 10% of the papillae anales (viewed ventrally). Segment 8 is narrow rectangular, thinly sclerotized; base of one anterior apophysis is 0.5× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is medium long, namely 0.4× longer than the dorsal width of segment 8 and without a broader end, usually slightly bent upwards; the dorsal width of segment 8 is bent inwards at centre (viewed dorsally in gen. no. 21 BMNH); the posterior apophyses are very long, 2.3× — 2.5× as long as anterior apophyses, with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 30 — 40% of the whole length of posterior apophysis, the latter are strongly bent upwards. The ductus bursae is short with 25 — 35% shorter than one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no membranous structure; corpus bursae is thinly membranous, without any structures, elongated oval-shaped, and if not pressed and not broken 1.5× as large as segment 8.

Description, male. *Head*: rough-scaled, with dense, short and long hair-like scales of deep olive with cream base as well as pale olive-buff scale tips and a light golden glint between and around compound eyes; eyes mummy brown without patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are narrow slits, a horizontal dorsal ridge is absent; antennae bipectinate, very long, 0.55 length of forewing (in both males) with long branches of 4.5× width of shaft, widely separated at base with 1.3× width of branch, scaled cream-buff laterally, shaft densely scaled cream-buff dorsally mixed with scales of deep olive (in both males); labial palpi unknown.

Thorax: Patagia with scales of deep olive with a cream base and cream scale tips forming no collar ring; tegulae with same coloured scales. Metathorax has longer hair-like scales of deep olive mixed with long scales of deep olive-buff forming a pronounced scale-crest mainly with scales of ecru-olive and deep olive-buff. Forelegs are unknown. Hindlegs (missing in male with gen. no. 18/112007) with fine hair-like scales of deep olive-buff and tips of pale olive-buff; two pairs of tibial spurs are present, 1.0 mm/0.8 mm (upper pair) and 0.9 mm/0.7 mm (lower pair). Forewing length 11.5 mm (in male with gen. no. 05/082005) and 11.0 mm, wingspan 26.0 mm and 25.0 mm, respectively. Forewing upperside largely buffy olive as well as tawny-olive with a light golden glint and with an elongated dominant rectangular patch of Saccardo's umber (in gen. no. 05/082005), or the patch is tawny-olive, extending from CuA_2 to near costa and bent inwards between M_2 and R_5; costa buffy olive in both males; upper two-thirds of CuA_2 as well as end of lower median distinctly marked white in both males and resulting in a dominant white "Y" in horizontal position; end of 1A + 2A also narrowly marked white in both males; a medium broad sub-terminal line of buffy olive occurs from near apex to the end of CuA_2 and is broadly edged Saccardo's umber (in gen. no. 05/082005) or tawny-olive; termen Saccardo's umber or buffy olive with triangular striae of sepia; veins not distinctly coloured; cilia very long, 1.3 mm in both males, colourful with Saccardo's umber at base, or buffy olive, with cream at centre and dark olive-buff tips, or tips of Saccardo's umber. Underside of forewing is buffy olive and dark olive-buff with a light golden glint.

Hindwing upperside is Saccardo's umber, or Dresden brown with a light golden glint; cilia as long as in forewing, buffy olive with white tips in both males; underside as in forewing.

Abdomen: Mainly buffy olive mixed with hair-like scales of pale olive-buff and Saccardo's umber; abdominal tuft long, 35% length of abdomen (in both males), Saccardo's umber mixed with sepia, or Dresden brown mixed with dark olive-buff. Genitalia (Fig 15.b.) with tegumen *ca.* 0.3× basal width of vinculum; saccus broad, twice as broad as basal width of aedeagus and medium long, namely 20% shorter than ventral width of valva; uncus broad, upper part narrower as basal part, width of upper part of uncus *ca.* 0.8× as broad as basal width, bifid with mucronate tips, emargination as deep as 35% of uncus length and as wide as 40% of basal uncus width, lunule-like in shape; uncus with a narrow oval hole dorsally. The thinly sclerotized juxta is *ca.* 0.3× as large as saccus, almost rectangular, with two long thorn-like appendices dorsally. The valva is large, *ca.* 4.5× larger than saccus, rectangular-shaped, horizontal costal margin is almost rectangular near the base of the semi-transtilla and rounded distally with some setae, semi-transtilla is small and with its base only 20% as broad as basal part of saccus and 25% the size of juxta, its end is acuminate but tiny, ventral edge without setae; *ca.* 30% of valva thinly membranous along the dorsal edge with a short lunule-like sclerotized oblique structure with few setae near the central part of basal width of valva — this structure is as long as the horizontal base of semi-transtilla and hence, short; a large part (*ca.* 70%) of inner valva strongly sclerotized. The distal margin of valva is strongly C-shaped and as long as the ventral margin. The sacculus is very narrow and ends in an extended almost rectangular appendice ventral distally that is 20% as long as ventral edge of valva. Phallus is long, narrow, tube-like, 3.0× length of saccus and without any structures.

Diagnosis. The males of *K. nubifera* can be separated from all other congeners by their very long antennae with 0.55 length of forewing in combination with mucronate uncus tips, a strongly C-shaped distal margin of valva and an extended almost rectangular appendice ventral distally that is 20% as long as ventral edge of valva.

The length of the male antennae is similar in the much smaller species of *K. wellsi* **sp. nov.** but 0.60 length of forewing in *K. vau-alba*. A common character in regard to the antennae is shared with three other species, namely their long branches on the antennae that are among the longest in the genus: in *K. nubifera* 4.5× width of shaft, in *K. wellsi* **sp. nov.** 3.5× — 4.0× width of shaft, in *K. fontainei* **sp. nov.** as well as in *K. vau-alba* 5.0× width of shaft.

Kayamukakaia nubifera shares a similar forewing pattern with *K. vau-alba, K. fontainei* **sp. nov.** and with *K. ngwenoae* **sp. nov.** although the antennae of both latter species are shorter with 0.41 length of forewing in the former species and 0.43 — 0.48 in *K. ngwenoae* **sp. nov.** The latter two species can be further separated from *K. nubifera* based on characters in the male genitalia: First, the distal margin of valva is S-shaped in *K. fontainei* **sp. nov.** and only slightly C-shaped in *K. ngwenoae* **sp. nov.** Second, the tips of uncus are mucronate in *K. nubifera* but rectangular in *K. ngwenoae* **sp. nov.** and acuminate in *K. fontainei* **sp. nov.**

The uncus is among the broadest of *Kayamuhakaia* in all three species with the basal part 50% as broad as the upper part in *K. fontainei* **sp. nov.** but 70% as broad as the upper part in *K. ngwenoae* **sp. nov.** as well as in *K. nubifera*. Hence, both latter species share an important character, namely the width of uncus.

The female of *K. nubifera* can be separated from all other congeners also by the very long antennae in combination with long branches towards tip of antennae as well as only two-segmented labial palpi. *Kayamuhakaia nubifera* is superficially very similar in size and wing pattern to the female of *K. nanyukiensis* **sp. nov.** In contrast to the latter species are the anterior apophysis bent upwards, the ductus bursae is short namely at least 25% shorter than the length of the posterior apophyses and the corpus bursae is elongated oval-shaped that is only visible as long as the female genitalia is not broken or pressed below glass (*cf.* diagnosis of *K. nanyukiensis* **sp. nov.** below).

Distribution. *Kayamuhakaia nubifera* is only known from Nairobi (altitude range 1.568 m — 1.895 m) located *ca.* 25 km east of the Kenya Rift and in the *Afromontane archipelago-like regional centre of endemism.*

Noteworthy, several morphological characters are shared with *K. ngwenoae* **sp. nov.** that represents a Zanzibar-Inhambane endemic. Hence, *K. nubifera* is classified as *Afromontane/Zanzibar-Inhambane linking* as well as Nairobi endemic species, in particular endemic to the drier montane forest and woodland habitats in and near Nairobi. It occurs possibly sympatric with *K. nanyukiensis* **sp. nov**., *e.g.* in and near Ngong Forest.

Habitat. The East African plateau supported formerly a dry type of forest in which Afromontane and non-Afromontane species occurred together. Only small and few forest fragments remain until present in and near Nairobi (average annual rainfall 925 mm) and were classified as *"Dry transitional montane forest"* by White (1983: 166). The main canopy is at 15 — 20 m with emergents up to 32 m, *e.g.* in Karura Forest (1045 ha in size), a potential habitat for *K. nubifera.* Emergents comprise in Karura Forest, *e.g. Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae) and *Craibia brownii* Dunn (Papilionoideae). Noteworthy, one of the first ten forest nurseries of British East Africa was established in Karura Forest before the year 1920 (Naval Intelligence Division 1920: 425) suggesting also a local forest management in at least some parts of Karura Forest.

According to observations of I.L., Karura Forest represents largely an old secondary forest at present — that might still include primary forest structures, *e.g.* near the Karura River with few large and tall trees (25 — 32 m height) of *N. buchananii* (Mimosoideae), *C. brownii* and the rare treelet *Uvariodendron anisatum* Verdc. (Annonaceae).

Based on unpublished fieldwork data collected in the central part of Karura Forest and to the South of New Runda by Lehmann (2017: comprising all plant specimens, including seedlings, measured with their height, diameter at breast height and crown diameter on three Sample Sites, each 25 m x 25 m, in May and June), the dominant tree species have often a height below 15 m and include *Drypetes gerrardii* Hutch. (Putranjivaceae), *Rawsonia lucida* Harv. & Sond. (Achariaceae), *Markhamia lutea* K. Schum. (Bignoniaceae), *Brachylaena huillensis* O. Hoffm. (Asteraceae), *Warburgia ugandensis* Sprague (Canellaceae), *Croton megalocarpus* Hutch. (Euphorbiaceae) and *Calodendrum capense* Thunb. (Rutaceae). It is possible that *W. ugandensis* was once more dominant and more common in drier primary forests in and near Nairobi (Q. Luke pers. comm. to I.L. in 2015). Understorey tree, shrub and liana species comprise, *e.g. Dracaena steudneri* Engl. (Asparagaceae), *Strychnos usambarensis* Gilg (Loganiaceae), *Vepris simplicifolia* Mziray (Rutaceae), *Scutia myrtina* Kurz (Rhamnaceae/ shrub and liana), *Psydrax schimperiana* Bridson (Rubiaceae) and the rare *Uvariodendron anisatum* Verdc. (Annonaceae) occurs sometimes close to the Karura River.

No species of *Kayamuhakaia* was recorded during five light-trapping nights using two light-traps on the three Sample Sites mentioned above.

The collecting Site on the Loresho Ridge was located just outside of Nairobi town (today near Lower Kabete Road) in a cultivated home garden but adjacent to large and old trees of *Croton megalocarpus* Hutch. (Euphorbiaceae) spread round the edge of a marshy area in the 1970s (Mike Peter Clifton pers. comm. to I.L. in 2016) representing a relict of a former *"Dry transitional montane forest" sensu* White (1983: 166).

Biological traits. The biology of *K. nubifera* is unknown. Since several drops of resin were found on the female collected on Loresho Ridge, I.L. assumes that this indicates that larvae feed on bark and/or in wood where pupation takes place, *e.g.* likely in wood of *Croton megalocarpus* Hutch. (Euphorbiaceae).

***Kayamuhakaia nanyukiensis* sp. nov.**

Figs 4.a., 4.b., 16.a.; Lehmann *et al.* (2018: Fig 2, bottom row, right)

Type locality and repository: Kenya, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, female, "Nanyuki Kenya [Laikipia County], April 1958, R. [Robert Herbert] Carcasson [leg.]", genitalia slide number 25/022020 I. Lehmann (NMK).

Paratypes: Female, "Ngong Nairobi" [Kenya, Ngong, Kajiado County and/or Nairobi City County], Mar-Apr [March to April] 1954, Fowler & Coulson [leg.]" genitalia slide number 07/032020 I. Lehmann (BMNH); female, "GM House [= General Manager's House at 0°13'03"N 37°07'33"E], Lolldaiga Hills [Lolldaiga Hills Ranch and Wildlife Conservancy], Nanyuki, Laikipia [*ca.*15 km northeast from Nanyuki, Laikipia County], 2.100 m [2.109 m altitude], 05/2016 [May 2016], M. [Mike] Roberts [leg.]", genitalia slide number 19/032020 I. Lehmann (NMK); female, same locality, March 2016, Mike Roberts [leg.], no genitalia dissection done (deposited in NMK collection); female, same locality, May 2017, Mike Roberts [leg.], genitalia slide number 26/032020 I. Lehmann (in private collection I.L.); female, "Kenya centr. Mount Kenya W Naro Moru River Lodge [Nyeri County] S 0°09'14" E37°00'41" 1.950 m ü. NN [1.948 m altitude], 06.-08.04.2019 LF ["LF" = Lichtfang = light trapping] leg. Fiebig & Schellhorn", on second label "coll. R. Fiebig [collection Ralf Fiebig/ Roßleben]", on third label "BC KEN 1103 ["BC" = barcode, "KEN" = KENYA]", genitalia slide number 11/112028 I. Lehmann (presented to the ZSM);

female, “Nanyuki Kenya [Laikipia County], April 1958, R. [Robert Herbert] Carcasson [leg.]”, on second label “BMNH drw. [ex drawer] 18626”, genitalia slide number 08/042020 I. Lehmann (BMNH).

Description, female. *Head*: rough-scaled, with dense, short and long hair-like scales of deep olive-buff with dark olive or Isabella colour below scale tips (only ♀ gen. slide 07/032020) and a light golden glint between and around compound eyes; eyes sorghum brown with small black patches; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are large narrowly oval, a horizontal dorsal ridge is absent; antennae long, 0.42 (in holotype) and 0.41 — 0.46 length of forewing in paratypes with branches 0.3× width of shaft on lower 30% of antenna and 1.2× — 1.6× width of shaft towards tip (1.5× in holotype); branches are medium broad (viewed laterally), widely separated at base with 1.3× width of branch, scaled cream-buff laterally, shaft densely scaled cream-buff dorsally mixed with scales of dark olive; labial palpi half of eye-diameter in length, dark olive-buff, three-segmented with basal segment short, broadly rectangular and 1.4× broader than central segment, the latter 2nd segment is oval, 3rd segment on top is egg-shaped, very long with 0.8× as long as central segment (♀ labial palpi broken in gen. no. 11/112028).

Thorax: Patagia with scales of deep olive-buff, cream-buff and ecru-olive or chamois towards scale tips forming no collar ring; tegulae with same cloured scales. Metathorax has longer hair-like scales of cream and cream-buff forming a little pronounced scale-crest. Forelegs are without epiphyses. Hindlegs with fine hair-like scales of deep olive-buff and cream-buff with ecru-olive towards tip; two pairs of tibial spurs present, 1.1 mm/0.7 mm (upper pair), 0.9 mm/0.6 mm (lower pair) in length; similar in paratypes with 1.1 mm/0.9 mm (upper pair) and 1.0 mm/0.8 mm (lower pair), *e.g.* genitalia slide number 19/032020. Forewing length 13.0 mm (in paratypes 12.5 mm — 13.5 mm), wingspan 29.0 mm (in paratypes 28.0 mm — 30.0 mm). Forewing upperside is variable coloured, with cream-buff or drab-grey with a light golden glint and with an elongated dominant rectangular patch of honey yellow or light brownish olive extending from CuA_2 to costa; costa is distinctly coloured with chamois or light brownish olive (in genitalia slide numbers 19/032020, 08/042020, 11/112028); CuA_2 is distinctly marked narrowly white or ivory-yellow including a reduced “Y” in horizontal position on lower median near the beginning of CuA_2 in all females; a medium broad drab-grey sub-terminal line occurs from near apex to the end of CuA_2 and is edged light brownish olive in all females; termen chamois or drab-grey with triangular striae of light brownish olive; other veins not distinctly coloured; cilia very long, 1.5 mm (in all females), deep olive-buff with tips of buffy olive or pale olive-buff with light brownish olive tips. Underside of forewing is warm-buff or ecru-olive with a light golden glint.

Hindwing upperside is chamois or ecru-olive with a light golden glint; cilia and underside as in forewing (in genitalia slide numbers 19/032020, 08/042020, 11/112028).

Abdomen: Mainly with cream scales of chamois to scale tip or cream with deep olive-buff scale tips (in genitalia slide numbers 19/032020, 08/042020, 11/112028); abdominal tuft short with 20% length of abdomen, buffy olive with light brownish-olive scale tips. Postabdominal structure and genitalia (Fig 16.a.) have papillae anales with short and long setae and very small lobes, one lobe 30% or 40% length of narrow dorsal width of segment 8 and with one lobe as large as only 6% or 9% of the papillae anales (viewed ventrally). Segment 8 is narrow rectangular, thinly sclerotized; base of one anterior apophysis is 0.8× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is long, namely 0.7× longer than the thinly sclerotized dorsal width of segment 8 and without a broader end, usually slightly S-shaped, not bent upwards; the dorsal width of segment 8 is slightly bent inwards at centre; the posterior apophyses are long, 2.0× as long as anterior apophyses (in all females), with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 50% of the whole length of posterior apophysis, the latter are slightly bent upwards. The ductus bursae is very long, at least as long as one posterior apophysis or up to 30% longer than the latter, thinly membranous, without any structures; below the base of the ductus bursae occurs a plate-like membranous structure; corpus bursae is thinly membranous, without any structures, always rounded in shape and never elongated, and if not pressed and not broken 1.2× as large as segment 8 or slightly smaller than segment 8 (viewed laterally).

Diagnosis. The female of *K. nanyukiensis* **sp. nov.** can be separated from all other congeners by three-segmented labial palpi with a very long third segment on top in combination with slightly S-shaped and long anterior apophyses that are 70% longer than the dorsal width of segment 8. Furthermore, the ductus bursae is very long, namely at least as long as one posterior apophysis or up to 30% longer than the latter. *Kayamuhakaia nubifera* is superficially very similar in size and wing pattern to *K. nanyukiensis* **sp. nov.** Differences between both species are significant in the genitalia as the ductus bursae is much shorter in *K. nubifera* namely at least 25% shorter than one posterior apophysis. The latter is at least 2.3× as long as one anterior apophysis and hence, much longer in *K. nubifera.* Additionally, the corpus bursae, if intact, is always rounded in shape in *K. nanyukiensis* **sp. nov.** but elongated oval in *K. nubifera.*

Distribution. *Kayamuhakaia nanyukiensis* **sp. nov.** is known from Ngong (near Nairobi) and most probably occurs as a relict species in drier woodland and forest patches near Naro Moru as well as Nanyuki (located *ca.* 140 km further to the North from Ngong) and at least *ca.*15 km further northeastwards in the Lolldaiga Hills (altitude range for Ngong is 1.824 m — 2.104 m; elevation range for Nanyuki is 1.870 m — 2.170 m; elevation range for the Lolldaiga Hills Ranch and Wildlife Conservancy is 1.750 m — 2.255 m with an average annual rainfall of 500 — 740 mm). The Lolldaiga Hills are located on the eastern Laikipia Plateau and *ca.* 15 km northwest from the lower northwestern slopes of Mount Kenya within the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161). Some areas of Ngong, Nanyuki, Naro Moru as well as of the Lolldaiga Hills abut the latter but belong to the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110).

Nevertheless, *K. nanyukiensis* **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of drier montane forest as well as woodland habitats that occur locally and scattered between Ngong and the Lolldaiga Hills.

Habitat. The habitats are located on plateau regions that were largely build-up by flood phonolites that came from sources within the central Kenya Rift between 13.5 — 11 Ma, but are much younger in the Nairobi area with 6.5 — 5.2 Ma (Shackleton 1978: 23, 24) as well as with the first build-up phase of Mount Kenya *ca.* 5.8 Ma (Schoorl *et al.* 2014: 50). This suggests that *K.nanyukiensis* **sp. nov.** might be an older species if compared to *K.nubifera.*

The paratype collecting Site in the Lolldaiga Hills and near the General Manager's house (average annual rainfall *ca.* 650 mm) is adjacent to two different habitats (*cf.* Fig 34.a.): First, *ca.* 40 m to the East occurs a relict of a drier type of *"Single-dominant Afromontane forest" sensu* White (1983) were the most dominant species once was *Juniperus procera* Hochst. (Cupressaceae). In 2018, this relict patch was open with only few scattered living and dead trees of *J. procera* with a height of 10 — 20 m. The age of this Site is certainly older than 100 years. This habitat can be classified at present as *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115) that often forms an ecotone between *J. procera* forest and deciduous *Acacia-Commiphora* bushland and thicket.*"East African evergreen and semi-evergreen bushland and thicket"* occurs in the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 111) but nearly everywhere its land is below 900 m descending to sea-level. Due to the elevation of the habitat — well above 2.000 m — it belongs to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161). In the woody understorey (rarely more than 7 m height) of one Sample Site (25 m x 25 m) occurs *Ochna holstii* Engl. (Ochnaceae) mixed with singletons of *J. procera*, *Euphorbia murielii* N.E.Br. (Euphorbiaceae), *Euclea divinorum* Hiern (Ebenaceae), *Olea europaea* L. (Oleaceae), *Gymnosporia senegalensis* Loes. (synonym: *Maytenus senegalensis* Exell/ Celastraceae) and *Lippia javanica* Spreng (Verbenaceae).

Second, *ca.* 20 m further to the North occurs another patch of *"East African evergreen and semi-evergreen bushland and thicket"* with an age of 40 — 50 years and almost certainly replaced a former drier type of *"Undifferentiated Afromontane forest" sensu* White (1983: 165) once dominated by *Juniperus procera* Hochst. (Cupressaceae) including almost pure stands of this tree species (*cf.* Fig 3 in Lehmann 2019b).

This patch — including one Sample Site — were dominated by species of *Acacia* Mill. (Mimosoideae), *e.g. A. drepanolobium* Harms and *A. xanthophloea* Benth. in February 2018. It is remarkable that no Metarbelidae was recorded on this Sample Site — comprising only young trees *ca.* 40 years old — during the light trapping on 4th June 2017 undertaken by Mike Roberts and I.L. (Lehmann unpubl. data collected on ten Sample Sites each 25 m x 25 m in the southern, central and northern part of the Lolldaiga Hills Ranch and Wildlife Conservancy established in March 2016 and June 2017; *cf.* examples in Lehmann 2019b: 17; Lehmann *et al.* 2023: 74, 75, 100).

Noteworthy, a large-scale replacement of Afromontane forest types by more fire-adapted species of *Acacia* Mill. is described for the Laikipia Plateau, *e.g.* by Taylor *et al.* (2005) and was due to climatic aridification 6,000 to 4,000 yr B.P. with frequent burning and additional overgrazing since 2,300 yr B.P.

The collecting Sites at Ngong, Naro Moru River Lodge as well as Nanyuki are unknown.

Biological traits. The biology of *K. nanyukiensis* **sp. nov.** is unknown. However, as one paratype indicates feeds the larvae most probably on bark and/or in wood including species of *Acacia* Mill. (Mimosoideae) and/or *Juniperus procera* Hochst. (Cupressaceae).

Etymology. The species is named for the holotype locality, the modern town Nanyuki, located just north of the Equator and *ca.* 30 km northwest from the peaks of Mount Kenya (5.199 m). The name “Nanyuki” is similar to the name “Nanyuke”, describing a “… considerably stream …” near the same place of the present town before 1920 but without any mention of “Nanyuki” near its banks (*cf.* Naval Intelligence Division 1920: 48). Originally, the Masai called this stream “Engare Nyuki [“Engare” is the correct spelling for “the water” in Masai language and “Nyuki” derived from “ne-nyokye” for “the red”; *cf.* also “the red soil” = “K-oonyokye” in Masai language, Hollis 1905]”. In descriptions of the late 19th century this river appears as “Ngare Nyuki” [a misspelling of Engare] corrected as “Enkare [a misspelling of Engare] Nanyokie” by Pavitt (1989: 167) who presented no translation for both words. Almost certainly, the name of modern “Nanyuki” originally derived from the words “Engare Nyuki” meaning “the red water” in the Masai language. As the town name neither appears, *e.g.* on the “Sketch Map of East Africa Protectorate” published by Sifton, Praed & Co. (1912) nor in earlier descriptions made by various explorers about areas near “Mount Kenia” in the 19th century, I.L. assumes that the beginning of the built-up phase for a town as well as its name “Nanyuki” originated after the years 1919/1920.

***Kayamuhakaia wellsi* sp. nov.**

Figs 4.c., 4.d., 16.b., 16.c., 26.c., 26.d., 27.a., 27.b., 28.c., 28.d.; Lehmann *et al.* (2018: Fig 2, middle row, right and bottom row, left)

Type locality and repository: Kenya, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, male, “GM House [= General Manager’s House 0°13’03”N 37°07’33”E], Lolldaiga Hills [Lolldaiga Hills Ranch and Wildlife Conservancy], Nanyuki, Laikipia [Laikipia County], 2.100 m [2.109 m altitude], 03/2016 [March 2016], M. [Mike] Roberts [leg.]”, genitalia slide number 06/012020 I. Lehmann (NMK).

Paratypes: male, same locality and date as holotype, no genitalia dissection done (deposited in author's collection); male, same locality and date, no genitalia dissection done (deposited in ZMH); female, "GM House [0°13'03"N 37°07'33"E], Lolldaiga Hills [Lolldaiga Hills Ranch and Wildlife Conservancy], Nanyuki, Laikipia [*ca.* 15 — 19 km northeast from Nanyuki, Laikipia County], 2.100 m [2.109 m altitude], 04/03/2016 [04th March 2016], M.[Mike] Roberts [leg.]", genitalia slide number 01/102016 I. Lehmann (ZMH); female, same locality, "10/2016 [October 2016], M.[Mike] Roberts [leg.]", genitalia slide number 07/042020 I. Lehmann (NMK); female, same locality, February 2017, Mike Roberts [leg.], no genitalia dissection done (deposited in author's collection).

Description, male (holotype). *Head*: rough-scaled, with dense, long hair-like scales of dark olive with a cream base and white scale tips; eyes sorghum brown with small black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are large narrowly oval, a horizontal dorsal ridge is absent; antennae very long, 0.53 (in holotype) and 0.44 — 0.47 length of forewing (in paratypes) with branches 3.5× width of shaft in holotype and up to 4.0× width of shaft in paratypes, branches are narrow (viewed laterally), widely separated at base with 2.5× width of branch, scaled white laterally, shaft densely scaled white dorsally; labial palpi half of eye-diameter in length, with long scales of dark olive, three-segmented, basal segment rectangular and slightly broader than central segment, the latter is broadly oval, 1.3× as long as basal segment, 3rd segment on top is narrowly oval-shaped, short, 30% as long as central segment.

Thorax: Patagia with scales of brownish olive and pure white towards scale tips, scales of sepia with a pure white tip forming a collar ring; tegulae with scales that have a cream base with brownish olive and white towards tip. Metathorax has longer hair-like scales with a broader base of cream and dark olive-buff tips forming a pronounced scale-crest. Epiphysis is rudimentary and tube-like with 0.3 mm length. Hindlegs with fine hair-like scales of cream and dark olive with pure white tips and a light golden glint; two pairs of tibial spurs are long, 1.1 mm/1.0 mm (upper pair) and 1.0 mm/0.9 mm (lower pair); lower pair with slightly broader spurs. Forewing length 7.5 — 9.0 mm (8.5 mm in holotype) and wingspan 18.0 — 20.0 mm (20.0 mm in holotype). Forewing short, broad and not longer than hindwing and almost butterfly-like, upperside largely pale olive-buff or ivory-yellow mixed with scales of sepia with a silvery glint; costa broadly deep olive-buff with small brownish olive or sepia spots, termen pale buffy-olive with a narrow sepia terminal line, lunules absent (also in male paratypes); a pronounced broad band-like patch of Isabella colour from CuA_2 to near base of M_2; all veins including lower median and upper part of CuA_2 in holotype and paratypes distinctly coloured with Isabella colour; below lower median and CuA_2 are no black patches; from near lower end of CuA_2 to near apex occurs a narrow sepia band; below near centre of CuA_2 a dominant white patch is present; cilia very long, 1.0 — 1.2 mm, cream-buff with buffy-olive at tip. Underside of forewing is dark olive-buff with a light golden glint.

Hindwing upperside pale olive-buff mixed with scales of dark olive with a light golden glint; cilia cream-buff with ivory-yellow tips; underside as in forewing.

Abdomen: Mainly cream-buff with a light golden glint mixed with hair-like scales of buffy olive; abdominal tuft with long scales of cream-buff with buffy olive tips, tuft long with 30 — 35% length of abdomen. Genitalia (Figs 16.b., 26.c., 26.d.) with tegumen *ca.* 0.4× basal width of vinculum; saccus broad, as broad as basal width of aedeagus, short with 80% of ventral width of valva; uncus broad, upper part narrower as basal part, width of upper part of uncus *ca.* 0.5× as broad as basal width, bifid at tip, uncus tips acuminate, emargination small with triangular-like shape that is only as deep as up to 10% of uncus length, uncus with a narrow elongated oval-shaped hole dorsally. The thinly sclerotized juxta is *ca.* 0.6× as large as saccus, almost rectangular, with a wide emargination along dorsal edge and two long thorn-like appendices. The valva is large, *ca.* 6.5× larger than saccus (in ventral view), rectangular-shaped, horizontal costal margin is straight and rounded distally with some long setae, semi-transtilla is small, broad with a rounded end and with its base 70% as broad as basal part of saccus, 40% the size of juxta; valva is *ca.* 60% thinly membranous on its upper part and along the dorsal edge; a short lunule-like sclerotized oblique structure occurs with setae near the central part of basal width of valva — this structure is shorter than the horizontal base of semi-transtilla; a large part with *ca.* 40% of inner valva is sclerotized. The distal margin of valva is C-shaped and 20% shorter than the ventral edge of valva. The sacculus is very narrow and ends in the slightly extended lunule-like appendice ventral distally. Phallus is long and broad, broader on basal half, with *ca.* 5.0× length of saccus, without any structures.

Description, female (genitalia slide number 01/102016). *Head*: rough-scaled, with dense, short and long hair-like scales of pale olive-buff with dark olive-buff below scale tips and a light golden glint between and around compound eyes; eyes sorghum brown with small black patches; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are small oval, a horizontal dorsal ridge is rudimentary; antennae very long, 0.47 length of forewing (in other ♀♀ 0.47 — 0.49) with branches 0.3× width of shaft on lower 30% of antenna and 1.0× width of shaft towards tip, branches are medium broad (viewed laterally), not widely separated at base with 1.0× width of branch, scaled cream-buff laterally, shaft densely scaled cream-buff and dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, deep olive-buff, three-segmented, basal segment rectangular and slightly broader than central segment, the latter is broadly oval and as long as basal segment, 3rd segment on top narrowly egg-shaped, short, 20% as long as central segment.

Thorax: Patagia with scales of cream-buff and ecru-olive towards scale tips forming no collar ring; tegulae with same cloured scales. Metathorax has longer hair-like scales of cream and cream-buff forming a little pronounced scale-crest. Epiphysis is absent. Hindlegs with fine hair-like scales of deep olive-buff with ecru-olive towards tip; two pairs of tibial spurs are present, upper pair 0.9 mm/0.8 mm, lower pair 0.7 mm/0.7 mm in length (upper pair 0.8 mm/0.8 mm and 0.7 mm/0.8 mm in lower pair in ♀♀ paratypes). Forewing length 9.5 mm (in ♀♀ paratypes 9.0 mm — 10.0 mm), wingspan 21.0 mm (in ♀♀ paratypes 20.0 mm — 22.0 mm). Forewing upperside cream-buff with a light golden glint and with an elongated rectangular patch of Isabella colour extending from CuA_2 to M_2 (best visible in fresh females); CuA_2 is distinctly marked narrowly cream including a reduced “Y” in horizontal position on lower median near the beginning of CuA_2 in all females; a medium broad buffy olive subterminal line as well as postmedial line occurs from near apex to the end of CuA_2 in all females; termen cream-buff without lunules or striae; other veins not distinctly coloured; at end of discal cell and below CuA_2 occurs a buffy olive patch; cilia very long, 1.0 mm (in all females), cream-buff with tips of deep olive-buff. Underside of forewing cream-buff with a light golden glint.

Hindwing upperside cream-buff with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with cream hair-like scales with tips of dark olive and a light golden glint; abdominal tuft unusually long for females with 35% length of abdomen, with decorative long hair-like scales with broader tips of buffy olive. Postabdominal structure and genitalia (Figs 16.c., 27.a., 27.b.) have papillae anales with short and long setae and small lobes, one lobe 50% length of dorsal width of segment 8 and with one lobe as large as 10% of the papillae anales (viewed ventrally). Segment 8 is broad rectangular, thinly sclerotized; base of one anterior apophysis is 1.2× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is 0.3× longer than the thinly sclerotized dorsal width of segment 8 and without a broader end, bent upwards; the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are 1.4× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 40% of the whole length of posterior apophysis, the latter are bent upwards; a knee-like shape of posterior apophysis is present on its first 30% of its length. The ductus bursae is short, namely *ca.* 30% shorter than one posterior apophysis, thinly membranous, without any structures. Below the base of the ductus bursae occurs a plate-like membranous structure with a deep emargination along its posterior edge. Corpus bursae is thinly membranous, without any structures, pear-shaped and slightly elongated, and if not pressed and not broken only 0.8× as large as segment 8 and hence, visibly smaller than segment 8 (viewed laterally).

Diagnosis. The females of *K. wellsi* **sp. nov.** can be separated from all other congeners by its very long antennae that are at least 0.47 length of forewing in combination with its small forewing size as well as a short ductus bursae that is 30% shorter than the posterior apophysis. The long antennae with at least 0.45 length of forewing and the short ductus bursae that is at least 25% shorter than the posterior apophysis are similar in *K. nubifera.* The smaller forewing size of *K. wellsi* **sp. nov.** as well as its broad rectangular segment 8 separates the latter species from *K. nubifera* with its narrow rectangular segment 8.

The male of *K. haberlandorum* shares two common characters with *K. wellsi* **sp. nov.**: First, the elongated and narrow uncus that is 30 — 35% narrower at its upper part if compared to the basal part of uncus. Second, the C-shaped distal margin of the valva that is 15% shorter than the ventral edge in *K. haberlandorum* and 20% shorter in *K. wellsi* **sp. nov.** The males of both species can be separated by the larger forewing size and the medium long antennae in *K. haberlandorum* with a maximum of 0.41 length of forewing but very long antennae with 0.53 length of forewing in *K. wellsi* **sp. nov.**

Distribution. *Kayamuhakaia wellsi* **sp. nov.** is only known from the Lolldaiga Hills Ranch and Wildlife Conservancy located in the Lolldaiga Hills that are also known as "Loldaika ridge" (Naval Intelligence Division 1920: 48). The latter represent the most eastern Laikipia Plateau *ca.* 19 km north of Nanyuki and *ca.* 15 km northwest from the lower northwestern slopes of Mount Kenya. The holotype locality belongs to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

Several morphological similarities are shared with Zanzibar-Inhambane as well as Afromontane endemics, *e.g.* with *K. haberlandorum* and *K. nubifera*. Hence, *K. wellsi* **sp. nov.** is classified as *Afromontane/Zanzibar-Inhambane linking* as well as endemic species of the Lolldaiga Hills. It might be still present as a relict species towards Mount Kenya in drier woodland and bushland patches occurring in grasslands that were once covered by Afromontane forest types prior to 1,700 yr B.P. (*cf.* Taylor *et al.* 2005: 844).

Habitat. *Kayamuhakaia wellsi* **sp. nov.** occurs sympatric with *K. nanyukiensis* **sp. nov.** (*cf.* habitat description above) in *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115). This vegetation type on the holotype collecting Site is more than 100 years old and replaced a drier type of *"Undifferentiated Afromontane forest" sensu* White (1983: 165) once dominated by *Juniperus procera* Hochst. (Cupressaceae) including almost pure stands of this tree species (*cf.* Lehmann 2019b: Fig 3; Fig 34.a. herein).

Biological traits. The biology of *K. wellsi* **sp. nov.** is unknown. The type locality indicates that larvae most probably feed on bark and/or in wood of species of *Acacia* Mill. (Mimosoideae) and/or *Juniperus procera* Hochst. (Cupressaceae).

Etymology. The species is named in honour of Robert James Wells, the former owner of the Lolldaiga Hills Ranch and Wildlife Conservancy (199 km^2 in size) who gave I.L. free accommodation, guides, armed rangers, transport, a great hospitality and unforgettable, precious days and nights among the diverse wildlife in the beauty of a unique Kenyan landscape on his former ranch. Spending the nights in his old ranch houses of English style or somewhere outside on the ranch, the melodies that reflect the hundreds of spirits from elephants, lions and small clouds of insects and sweeping down from the hills, were a dream of my childhood that became a vibrating echoe in my mind during fieldwork on Metarbelidae undertaken in 2016 — 2018 (*cf.* Lehmann *et al.* 2018; Lehmann 2019b: 17, 392; Lehmann *et al.* 2023: 74, 75, 100). A glimpse of the hidden beauty of Lolldaiga is presented herein with two new species.

Robert was born in London in 1960 where he later graduated from Chelsea College (as part of the University of London) with a First Class Honours degree in Zoology. Robert's maternal grandparents started with the Lolldaiga Hills Ranch in 1928 and he regularly joined the family Christmas holidays on the ranch since 1963. After he left London in 1981, Robert apprenticed himself to the farm manager

Rodney Minns, the son of Richard Nicholas Minns who farmed on Tegessi Farm (near Nanyuki) as early as 1930. Although the main activity of Lolldaiga Hills Ranch is husbandry of around 8000 livestock (cattle, sheep and camels) the emphasis has been increasingly on the conservation of the natural ecosystem and wildlife biodiversity (Robert Wells pers. comm. to I.L. in June 2017).

***Kayamuhakaia mountkenyaensis* sp. nov.**

Figs 4.e., 16.d.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Kenya centr. [Central Kenya], Mount Kenya South, Castle Forest Lodge area, S 0°22'47"/E 37°18'35" [Kirinyaga County, Mount Kenya Forest Reserve], 1900 — 2100 m ü. NN [correct altitude is 2.050 — 2.086 m], 30./31.03.2019 LF [= Lichtfang = light trapping], leg. Fiebig & Schellhorn"; on second label: "BC KEN 1274" ["BC" = barcode, "KEN" = KENYA]; on third label: "coll. [collection] R. Fiebig"; genitalia slide number 06/082028 I. Lehmann (ZSM).

Description, female. *Head*: rough-scaled, with dense, short and long hair-like scales of tawny-olive and white between and around compound eyes; eyes sorghum brown with small black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are large oval, a horizontal dorsal ridge is absent, the lower fronto-clypeus is unusually smooth; antennae medium long, 0.36 length of forewing with branches 0.3× width of shaft on lower 15% of antenna and 1.6× width of shaft towards tip, branches are medium broad (viewed laterally), not widely separated at base with 0.5× width of branch, scaled ivory-yellow laterally, shaft densely scaled ivory-yellow dorsally; labial palpi less than half of eye-diameter in length, tawny-olive, three-segmented, basal segment rectangular and 1.3× broader as well as longer than central segment, the latter is broadly oval, 3rd segment on top narrowly egg-shaped and 30% as long as central segment.

Thorax: Patagia with scales of tawny-olive and cream towards scale base forming no collar ring; tegulae with same cloured scales. Metathorax has longer hair-like scales of cream-buff and tawny-olive forming a little pronounced scale-crest. Epiphysis is absent. Hindlegs are missing. The remaining legs have fine hair-like scales of tawny-olive with a cream base. Forewing length 12.5 mm, wingspan 28.0 mm. Forewing upperside warm buff with a light golden glint and with an elongated rectangular patch of buckthorn brown extending from CuA_2 to base of M_2; CuA_2 is not distinctly marked; a medium broad light brownish olive subterminal band as well as postmedial band occur from near apex to the end of CuA_2, both bands are well separated except near the end of the latter vein; termen warm buff with well developed lunules some triangular shaped and light brownish olive; other veins not distinctly coloured; at end of discal cell a small patch of light brownish olive; below CuA_2 occur a few lines of light brownish olive to dorsum; cilia very long, 1.0 mm, warm buff with a light golden glint. Underside of forewing is ecru-olive with a light golden glint.

Hindwing upperside is ecru-olive with a light golden glint; cilia ecru-olive with ivory yellow tips; underside as in forewing.

Abdomen: Mainly cream mixed with ecru-olive hair-like scales with a light golden glint; abdominal tuft medium long with 25% length of abdomen, with decorative long hair-like scales with broader tips of cream and ecru-olive. Postabdominal structure and genitalia (Fig 16.d.) have papillae anales with short and long setae and small lobes, one lobe 50% length of dorsal width of segment 8 and with one lobe as large as 15% of the papillae anales (viewed ventrally). Segment 8 is narrow and almost triangular with a medium broad ventral band, all is thinly sclerotized; base of one anterior apophysis is 0.9× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is short, namely only as long as the dorsal width of the narrow segment 8 and without a broader end, not bent but straight; the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are very long, 2.4× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a narrow intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 45% of the whole length of posterior apophysis, the latter are not bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely *ca.* 30% longer than one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like membranous structure. Corpus bursae is thinly membranous, without any structures, oval-shaped and not elongated, and if not pressed and not broken 1.2× as large as segment 8 and hence, slightly larger than segment 8 (viewed laterally).

Male. Unknown.

Diagnosis. The female of *K. mountkenyaensis* **sp. nov.** is similar in size and wing pattern to *K. nubifera* as well as *K. nanyukiensis* **sp. nov.** but can be separated from both species by its forewing pattern that has a broad rectangular band extending only from above CuA_2 to M_2 while the band extends to near apex in *K. nubifera* and *K. nanyukiensis* **sp. nov.**

The genitalia has a unique combination of characters, namely an almost triangular shaped segment 8 with a very narrow ventral base — that is broad rectangular in the two latter species — in combination with a very long ductus bursae that is 30% longer than the posterior apophysis — similar only in *K. nanyukiensis* **sp. nov.** The antennae of *K. mountkenyaensis* **sp. nov.** are short with 0.36 length of forewing if compared to both other species with at least 0.45 length of forewing in *K. nubifera* and 0.41 in *K. nanyukiensis* **sp. nov.** The very long posterior apophyses are 2.4× as long as the anterior apophyses in *K. mountkenyaensis* **sp. nov.** and are of similar length in *K. nubifera.* The distal part of the anterior apophysis is shortest in *K. mountkenyaensis* **sp. nov.**, namely only as long as the dorsal width of the narrow segment 8, while in *K. nubifera* and *K. nanyukiensis* **sp.**

nov. the distal part of the anterior apophyses is 0.4× longer in the former species and 0.7× longer than the dorsal width of segment 8 in the latter species.

Distribution. *Kayamuhakaia mountkenyaensis* **sp. nov.** is only known from the wet lower south-central slopes of Mount Kenya that belong to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

Kayamuhakaia mountkenyaensis **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of Mount Kenya. This species cannot be older than the first build-up phase of Mount Kenya 5.8 Ma (Schoorl *et al.* 2014: 50; *cf.* also Lehmann 2019b: 340 — 341) and hence, represents a "younger species" of *Kayamuhakaia.*

Habitat. Mount Kenya is one of Kenya's *KBAs* (UNDP 2021: 21). The holotype locality is located in the Mount Kenya Forest Reserve (*cf.* map in Bennun & Njoroge 1999: 77) that was among the first 11 *"principal proclaimed forest reserves"* in the East Africa Protectorate under the *"Forests Ordinance of 1911"* (Naval Intelligence Division 1920: 199). The forest reserve is located below the Bamboo Zone and comprises 200.870 ha including *ca.* 8.700 ha plantations (The World Bank 1987: 16). In the forests of Mount Kenya occur between 882 and 1335 plant species, subspecies and varities (Gathaara 1999: 4; Zhou *et al.* 2018: Results) although they were and still are one of the most heavily utilized forest areas in Kenya.

For example, many thousands of Agikuyu (Kikuyu) families were forest squatters, *e.g.* used as labour force by the Forest Department (Leakey 1952: 108) and retired workers and their families caused at least until the mid-1970s major problems of forest encroachment. Large-scale encroachment of indigenous forest continued until the year 2000 due to illegal settlement, cultivation and through logging out of indigenous hardwood trees, *e.g. Kuloa usambarensis* Trofimov & Rohwer (synonym: *Ocotea usambarensis* Engl. /Lauraceae) resulting in extensive forest degradation amounting 11.021 ha but decreased substantially to 3.152 ha in 2002 as a result of "... important political measures... " implemented by the Government of Kenya (Vanleeuwe *et al.* 2003: 7, 13). Noteworthy, pressures from overgrazing by livestock in the forests are locally still high partly caused by droughts (Tom Butynski pers. comm. to I.L. in 2018). The cutting of grass in the Castle Forest area is usually allowed to feed livestock outside of the Forest Reserve (Peter Muriithi, **Nature***Kenya*, pers. comm. to I.L. in 2023). Additionally, Mount Kenya is one of the four sacred mountains of the Agikuyu. Hence, its forests were modified in the past and still have ethnic and political significance, *e.g.* they were part of a Kikuyu military pattern formed by the anti-White and anti-Christian "Mau Mau rebellion" during the Kenya State of Emergency (September/October 1952 — January 1960, *cf.* Leakey 1952: 2, 3, 102, 108; Bennett & Rosberg 1961: 8 — 19, 88).

The southern and south-eastern slopes of Mount Kenya receive the highest average annual rainfall on the mountain. Baker (1967: 6) mentioned an average annual rainfall of 84.48 inches (2146 mm) for the year 1959 for the Castle Forest Station (1.898 m) located *ca.* 3.5 km south of the collecting Site of the holotype (altitude 2.050 — 2.086 m). Zhou *et al.* (2018: Fig 1, Table 1) classified the forest area located below the Bamboo Zone as well as on the southern, south-eastern and eastern slopes (elevation range 1.450 — 3.110 m) as *"Lower Montane Wet Forest"* comprising 85.200 ha. Bussmann & Beck (1995: 488, *cf.* also Fig 29) classified the forests near the Castle Forest Station as well as near the holotype collecting Site as *"Ocotetalia usambarensis"* (altitude range 1.970 — 2.520 m / rainfall range 1800 — 2200 mm) separating a "secondary Ocotetalia" and a "primary Ocotetalia". The characteristic tree species of both is *Kuloa usambarensis* Trofimov & Rohwer (Lauraceae). The "secondary Ocotetalia" is characterized by often pure stands of *Macaranga kilimandscharica* Pax (Euphorbiaceae), locally mixed with *Olea capensis* L. (Oleaceae) and *Neoboutonia macrocalyx* Pax (Euphorbiaceae), occurring after intense logging of *Kuloa usambarensis*. By contrast, the "primary Ocotetalia" — rare today due to heavy logging but they still occur locally, *e.g.* on steep slopes — comprise pure stands of *K. usambarensis* with *Carex uhligii* K. Schum. (synonym: *Schoenoxiphium lehmannii* Steud./ Cyperaceae) in herb and shrub layers and are sometimes mixed with stands of *Dracaena afromontana* Mildbr. (Asparagaceae) in the lower canopy stratum and/or *Tabernaemontana stapfiana* Britten (Apocynaceae).

Zhou *et al.* (2018: Table 1) mentioned for the *"Lower Montane Wet Forest"* also other characteristic tree species, *e.g. Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae), *Vitex fischeri* var. *keniensis* Meerts (Lamiaceae/ synonym: *Vitex keniensis* Turrill, Verbenaceae), *Xymalos monospora* Baill. (Monimiaceae) and *Zanthoxylum gilletii* P.G. Waterman (Rutaceae).

Hence, the habitat of *K. mountkenyaensis* **sp. nov.** was or still is almost certainly linked to pure stands of *Kuloa usambarensis*.

Biological traits. The biology of *K. mountkenyaensis* **sp. nov.** is unknown.

Etymology. The species is named for Mount Kenya (altitude 5.199 m). The present spelling of "Kenya" was officially introduced when "Kenya Colony and Kenya Protectorate" (formerly East Africa Protectorate and Protectorate of Zanzibar; commonly known as British East Africa / B.E.A.) were established on 23rd July 1920. As the colony was named after this mountain (Ordnanee Survey 1920) the name of "Mount Kenia" changed to "Mount Kenya" as well, *e.g.* Hobley (1920), Naval Intelligence Devision (1920).

Earlier than 1919/1920, the spelling "Kenya" did most probably neither exist in regard to the mountain nor in general, *e.g.* the "Sketch Map of East Africa Protectorate" published by Sifton, Praed & Co. (1912) as well as Tania von Blixen in her letter to Ingeborg Dinesen dated 24th February, 1915 (*cf.* Lasson 1988: 66) used the spelling "Kenia". The spelling "Kenia" appears also much earlier and is linked to the WaKamba who call the mountain "Kenia" ("Ndur-Kenia" based on Burton & Speke 1858 by carefully comparing accounts of several travellers and informants regarding Ukambani: 194, 195; also Sadebeck 1879: 37).

Krapf (1860: 360, 544) published the WaKamba names "Oredoinio-eibor" and "[incorrectly] Kima ja Kegnia" which means "Mount of Whiteness".

The Masai call it "Doinyo Egere" which means "dabbled mountain" — a term that refers to the white (snow) patches (Gedge 1892: 532). The Agikuyu as the first major inhabitants of the mountain (Leakey 1952: 2) call it "Kiri-nyaga" which is a loose translation for "mountain of ostriches" Pavitt (1989: 55) [or more likely mountain of ostrich feathers] but literally means in Kikuyu "mountain filled with ostriches" (Anne Wangare-Lehmann pers. comm. to I.L. in 2025).

Another name is "Dóenyo Ebór" which means "White Mountain" *sensu* Wakefield (1870: 317; *cf.* also Hassenstein 1873) and was possibly given by the "WaSáwahili"; for the term "WaSáwahili", *cf.* Berg (1968: 35 — 37).

Note: The WaKamba name "Kegnia" (correct name and spelling by the WaKamba is "Kenia", *e.g.* Burton & Speke 1858, Pigott 1890, Gedge 1892) is based on a hearing defect established in a conversation by Rev. Dr. Johannes Lewis Krapf, a pioneer among missionary-explorers in East Africa with Kivoi — "the chief of the Wakamba tribe Kitui" — on 28th November 1849. On 03rd December 1849, Rev. Dr. Krapf stated: "*I saw from Kitui* — as the first European (Gedge 1892: 532) — ... *the Kegnia* ... *with two large horns of pillars* ... *covered with a white substance...*" (Krapf 1860: 544; also published as "Kegnia" in his notes on Ukambani as well as on a map of East Africa comprising the routes of Dr. Krapf between the years 1837 — 1855). Noteworthy, in the same book of the year 1860 the mountain was only correctly published as "Kenia" on a sketch map of East Africa compiled by Ravenstein / F.R.G.S. based on various documents and informations as part of his "Introduction" to the book of Krapf.

Pavitt (1989: 55) confirms the opinion of I.L. that the present spelling "Kenya" was created by British administrators. He also stated that the spelling was designed by them from the KiKamba words "Kiima Nyaa" or "Ki-nyaa" meaning "mountain of ostriches" [*cf.* correct translation and meaning in Kikuyu language as "mountain filled with ostriches" as well as the correct spelling for the mountain by WaKamba as "Kenia"]. Hence, most probably the spelling "Ki-nyaa" is incorrect in this context.

Kenya's highest mountain was among the highest mountains globally during the Pliocene between 5.8 — 2.8 Ma (Schoorl *et al.* 2014: 50).

***Kayamuhakaia nancycammae* sp. nov.**

Figs 4.f., 17.a.

Type locality and repository: Kenya, the Natural History Museum, London, UK (NHMUK formerly BMNH).

Material examined. Holotype, female, "E. Africa [East Africa], Mount Kenya. Kathita river. [also "River Kazita", Mount Kenya Forest Reserve, Meru County], 9.900 ft. [altitude 3.018 m — north of Rutundu lake 0°01'39"S 37°27'50"E / present "Meru Route" or nearby], 9.viii.1949. J.A. Riley. [leg.]"; on second label:

“O.U.E.C. [?] Exp. Mt. Kenya [Expedition Mount Kenya] B.M. 1949 — 562 [B.M. = British Museum]”; on third label: “BMNH drawer 32614 I”; genitalia slide number 19/022020 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense, short and long hair-like scales of Saccardo’s umber as well as cream-buff between and around compound eyes; eyes ecru-olive with small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are elongated oval, a horizontal dorsal ridge is rudimentary present on lower fronto-clypeus; antennae medium long, 0.34 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and 1.3× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.5× width of branch, scaled Saccardo’s umber laterally, shaft densely scaled cream and Saccardo’s umber dorsally; labial palpi less than half of eye-diameter in length, with scales of Saccardo’s umber and deep olive-buff, three segmented, all three segments of same length, 3rd segment on top narrowest and rectangular, both other segments rectangular with basal segment slightly broader.

Thorax: Patagia with scales of clay colour and cream towards scale base, forming no collar ring; tegulae with same cloured scales with Light Pinkish Lilac glint. Metathorax has longer hair-like scales of cream-buff and clay colour forming a little pronounced scale-crest. Epiphysis is absent. Hindlegs with fine hair-like scales of deep olive-buff, dark olive and cream scale tips with two pairs of medium broad spurs, upper pair is 1.2 mm/1.0 mm long, lower pair 1.0 mm/0.8 mm. Forewing length is 14.5 mm, wingspan 32.5 mm. Forewing upperside with a cream-buff ground-colour on inner half and clay colour on outer half with a light golden glint and an elongated rectangular patch of Saccardo’s umber extending from CuA_2 to middle of M_2, the latter has a Light Pinkish Lilac glint; CuA_2 is not distinctly marked; three small white patches below CuA_2 occur near dorsum, all are edged by a large clay coloured patch; above base of 1A+2A a large oval shaped clay coloured patch is present; a medium broad terminal band of Saccardo’s umber occurs from near apex to the end of CuA_2; end of discal cell with a small patch of clay colour; termen Saccardo’s umber without lunules; cilia very long, 1.0 mm, buffy olive with white or olive coloured tips and a light golden glint. Underside of forewing is buffy olive with a light golden glint.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly buffy olive mixed with hair-like scales with a cream base and a light golden glint; abdominal tuft medium long with 20% length of abdomen, with decorative long hair-like scales with broader tips of olive. Postabdominal structure and genitalia (Fig 17.a.) have papillae anales with short and long setae and small lobes, one lobe has the same length as the dorsal width of the narrow segment 8 and with one lobe as large as 15% of the papillae anales (viewed ventrally). Segment 8 is narrow and triangular with a narrow sclerotized ventral band; base of one anterior apophysis is 0.8× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the straight anterior apophysis is short, but 30% longer than the dorsal width of the narrow segment 8 and without a broader end; the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are very long, 2.5× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally almost to near base of papillae anales, the length of the T-shaped base is 40% of the whole length of posterior apophysis, the latter are not bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae and corpus bursae are unknown.

Male. Unknown.

Diagnosis. The female of *K. nancycammae* **sp. nov.** is slightly larger than the females of *K. mountkenyaensis* **sp. nov.**, *K. nubifera* as well as *K. nanyukiensis* **sp. nov.** The former species can be separated from the three latter species by its forewing pattern that has three well visible white patches below CuA_2 combined with a very small areole of 10% the size of upper discal cell in the forewing of *K. nancycammae* **sp. nov.** while the areole is 30% in *K. mountkenyaensis* **sp. nov.**, at least 35% in *K. nubifera* and at least 40% in *K. nanyukiensis* **sp. nov.**

The postabdominal structure has a unique combination of characters, namely a triangular shaped segment 8 with a narrow dorsal width in combination with anterior apophyses that are 30% longer than the dorsal width of segment 8. The antennae are with 0.34 length of forewing the shortest in *K. nancycammae* **sp. nov.** if compared to the three species mentioned above. The short length of the antennae, the triangular shape of segment 8 with long posterior apophyses with 2.5× as long as anterior apophyses in *K. nancycammae* **sp. nov.** are most similar in *K. mountkenyaensis* **sp. nov.** — but with the anterior apophysis as long as the dorsal width of segment 8 in the latter species.

Distribution. *Kayamuhakaia nancycammae* **sp. nov.** is only known from the upper northeastern slopes of Mount Kenya and occurs in the Rutundu lake area within the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

Hence, *K. nancycammae* **sp. nov.** is classified as *Afromontane endemic* and endemic species of Mount Kenya — possibly occurring in Riparian Forest of the Kathita River also on elevations below 3.000 m.

Habitat. The collecting Site of the holotype lies within the Mount Kenya Forest Reserve and near Lake Rutundu (*cf.* map in Bennun & Njoroge 1999: 77 as well as the habitat description of *K. mountkenyaensis* **sp. nov.**).

The northeastern slopes of Mount Kenya receive medium high average annual rainfall on the mountain. Baker (1967: Fig 1) mentioned for the Rutundu lake area an average annual rainfall of 40 — 46 inches (1016 mm — 1168 mm) for the year 1959. As the holotype was collected at an altitude of 3.018 m there are three possible habitats: First, *"Hagenia abyssinica forest" sensu* White (1983: 166) representing grassland to the East of Lake Rutundu with a narrow band of *"Hagenietalia abyssinicae" sensu* Bussmann & Beck (1995: 524) including groups of trees of *Hagenia abyssinica* J.F. Gmelin (Rosaceae) with *Carex peregrina* Link (Cyperaceae) in the herb layer; the latter species occurs often near streams (*cf.*

Haines & Lye 1983: 371, 372). Second, *"Myrsino africanae-Juniperetum procerae ekebergietosum capensis" sensu* Bussmann & Beck (1995: 512) with *Juniperus procera* Hochst. (Cupressaceae) mixed with tall trees of *Ekebergia capensis* Sparrm. (Meliaceae) and shrubs of *Myrsine africana* L. (Primulaceae). Third, *"Afromontane bamboo" sensu* White (1983: 167) comprising a bamboo forest *"Podocarpo latifolii-Sinarundinarietum alpinae caricetosum chlorosacci" sensu* Bussmann & Beck (1995: 520) dominated by *Podocarpus latifolius* R.Br. (Podocarpaceae) mixed with *Nuxia congesta* R.Br. (Stilbaceae) and overtopping the bamboo canopy of *Sinarundinaria alpina* C.S. Chao & Renvoize, now known as *Yushania alpina* W.C. Lin (Gramineae) (*cf.* White *et al.* 2001: 102).

Hence, *Kayamuhakaia nancycammae* **sp. nov.** certainly occurs in an habitat that is not dominated by woody Leguminosae.

Biological traits. The biology of *K. nancycammae* **sp. nov.** is unknown.

Etymology. The species is named in honour of Nancy Elizabeth Conztance Camm, ne Murry, born on 10th September 1927 in Cambridge (England), died on 23rd January 2012 in Nanyuki (Kenya).

Nancy moved together with her parents first to Mweiga (*ca.* 10 km northwest of Nyeri/Kenya Colony) to farm coffee in the 1930's, tried gold mining near Kakamega/Kenya Colony (*cf.* Mitchell 2004: 32) and returning once more to Mweiga at the end of the 1940's to farm pyrethrum, *e.g. Tanacetum coccineum* subsp. *coccineum* Grierson (formerly *Pyrethrum roseum* M. Bieb./ Asteraceae) which was farmed extensively in Kenya Colony by then (Collyer & Barradell 1950: 75, 82). Between 1961 and 1972 she lived in Weenen (Province of Natal, Republic of South Africa) to farm lucerne (*Medicago sativa* L./ Fabaceae) but came back to Kenya in 1972 to run "Samburu Lodge" until 1982 and a second lodge, namely "Govenor's Camp", in the Masai Mara National Reserve (MMNR) during 1977 — 1979. Nancy lived from 1982 to March 2004 in Gatuamba House (0°13'55.86"S 37°02'43.45"E, *ca.* 7 km west from Mount Kenya Forest Reserve) where she designed and produced unique and attractive knitwear, *e.g.* sweaters and blankets dyed with pure vegetable dyes obtained from roots, flowers and leaves of local plants. Nancy always supported the light trappings of I.L. at her beautiful house — built by Jo Prettejohn and "fundi" Muna in *ca.* 1946 — as well as in her large and always flowering garden area (Nancy Camm pers. comm. to I.L. in January 2006; Hilary Sommerlatte pers. comm. to I.L. in August 2023).

Remembering Nancy contains for I.L. an expressive picture showing the fearless life of a woman who lived in harmony by using a very delicate colouring for everything in the house, in the garden and in her knitwear that emphasized the pure beauty of Kenyan nature but reflecting also the warm gleam of different cultures and their fragility.

No species of Metarbelidae, *e.g. Kayamuhakaia nanyukiensis* **sp. nov.**, was found by light-trapping or other field studies in the garden area as well as close to the house (elevation 1.982 m) by I.L. during 1992 — 2017, *e.g.* near trees — older than 70 years — of *Eucalyptus globulus* Labill., *E. saligna* Smith, *E. sideroxylon* A. Cunn. (Myrtaceae, *cf.* Noad & Birnie 1990: 191 — 194) and slightly younger *Acacia xanthophloea* Benth. (Mimosoideae) trees as well as treelets of *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae). The latter were first planted in 1992 and 1993 (Figs 33.a., 33.b.).

Kayamuhakaia hermannstaudei **sp. nov.**

Figs 5.a., 17.b.

Type locality and repository: Kenya, the Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria, Republic of South Africa.

Material examined. Holotype, female, "Kenya, Mount Kenya, Rutunga Road [misspelling of Rutundu road, Mount Kenya Forest Reserve, Meru County], Juniper/Hagenia forest & fynbos mosaic [*Juniperus* L. — *Hagenia* J.F.Gmelin forest], 2.900m 0°02'53"N 37°26'14"E [altitude 2.954 m — collecting Site *ca.* 4 km east of Rutundu road], 16-11-2009., H.S. Staude [Hermann Siegfried Staude leg.]"; genitalia slide number 27/032020 I. Lehmann (TMSA).

Paratype, female, same label data as holotype, genitalia slide number 31/032020 I. Lehmann (NMK).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of greyish olive with pale olive-buff base around compound eyes; eyes Saccardo's umber with black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are narrowly elongated slit-like, a pair of projections is present, a horizontal dorsal ridge is rudimentary on lower fronto-clypeus; antennae short, 0.32 (in paratype 0.31) length of forewing with branches 0.3× width of shaft on lower 40% of antenna and 1.7 — 2.0× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.3× width of branch, scaled cream laterally, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, with scales of deep olive-buff, two-segmented, both segments are narrowly rectangular and of equal length, basal segment 0.3× broader as central segment; a segment on top is strongly reduced, tiny, triangular in lateral view, less than 10% length of central segment and hence, not counted as third segment.

Thorax: Patagia and tegulae with long hair-like scales of greyish olive and cream towards scale base forming no collar ring. Metathorax with long hair-like scales of cream-buff and dark olive-buff forming pronounced scale-crest. Epiphysis is absent. Hindlegs with fine hair-like scales of deep olive-buff, dark olive and cream scale tips with two pairs of medium broad spurs, upper pair short with 0.7 mm/ 0.6 mm, lower pair 1.1 mm/ 0.9 mm long. Forewing length 16.5 mm, wingspan

38.0 mm (in paratype 15.5 mm, wingspan 34.5 mm). Forewing upperside with a deep olive-buff ground-colour with a light golden glint and a broad, dominant rectangular patch of Mummy brown extending from CuA_2 to base of M_1, the latter has a light golden glint; CuA_2 is broadly distinctly marked with pale olive-buff scales; above base of 1A+2A occurs no oval shaped patch in holotype and paratype; a medium broad terminal band of greyish is present from near apex to the end of CuA_2; end of discal cell not distinctly coloured; termen with lunules of greyish olive, almost triangular shaped; cilia very long, 1.0 mm, deep olive-buff with a light golden glint. Underside of forewing deep olive-buff with a light golden glint.

Hindwing upperside deep olive-buff with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly deep olive-buff mixed with hair-like scales of pale olive-buff and a cream base with a light golden glint; abdominal tuft medium long with 20% length of abdomen, with long hair-like scales of pale olive-buff. Postabdominal structure and genitalia (Fig 17.b.) have papillae anales with short and long setae and lobes with one lobe 20% longer as the dorsal width of the narrow segment 8 and with one lobe less than 10% of the papillae anales (viewed ventrally). Segment 8 is narrowly rectangular, dorsally narrow and also narrow ventrally with a sclerotized dorsal and ventral band, vertically 15% longer than the long posterior apophysis; base of one anterior apophysis is 1.2× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is very narrow and short but 75% longer than the dorsal width of the narrow segment 8 and without a broader end, strongly bent downwards; the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are very long, 2.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to the base of papillae anales, the length of the T-shaped base is 50% of the whole length of posterior apophysis, the latter are bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like structure; corpus bursae is thinly membranous, without any structures, broadly oval-shaped, slightly elongated, and if not pressed and not broken 1.5× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The females of *K. hermannstaudei* **sp. nov.** represent the largest species of *Kayamuhakaia* on Mount Kenya if compared to the other five species that occur on and near Mount Kenya (*K. nubifera*, *K. nanyukiensis* **sp. nov.**, *K. wellsi* **sp. nov.**, *K. mountkenyaensis* **sp.nov.**, *K. nancycammae* **sp. nov.**). The forewing pattern is significantly darker than in the other five species and is dominated by a large Mummy brown rectangular patch above CuA_2 but it does not extend from CuA_2 to near apex as in *K. nubifera* and *K. nanyukiensis* **sp. nov.**

In the postabdominal structure of *K. hermannstaudei* **sp. nov.** occurs a unique character namely the largest lobes (*cf.* 17. b., b.1.) of the papillae anales among species of *Kayamuhakaia* that are 20% longer than the dorsal width of segment 8 (in a not pressed condition) as well as 20% larger than one base of the anterior apophysis viewed posteriorly (*cf.* 17.b., b.2.). Furthermore a unique character combination occurs in the length of the anterior apophyses that are 75% longer than the dorsal width of segment 8 combined with short antennae of 0.31 — 0.32 length of forewing. A similar length of 70% in regard to the anterior apophyses occurs in *K. nanyukiensis* **sp. nov.** in combination with longer antennae of 0.41 — 0.46 length of forewing. Segment 8 has a narrow rectangular shape in both species. In *K. nubifera* segment 8 is also narrowly rectangular in combination with very long antennae of 0.45 — 0.55 length of forewing while the length of the anterior apophyses are only 40% longer than the dorsal width of segment 8. The shape of segment 8 is broadly rectangular in *K. wellsi* **sp. nov.**, almost triangular in *K. mountkenyaensis* **sp.nov.** and triangular in *K. nancycammae* **sp. nov.**

Other remarkable differences to the latter three species exist, *e.g.* in the length of the posterior apophyses that are 1.4× as long as the anterior apophyses in *K. wellsi* **sp. nov.**, 2.3× as long as the anterior apophyses in *K. nubifera*, 2.4× as long as the anterior apophyses in *K. mountkenyaensis* **sp. nov.**, 2.5× as long as the anterior apophyses in *K. nancycammae* **sp. nov.**, but only 2.0× as long as the anterior apophyses in *K. hermannstaudei* **sp. nov.** and *K. nanyukiensis* **sp. nov.**

Hence, both latter species are morphologically more similar in regard to the postabdominal structure.

Distribution. *Kayamuhakaia hermannstaudei* **sp. nov.** is only known from the upper northeastern slopes of Mount Kenya that belong to the *"Afromontane archipelago-like regional centre of endemism". Kayamuhakaia hermannstaudei* **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of Mount Kenya.

Habitat. The collecting Site (Fig 34.b.) of the holotype and paratype is located within the Mount Kenya Forest Reserve (*cf.* habitat description of *K. mountkenyaensis* **sp. nov.**) and receives much lower average annual rainfall if compared to the habitats of *K. mountkenyaensis* **sp. nov.** and *K. nancycammae* **sp. nov.** Baker (1967: Fig 1) mentioned for the area near the collecting Site an average annual rainfall of 30 inches (762 mm) for the year 1959.

As the holotype and paratype were collected at an elevation of 2.954 m, the forest of the type locality belongs — also based on the label data — to the *"Hagenio abyssinicae – Juniperion procerae" sensu* Bussmann & Beck (1995: 526) as well as to *"Undifferentiated Afromontane forest" sensu* White (1983: 165) with annual rainfall of 750 — 1250 mm at altitudes of 2.650 — 3.200 m. Forests of this type are present in the transition zone to the drier *"Juniperion procerae"* and comprise in the assoziation of the *"Hagenio abyssinicae – Juniperetum procerae"* a high frequency of *Juniperus procera* Hochst. (Cupressaceae) with *Hagenia abyssinica* J.F. Gmelin (Rosaceae) as a co-dominant canopy tree species. In the lower canopy occur *Nuxia congesta* R.Br. (Stilbaceae), *Myrsine melanophloeos* R.Br. (Primulaceae) and *Olea europaea* L. subsp. *cuspidata* Cif. (Oleaceae) with *Daucus incognitus* Spalik, Reduron & Banasiak (synonym: *Agrocharis incognita* Heywood & Jury/ Apiaceae) as character species in the shrub and herb layer.

Hence, *K. hermannstaudei* **sp. nov.** occurs in a drier montane forest habitat that is not dominated by woody Leguminosae.

Biological traits. The biology of *K. hermannstaudei* **sp. nov.** is unknown.

Etymology. The species is named in honour for the South African Lepidopterist Hermann Siegfried Staude born in December 1956 in Krugersdorp (near Johannesburg). Hermann presented the holotype and paratype — together with other species of Metarbelidae — to I.L. in Hannover (Germany) on 25th September 2010.

Hermann made long-term significant contributions both as an individual as well as financially for the research and conservation on the lepidopterous fauna of the Republic of South Africa through the Lepidopterists' Society of Africa (Knysna). Outstanding are his surveys in 28 Nature Reserves and other protected areas in the northern and eastern side of this country where he recorded 510 species and subspecies of Geometridae between 1991 — 1999, representing *ca.* 50% of the southern African Geometridae fauna at that time (Staude 1999). Hermann's achievements for more formal relationships with nature conservation authorities resulted in a better collaboration in regard to the protection of habitats through the above mentioned Society since the year 2004.

***Kayamuhakaia aberdarensis* sp. nov.**

Figs 5.b., 17.c.

Type locality and repository: Kenya, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, female, "Kenya, Aberdares Nat. Park [Aberdare National Park, Nyeri County], alt. 2126 m Salient [correct altitude is 2.087 m, *"Lower Salient" sensu* Schmitt 1991: Fig 34.], 4/04/2000 0°23'S 36°52'E (I 6), Ugo Dall'Asta [Dr. Ugo Dall'Asta leg.]", genitalia slide number 03/042020 I. Lehmann. Paratype, female, "Kenya, Aberdares Nat. Park [Aberdare National Park, Nyeri County], M1 alt. 2073 m Salient Camping Site [correct altitude is 1.967 m, *"Lower Salient" sensu* Schmitt 1991: Fig 34.], 6/04/2000 0°22'S 36°54'E (J 6), Ugo Dall'Asta [Dr. Ugo Dall'Asta leg.]", genitalia slide number 10/112014 I. Lehmann (RMCA); paratype, female, same label data as the paratype mentioned above, abdomen missing.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream with dark olive below tips around compound eyes; eyes clay colour with small sepia spots; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae long, 0.45 length of forewing (in paratype 0.46; antennae are broken in second paratype) with branches 0.3× width of shaft on lower 30% of antenna and 1.4 — 1.5× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.3× width of branch, scaled cream laterally, shaft densely scaled cream and dark olive dorsally; labial palpi less than half of eye-diameter in length, two-segmented, with upper segment broadly egg-shaped and with basal segment broader, slightly longer and rectangular in shape.

Thorax: Patagia and tegulae with long hair-like scales of cream with Saccardo's umber below scale tip forming no collar ring. Metathorax with long hair-like scales of same colours forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs with fine hair-like scales of dark olive-buff and cream scale tips, with two pairs of medium broad spurs, upper pair short with 0.8 mm/0.6 mm, lower pair 1.0 mm/0.8 mm in length. Forewing length 13.0 mm, wingspan 29.0 mm (in paratype 11.5 mm, wingspan 25.0 mm; in paratype with missing abdomen 12.5 mm, wingspan 28.5 mm). Forewing upperside with a dark olive-buff ground-colour with a light golden glint and suffused with scales of Saccardo's umber; a broad, dominant rectangular patch of Saccardo's umber extending from CuA_2 to costa (also in paratypes), the latter has a light golden glint; CuA_2 is narrowly distinctly marked with cream scales; above base of 1A+2A occurs no oval shaped patch in holotype and paratypes; a terminal band is absent from near apex to the end of CuA_2; end of discal cell not distinctly coloured; termen without lunules; cilia very long, 1.1 mm, deep olive-buff with tips of Saccardo's umber and a light golden glint. Underside of forewing dark olive-buff suffused with scattered scales of Saccardo's umber and a light golden glint.

Hindwing upperside dark olive-buff suffused with scales of Saccardo's umber with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a light golden glint; abdominal tuft short with 15% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 17.c.) have papillae anales with short and long setae and large lobes with one lobe 90% as long as the dorsal width of segment 8 and with one lobe 30% the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and slightly broader ventrally with a sclerotized dorsal and ventral band; the shape of segment 8 is broadly rectangular, vertically 25% longer as the long posterior apophysis; base of one anterior apophysis is only 0.3× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is short, only 20% longer than the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are long, 2.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to the base of papillae anales, the length of the T-shaped base is 40% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely 1.5× as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like structure; corpus bursae is thinly membranous, without any structures, rounded in shape, and if not pressed and not broken 1.7× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The females of *K. aberdarensis* **sp. nov.** have a unique combination of characters, namely a broadly rectangular shaped segment 8 combined with anterior apophyses that are 20% longer than the dorsal width of segment 8 as well as a rounded corpus bursae that is 70% larger that segment 8. The broadly rectangular shape of segment 8 is similar in the much smaller species of *K. kismayuensis* **sp. nov.** with anterior apophyses that are 10% longer than the dorsal width of segment 8 as well as an oval-shaped corpus bursae that is 20% smaller that segment 8. Apart from the size, the shorter antennae separate both species visibly. The long ductus bursae is shared between both species since it is 50% longer than the posterior apophyses in *K. aberdarensis* **sp. nov.** and 20% longer than the posterior apophyses in *K. kismayuensis* **sp. nov.** Significant is, that the long antennae, the large corpus bursae and the two-segmented labial palpi are shared with *K. bokatolaensis* **sp. nov.** (*cf.* diagnosis of *K. bokatolaensis* **sp. nov.**).

In the postabdominal structure of *K. aberdarensis* **sp. nov.** occurs a character similar to *K. barrychappelli* **sp. nov.**, namely large lobes of the papillae anales with one lobe 90% as long as the dorsal width of segment 8 and with one lobe 30% the size of the papillae anales in the former species (*cf.* diagnosis of *K. barrychappelli* **sp. nov.**).

Distribution. *Kayamuhakaia aberdarensis* **sp. nov.** is only known from the Salient — a strip of land projecting eastward from the eastern Aberdare Range and stretching down to 1.920 m. The Aberdare Range (also known as, *e.g.* “Nyandarua Range” by the Agikuyu) has an altitude up to 4.001 m and was gazetted as Aberdare National Park (572.2 km^2) in May 1950 with three subsequent extensions until June 1968 resulting in a size of 765.7 km^2 (Schmitt 1991: 25).

Morphological similarities are shared with two lowland species, namely *K. kismayuensis* **sp. nov.** and *K. bokatolaensis* **sp. nov.**, as well as with the Afromontane endemic *K. barrychappelli* **sp. nov.**

Hence, *K. aberdarensis* **sp. nov.** is classified as *Afromontane/Guineo-Congolian linking* as well as endemic species to the montane forest and woodland habitats of the Aberdare Range, possibly occurring also on Nyeri Hill.

Habitat. The Aberdares form the easternmost edge of the Gregory Rift Valley (King 1978: Fig 3:14) or Kenya Rift of the Eastern Branch of the EARS, extending from a geological point of view from *ca.* 30 km north of the equator for *ca.* 120 km southeastwards to the Kikuyu Escarpment and to the East of Magina located *ca.* 30 km northwest of Nairobi (King 1978: Fig 3:1; Lambrechts *et al.* 2003: Map 1).

The Aberdare Range and the Salient were once part of Kenya's first game reserve, namely the *"Kenia Game Reserve"* of 1897 (Ian Parker pers. comm. to I.L. in December 2020). The forests were largely cleared until the end of 1911 (Naval Intelligence Division 1920: 190). The remaining forests between the two Chania rivers were included among the first 11 *"principal proclaimed forest reserves"* of the East Africa Protectorate under the *"Forest Ordinance of 1911"* (Naval Intelligence Division 1920: 199). The forest area of the Aberdares exceeded 1.295 km^2 in 1919 (Naval Intelligence Division 1920: 190) and comprised, without plantations, 2.191,70 km^2 in the 1980's (The World Bank 1987: 18) and 1.799 km^2 ten years later (Bennun & Njoroge 1999: 63).

The Aberdare Range is one of Kenya's *KBAs* (UNDP 2021: 25) but nevertheless its forests are under threat at present (Gacheru *et al.* 2024: 6, 16).

The temperature regimes range from "tropically moderately cool" to "tropically very cold" based on Jätzold (1981). The average annual rainfall is between 1000 — 2200 mm with highest records in the southeastern Aberdare National Park, *e.g.* near Kiandongoro Gate. The closest meterological station to the habitats of the holotype and paratypes is located *ca.* 6 — 10 km to the East in Nyeri at 1.829 m with an average annual rainfall of 924 mm. Schmitt (1991: Fig 17) presented an average annual rainfall of 1000 — 1200 mm for the area of the *"Lower Salient"*. Hence, the type localities belong to the drier areas of the Aberdare National Park.

According to Hedberg (1951) both type localities are part of the *"Montane Rain-forest Zone"* — the holotype locality additionally includes *"Secondary bushland with Toddalia"*. The detailed "Vegetation Map of the Aberdare National Park" presented by Schmitt (1991: North Sheet) shows that the holotype was collected in an *"Evergreen seasonal submontane forest" sensu* Schmitt (1991: 82) and in particular in a small patch of closed forest of the "*Cassipourea malosana* - *Setaria plicatilis* agg. community" *sensu* Schmitt (1991: 83) dominated by tall trees (up to 30 m height) of *Cassipourea malosana* Alston (Rhizophoraceae) and *Ekebergia capensis* Sparrm. (Meliaceae) with emergents of *Nuxia congesta* R. Br. (Stilbaceae). In the understorey occur *Ehretia cymosa* Thonn. var. *silvatica* Brenan (Boraginaceae) and *Erythrococca bongensis* Pax (Euphorbiaceae).

The collecting Site of the paratypes is located in *"Submontane and Secondary Bushland" sensu* Schmitt (1991) dominated by "Kikuyugrass grassland" of the "*Pennisetum clandestinum* [Kikuyu Grass] – *Cyperus rigidifolius* community" *sensu* (Schmitt 1991: 72) with few scattered trees to the South of the Treetops Lodge. The dominant species are the grass *Pennisetum clandestinum* Hochst. (Gramineae) and the sedge *Cyperus rigidifolius* Steudel (Cyperaceae). The grass *P. clandestinum* is a characteristic species that follows a period of forest clearance in the Highland Forest regions of Kenya (Edwards & Bogdan 1951: 62). This view is supported by the fact that the Salient, and including the area near the Treetops Lodge, has undergone significant changes in vegetation cover and forest destruction in particular, *e.g.* logging of *Kuloa usambarensis* Trofimov & Rohwer (Lauraceae) since the year 1932 (*cf.* Schmitt 1991: Fig 60). As *K. usambarensis* was no longer found in the Salient by Schmitt in the late 1980's, the scattered trees mentioned above represent *Cassipourea malosana* Alston (Rhizophoraceae), *Calodendrum capense* Thunb. and *Vepris nobilis* Mziray (Rutaceae), *Ekebergia capensis* Sparrm. (Meliaceae) and *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae). The latter species was additionally planted as plantation in the Aberdare forests in the 1960's, *e.g.* one plantation occurs in the *"Northern Salient"* as well as one in the *"Lower Salient"* near Treetops Gate (Schmitt 1991: 88). Noteworthy, workers of the Forest Department once lived in the Salient with their goats and sheep (Schmitt 1991: 25) and they also contributed to the origin of secondary bushlands as described above.

Hence, *K. aberdarensis* **sp. nov.** occurs in relicts of drier montane forest habitats that are not dominated by woody Leguminosae.

Biological traits. The biology of *K. aberdarensis* **sp. nov.** is unknown. However, as most of the forested areas of the Salient (*ca.* 1.920 — 2.500 m) are still dominated or were once dominated respectively, by *Cassipourea malosana* Alston (Rhizophoraceae) it is likely that the bark and/or wood of this tall tree species represents a food plant for the larvae of the new species.

Etymology. The species is named for the "Aberdare Range" — a name that was created and first published by its European discoverer Joseph Thomson (1885: 358, 359) to honour Lord Aberdare (Henry Austin Bruce 1st Baron Aberdare, 16th April 1815 — 25th February 1895) who was by then the president (since 1881) of the Royal Geographical Society (London) which had sent Thomson towards Mount Kenia. The name "Aberdare Range" was subsequently used for this mountain range, *e.g.* on the "Sketch Map of East Africa Protectorate" published by Sifton, Praed & Co. (1912), by the Naval Intelligence Division (1920: 37), on the map of the Survey of Kenya (1965), by King (1978: 31) and by Lambrechts *et al.* (2003). The mountain range was once inhabited by various tribes, *e.g.* by WaGumba, WaNdorobo, Agikuyu, Laikipia Masai and hence, is known also by various other names.

***Kayamuhakaia karenae* sp. nov.**

Figs 5.c., 17.d.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Kenia, Katamayo [misspellings of Kenya and Gatamaiyu, possibly collected in Gatamaiyu Forest Nature Reserve, *e.g.* 0°58'19"S 36°41'50"E, located north of Uplands, Kiambu County, altitude range is 2.130 — 2.645 m], 22. — 29.10.92 [1992], Dr. Politzar [leg.]"; genitalia slide number 20/032020 I. Lehmann (MWM). Paratype, female, "Kenya, Aberdares, Katamayo [possibly same locality as holotype, Kiambu County], 5.2.96 [1996], Dr. Politzar [leg.]"; genitalia slide number 30/032020 I. Lehmann (MWM).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream with dark olive-buff towards tips around compound eyes; eyes sorghum brown with black patches; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short, 0.32 length of forewing (in paratype 0.33) with branches 0.3× width of shaft on lower 30% of antenna and 1.1 — 1.3× width of shaft towards tip (in both holotype and paratype), branches are medium broad (viewed laterally), widely separated at base with 1.1× width of branch, scaled cream laterally, shaft densely scaled cream dorsally; labial palpi half of eye-diameter in length, three-segmented, with segment on top broadly egg-shaped and 60% as long as central segment (in both holotype and paratype), central segment broadly oval and as long as basal segment, the latter is slightly broader and rectangular.

Thorax: Patagia and tegulae with long hair-like scales of dark olive-buff with a golden glint forming no collar ring. Metathorax with long hair-like scales of same colour forming a little pronounced scale-crest. Epiphyses are present, needle-like, rudimentary, 0.7 mm long. Hindlegs with fine hair-like scales of dark olive-buff and a golden glint with two pairs of medium broad tibial spurs, upper pair 1.0 mm/0.7 mm, lower pair 1.1 mm/0.8 mm in length. Forewing length 17.0 mm, wingspan 37.0 mm (in paratype 16.5 mm, wingspan 36.0 mm). Forewing upperside with a dark olive-buff ground-colour with a golden glint; a broad and dominant, almost rectangular patch of Saccardo's umber extends from CuA_2 to R_3 (best visible in paratype); CuA_2 is not distinctly marked; above base of 1A+2A occurs no oval shaped patch in holotype and paratype; a weak light brownish-olive terminal band is present from near apex to the end of CuA_2 (best visible in paratype); end of discal cell not distinctly coloured; termen with weak lunules of light brownish-olive; cilia long, 1.0 mm, deep olive-buff with a golden glint. Underside of forewing is dark olive-buff with a golden glint.

Hindwing upperside is dark olive-buff with a golden glint and as forewing not suffused with scales of Saccardo's umber; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 17.d.) have papillae anales with short and long setae and small lobes with one lobe 80% as long as the narrow dorsal width of segment 8 and with one lobe 10% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and narrower ventrally dominated by a thinly sclerotized ring-like band that represents the ventral edge as well as mainly the dorsal part and hence, is only slightly narrower than segment 8 dorsally; the shape of segment 8 is narrowly triangular (viewed laterally and in holotype and paratype), it is vertically 30% longer as the long posterior apophysis (in not pressed condition); base of one anterior apophysis is 0.9× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is 70% longer than the dorsal width of segment 8 and without a broader end, not bent; the dorsal width of segment 8 is strongly and broadly bent inwards at centre; the posterior apophyses are very long, 2.1× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to the base of papillae anales, the length of the T-shaped base is 50% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like structure; corpus bursae is thinly membranous, without any structures, narrowly oval-shaped (if not pressed and not broken), only 1.2× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The females of *K. karenae* **sp. nov.** represent a species that is very similar in size, forewing pattern as well as short antennae to *K. hermannstaudei* **sp. nov**. Nevertheless, significant differences exist between both species in regard to four characters: First, the labal palpi are three-segmented with the segment on top pronounced and 60% of the length of the central segment in *K. karenae* **sp. nov.** but two-segmented in *K. hermannstaudei* **sp. nov.** Second, the length of the branches near the tip of the antennae are only 1.1 — 1.3× width of shaft in *K. karenae* **sp. nov.** but 1.7 — 2.0× width of shaft in *K. hermannstaudei* **sp. nov.** Third, the epiphyses are absent in the latter species but present in *K. karenae* **sp. nov.** representing the longest epiphyses in a female of *Kayamuhakaia* presented herein. Fourth, segment 8 has a narrow rectangular shape with a narrow dorsal as well as ventral base in *K. hermannstaudei* **sp. nov.** but is narrowly triangular in *K. karenae* **sp. nov.**

Two characters of the postabdominal structure are shared by both species: First, the similar length of the anterior apophyses that are 70% longer than the dorsal width of segment 8 in *K. karenae* **sp. nov.** and 75% longer than the dorsal width of segment 8 in *K. hermannstaudei* **sp. nov.** Second, the long ductus bursae is as long as the posterior apophysis.

Distribution. *Kayamuhakaia karenae* **sp. nov.** is only known from the southern end of the Aberdare Range, namely from the Kikuyu Escarpment Forest that includes several scattered forest fragments to the South, to the East and to the Southeast of Kijabe, *e.g.* Gatamaiyu Forest Nature Reserve and Nyamweru Forest to the North of Uplands. Both forest areas are located *ca.* 30 km northwest of Nairobi (Bennun & Njoroge 1999: 69, 70; Lambrechts *et al.* 2003: Map 2). All forest fragments belong to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

Kayamuhakaia karenae **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of the Kikuyu Escarpment Forest and nearby forest patches.

Habitat. The Kikuyu Escarpment Forest Reserve covers 376 km^2 at altitudes between 1.800 and 2.700 m and represents one of Kenya's *KBAs* (UNDP 2021: 25) as well as one of Kenya's *IBAs* (Bennun & Njoroge 1999: 69, 71).

The average annual rainfall is 1500 — 1721 mm (the latter figure is for Kieni Forest Station at *ca.* 2.500 m) with an average annual rainfall at Uplands (altitude 2.348 — 2.410 m) of 1589 mm — located *ca.* 10 km to the South of Gatamaiyu Forest Nature Reserve. The latter is located in the Southeast of the Kikuyu Escarpment Forest Reserve and represents its most southern remnant forest (Bennun & Njoroge 1999: 69, 70) that is considered herein as the collecting locality of the holotype and paratype (*cf.* Fig 35.a.).

Lambrechts *et al.* (2003: 9) mention a *"Moist Montane forest"* for this area between 2.100 — 2.500 m with some large-scale destruction for charcoal production, *e.g.* near Uplands. Characteristic tree species comprise, *e.g.* *Cassipourea malosana* Alston (Rhizophoraceae), *Kuloa usambarensis* Trofimov & Rohwer (Lauraceae) — if not logged it might be still present, *cf.* Lambrechts *et al.* (2003: Map 6 that indicates heavy logging of this species in the eastern Kikuyu Escarpment Forest Reserve), *Macaranga kilimandscharica* Pax, *Neoboutonia macrocalyx* Pax (Euphorbiaceae), *Prunus africana* Kalkman (Rosaceae) in the overstorey and *Tabernaemontana stapfiana* Britten (Apocynaceae) in the understorey.

To the South of Gatamaiyu Forest and just west and northwest of Uplands is a another potential habitat for *K. karenae* **sp. nov.**, namely Nyamweru Forest (1°S — 1°03'S and 36°39'E — 36°42'E) that was considered by Braun *et al.* (1993) as well as by Karachi *et al.* (2007: 243) as a *"secondary moist montane forest"* of *ca.* 800 ha in size. The forest is located at an elevation of 2.214 — 2.394 m. All authors reported about a widespread destruction of the natural forest habitat already before the 1890's. Nevertheless, forest patches still include the rare Kenyan endemic tree *Polyscias kikuyuensis* Summerh. (Araliaceae) mainly found in closed natural canopy forest but with poor natural regeneration possibly due to inefficient pollination (Albrecht 1993) and forest exploitation until present.

Hence, *K. karenae* **sp. nov.** occurs in wetter montane forest habitats that are not dominated by woody Leguminosae.

Biological traits. The biology of *K. karenae* **sp. nov.** is unknown.

Etymology. The species is named for Karen Christentze (Tania) Dinesen, who was called 'Tanne' by her family and close friends. Karen was born on 17th April 1885 in Rungstedlund — died 07th September 1962 in Rungstedlund, located near the fishing village of Rungsted (Denmark).

Tania Dinesen arrived on 13th January 1914 (Trzebinski 1977: 97) in Kilindini-Mombasa (B.E.A. Protectorate) and got married to the Swedish Baron Bror von Blixen-Finecke on 14th January 1914 in the D.C.s office in Mombasa. In the same month both moved to Karen Estate — with 6000 morgen and located close to the Ngong Hills — one of the largest farms in B.E.A. Protectorate in 1916 and owned by "The Karen Coffee Company Ltd." In 1925 a Swedish divorce was made absolute.

Most impressing for I.L. is how Tania often described in detail directly or indirectly the “open heart of Africa”, *e.g.* in her letter to Ingeborg Dinesen dated 19th January 1927 (*cf.* Lasson 1988: 336). Her love for B.E.A. and Kenya Colony, *e.g.* mentioned in her letter to Ingeborg Dinesen dated 29th June 1918 (*cf.* Lasson 1988: 109), was so deeply rooted in her that she tried to find land for her 153 squatter families before the farm was sold after she left Kenya Colony finally in July 1931. Her wonderful personality and love for Kenya, its people and animals was a treasure throughout her life and is expressed, *e.g.* in her distaste — shared with Denys (*cf.* etymology of *K. finchhattoni* **sp. nov.**) — that wanton killing is “... ugly or vulgar ...” (Trzebinski 1977: 249) as well as in a letter addressed to her and written by hand in KiSwahili by Mzee Jomo Kenyatta dated 03rd August 1937 (*cf.* Lasson & Selborn 1987: 133) as follows: — *“... yote ufanyayo kumbuka nchi unayoipenda na wemynji waliomo ...”* — and even in a new gramophone to which she was listening two days before she died and which was fixed to a box that once belonged to her Somali servant and friend Farah Aden. Farah first joined her in Aden (today Aden City, People’s Democratic Republic of Yemen) in December 1913 to accompany Tania to Mombasa. He stayed with her on Karen Estate since January 1914 and the last time in her life in Mombasa again, in July 1931.

One new species of Metarbelidae of an undescribed genus (Lehmann in prep.) was recorded by I.L. and by the late Joseph Mugambi Ruthiiri (NMK, *cf.* Lehmann 2011: 29, 30) in woodland dominated by old trees of *Croton megalocarpus* Hutch. (Euphorbiaceae) located adjacent to the M’bogani farm house (today Karen Blixen Museum, Nairobi) during five light-trappings in March 2015 as well as March 2016.

***Kayamuhakaia barrychappelli* sp. nov.**

Figs 6.a., 18.a.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, “Kenya NW, Maralal, Sanctuary Rd. 7.5 km E [7.5 km east of Sanctuary Road in Maralal, Samburu County], S1°05’15’/E 36°46’16 2130 m ü. NN [corrected data is: 1°05’15” N 36°46’16” E altitude 2.135 m, northwestern Karisia Hills, lower Loroghi Forest, collecting Site possibly near a sandy road], 05.04.2019 LF [“LF” = Lichtfang for light trapping], leg. Fiebig & Schellhorn”; on second label: „BC KEN 1060 [“BC” = barcode, “KEN” = KENYA]”; third label: “coll. R. Fiebig [collection Ralf Fiebig]”; genitalia slide number 22/0112028 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream with dark olive-buff towards white tips and around compound eyes; eyes light brownish-olive with small sepia spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae long, 0.45 length of forewing with branches 0.4× width of shaft on lower 30% of antenna and 1.4× width of shaft towards tip, branches are medium broad (viewed laterally), not separated at base, scaled deep olive-buff laterally, shaft densely scaled cream and dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, broken during preparation, possibly three-segmented with segment on top triangular.

Thorax: Patagia and tegulae with long hair-like scales of dark olive-buff and white tips with a vinaceous-buff glint forming no collar ring. Metathorax with long hair-like scales of cream and dark olive-buff forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs are missing. Forewing length 11.0 mm, wingspan 26.0 mm. Forewing upperside with a pale olive-buff ground-colour with a vinaceous-buff and silvery glint mixed with scales that have a sepia tip; a broad dominant, almost rectangular patch of Mummy brown extends from CuA_2 to M_3 and is less dominant coloured towards costa, edged by a narrow band of ecru-olive; CuA_2 is narrowly pure white as the base of CuA_1 and M_3 as well as the end of lower median, resembling a reduced “Y” in horizontal position; above base of 1A+2A occurs no oval shaped patch; a brownish-olive terminal band is present from near apex to the end of CuA_2; end of discal cell not distinctly coloured; termen with small lunules of brownish-olive; cilia very long, 1.3 mm, cream with deep olive-buff tips. Underside of forewing is ecru-olive with a light golden glint.

Hindwing upperside brownish-olive with a light golden glint and suffused with scales of brownish-olive as in forewing; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 18.a.) have papillae anales with short and long setae and with a pronounced belly-like shape on the central part of the papillae anales; large lobes are present with one lobe as long as the narrow dorsal width of segment 8 and with one lobe 25% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and slightly broader ventrally with a ventral edge that is bent inwards near its anterior margin; lower half of segment 8 only membranous, dominated by a narrow sclerotized ring-like band that represents a part of the ventral edge; the shape of segment 8 is narrowly rectangular (viewed laterally); base of one anterior apophysis is very small and only 0.1× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is medium long and 30% longer than the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is lunule-like bent inwards at centre, emargination small and as deep as 20% of dorsal width; the posterior apophyses are long, 2.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 60% of the whole length of posterior apophysis, the latter are not bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is medium long, namely 90% the length of one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a broadly triangular membranous plate-like structure that is fixed to the narrow sclerotized band-like structure mentioned above; corpus bursae is thinly membranous, without any structures, rounded in shape if not pressed and not broken, only 1.2× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. barrychappelli* **sp. nov.** represents a species that is similar in antennae length, wing size and forewing pattern to *K. aberdarensis* **sp. nov**. In the postabdominal structure of both species occur large lobes of the papillae anales with one lobe 90% as long as the dorsal width of segment 8 and with one lobe 30% the size of the papillae anales in the latter species but with one lobe as long as the dorsal width of segment 8 in *K. barrychappelli* **sp. nov.** Additionally, both species share also a similar length of the anterior apophyses that are 20% and 30% longer than the dorsal width of segment 8, respectively.

Differences exist in the length of the ductus bursae that is only 90% the length of one posterior apophysis in *K. barrychappelli* **sp. nov.** The latter comprises below its base a broadly triangular membranous plate-like structure that is fixed to a narrow sclerotized band-like structure ventrally. In contrast, the ductus bursae is much longer in *K. aberdarensis* **sp. nov**. with 1.5× as long as one posterior apophysis and without any plate-like structure below its base. Although the corpus bursae is rounded in both species it is 1.7× as large as segment 8 in lateral view in *K. aberdarensis* **sp. nov.** but only 1.2× as large as segment 8 in *K. barrychappelli* **sp. nov.** (if not pressed or broken).

Distribution. *Kayamuhakaia barrychappelli* **sp. nov.** is only known from the northwestern slopes of the Karisia Hills (also known as Loroghi or Lorogai Mountains / Naval Intelligence Division 1920: 49) that are covered by the Loroghi Forest. The type locality is located *ca.* 160 km to the North of the Aberdare Range. The Karisia Hills are located on the Maralal Plateau that borders the Laikipia Plateau with the latter located to the South. They belong to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161) of northern Kenya where isolated forests occur on mountains that in particular provide important water catchment and soil protection for adjacent semi-arid and arid areas located at altitudes well below 1.200 m in the *"Somalia Masai regional centre of endemism" sensu* White (1983: 110, 112).

Both plateau areas occur adjacent to the eastern flanks of the Gregory Rift Valley and Kenya Rift (EARS), respectively and on upper Miocene phonolites that originated between 16 and 11 Ma (King 1978: Fig 3:14).

Kayamuhakaia barrychappelli **sp. nov.** is classified as *Afromontane endemic* as well as endemic species to the drier forest and woodland habitats of the Karisia Hills possibly occurring also on Porror and Saanta Hill located north of Maralal.

Habitat. The forest reserves of Loroghi (altitude 1.944 — 2.329 m), Maralal (1.900 — 2.104 m) and Porror (2.040 — 2.583 m) cover together 918 km^2 of which only 290 km^2 are still covered by forest (Bussmann 2002: 28). All forests are little studied from the scientific point of view and large areas were most probably destroyed by humans during the last 23 years, *e.g.* by fire and livestock.

The temperature regime of the Karisia Hills and Maralal is a "hot, arid tropical climate" with two subhumid seasons based on Jätzold (1981). The average annual rainfall is between 1200 — 2000 mm with highest records on top of the Karisia Hills due to frequent mist cover. The closest meterological station to the habitat of the holotype is located *ca.* 7.5 km to the West in Maralal with an average annual rainfall of 1436 mm. Hence, the type locality belongs to the drier areas if compared to the average rainfall maximum on top of the Karisia Hills.

Bussmann (2002: 30, 47, 49, 50, 54, Table 2) appears to be the only one who studied the vegetation in areas around Maralal as well as in the Loroghi Forest from 1992 to 1996 (Quentin Luke pers. comm. to I.L. in 2004). He noted that many parts in the vicinity of Maralal were found by him in "... extremely disturbed conditions." Nevertheless, *Juniperus procera* Hochst. (Cupressaceae) had still a high abundance but with many trees dying or already dead. Dense shrub thickets replace the former *"Undifferentiated Afromontane forest" sensu* White (1983: 165) and were dominated by *Searsia natalensis* F.A.Barkley (synonym: *Rhus natalensis* Bernh.), *Searsia pyroides* Moffett (synonym: *R. vulgaris* Meikle/ Anacardiaceae) and *Pluchea ovalis* DC. (Asteraceae).

Large tracts of Loroghi Forest that are located in the montane zone between 2.000 — 2.300 m were formed by very old and tall *J. procera* and *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae) mixed with small trees and shrubs of *Myrsine africana* L. (Primulaceae) as well as *Pistacia aethiopica* Kokwaro (Anacardiaceae). Old forest stands with a close canopy also comprise large specimens of *Prunus africana* Kalkman (Rosaceae) and *Podocarpus falcatus* Mirb. (Podocarpaceae) with many trees of *Vepris nobilis* Mziray (Rutaceae) in the understorey. In particular *P. falcatus* is typical for wetter types of *"Undifferentiated Afromontane forest" sensu* White (1983: 165) and montane riverine forest (*cf.* White *et al.* 2001: 86). In more open areas where former Afromontane forest has been destroyed — possibly also at the collecting Site — dense bush thickets are present comprising *Euclea divinorum* Hiern (Ebenaceae), *Grewia similis* K. Schum. (Malvaceae) and *Carissa spinarum* L. (synonym: *Carissa edulis* Vahl/ Apocynaceae).

Hence, *K. barrychappelli* **sp. nov.** occurs in drier montane forest habitats — and as a relict species of the latter also in secondary vegetation — both are not dominated by woody Leguminosae.

Biological traits. The biology of *K. barrychappelli* **sp. nov.** is unknown.

Etymology. The species is named for a member of the former Game Capture Unit, Barry Chappell, who was the only Game Warden (1962 — 1965) of the Kenya Game Department who died in the course of duty, in regard to the period between 1900 — 1964 [or 1965?], when his Piper Super Cup he was flying crashed (King 2001: 207; Parker & Bleazard 2001, Appendix II: 341).

***Kayamuhakaia finchhattoni* sp. nov.**

Figs 6.b., 18.b.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, “Kenya, Transmara [formerly Trans Mara District], Lolgorien [Narok County], 2000 m [corrected altitude is 1.610 — 1.773 m], 15.3. — 5.4. 2001 Lf. [“Lf.” = Lichtfang = light trapping], leg. Dr. Politzar, Museum Witt”; genitalia slide number 09/042020 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and deep olive-buff but dark olive-buff towards white tips and around compound eyes; eyes ecru-olive with tiny dark olive spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae very long, 0.48 length of forewing length with branches 0.3× width of shaft on lower 30% of antenna and 1.2× width of shaft towards tip, branches are broad and broadest at centre (viewed laterally), not widely separated at base, scaled deep olive-buff laterally, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular and 1.3× length of central segment, central segment slightly narrower and rectangular, segment on top narrowly triangular and 80% length of central segment.

Thorax: Patagia and tegulae with long hair-like scales of cream and deep olive-buff with dark olive-buff towards white tips forming no collar ring. Metathorax with long hair-like scales of cream and dark olive-buff forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair more narrow and 0.9 mm/0.7 mm long, lower pair with both spurs 0.7 mm long. Forewing length 12.5 mm, wingspan 28.0 mm. Forewing upperside with a pale olive-buff ground-colour with a vinaceous-buff and silvery glint mixed with scales that have a dark olive-buff tip; a broad dominant, almost rectangular patch of Saccardo’s umber extends from CuA_2 to R_5 and is less dominant coloured towards costa, edged by a narrow band of ecru-olive; CuA_2 is narrowly pure white; above base of 1A+2A occurs no oval shaped patch; end of discal cell not distinctly coloured; termen with small lunules of brownish-olive; cilia long, 1.0 mm, cream with deep olive-buff tips. Underside of forewing is buffy olive with a light golden glint.

Hindwing upperside is ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream and ivory-yellow with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 18.b.) have papillae anales with short and long setae and with a little pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe 50% as long as the medium broad dorsal width of segment 8 and with one lobe 15% the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad with two small sclerotized, narrow band-like structures posteriorly and slightly narrower ventrally with a horizontal ventral edge; lower half of segment 8 is dominated by a narrow sclerotized ring-like band that represents a part of the ventral edge posteriorly; the shape of segment 8 is rectangular (viewed laterally); base of one anterior apophysis is small and only 0.5× the size of one lobe of papillae anales; the distal part of the anterior apophysis is medium long and 20% longer than the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is not lunule-like bent inwards at centre; the posterior apophyses are long, 2.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 70% of the whole length of posterior apophysis, the latter are bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely 10% longer than one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a broadly triangular membranous plate-like structure that is twice as large as one lobe of papillae anales and is fixed to the narrow sclerotized band-like structure mentioned above; corpus bursae is thinly membranous, without any structures, slightly pear-shaped if not pressed and not broken, only 0.9× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. finchhattoni* **sp. nov.** represents a species that is similar in antennae length and wing size to *K. lolgoriensis* **sp. nov**. Both species also share an almost similar length of the posterior apophyses that are 2.0× as long as anterior apophyses in *K. finchhattoni* **sp. nov.** but 1.7× as long as anterior apophyses in *K. lolgoriensis* **sp. nov.** The most striking differences between both species occur in the genitalia: First, the ductus bursae is 10% longer than the length of one posterior apophysis with the corpus bursae slightly pear-shaped in *K. finchhattoni* **sp. nov.** In contrast, the ductus bursae is 30% shorter as one posterior apophysis with a rounded corpus bursae in *K. lolgoriensis* **sp. nov.** Second, the corpus bursae is 0.9× as large as segment 8 in lateral view in *K. finchhattoni* **sp. nov.** but only 0.5× as large as segment 8 in *K. lolgoriensis* **sp. nov.** Third, the length and lateral shape of the antenna branches are broadened at centre and not widely separated at base in *K. finchhattoni* **sp. nov.** but narrow elongated in *K. lolgoriensis* **sp. nov.** on the upper two-thirds of the antenna. Fourth, the labial palpi are three-segmented in *K. finchhattoni* **sp. nov.** but two-segmented in *K. lolgoriensis* **sp. nov.** Significant characters are shared with *K. gitegaensis* **sp. nov.** (*cf.* diagnosis of the latter species).

Distribution. *Kayamuhakaia finchhattoni* **sp. nov.** is only known from Lolgorien (1°13’52”S 34°48’03”E/ elevation 1.610 — 1.773 m) located in southwest Kenya *ca.* 80 km to the East of Lake Victoria as well as *ca.* 16 km to the West of the Masai Mara National Reserve (MMNR) and the Oloololo Escarpment (also known as

Soit Ololol Escarpment). The area belongs to the *"Afromontane archipelago-like regional centre of endemism"* but is adjacent to the *"Lake Victoria regional mosaic" sensu* White (1983: 161, 179).

Kayamuhakaia finchhattoni **sp. nov.** is classified as *Afromontane endemic* species as well as *Afromontane/Lake Victoria linking* species of drier montane forest and woodland habitats of the areas in and around Lolgorien. Possibly the species occurs in a relict distribution in riverine forests and riverine thickets, *e.g.* in the MMNR.

Habitat. The average annual rainfall for Lolgorien is between 1010 — 1100 mm. Hence, forests and woodlands belong to drier types.

The undulating areas near Lolgorien comprised largely *"Evergreen clump-grassland"* with patches of semi-deciduous *"Diospyros-Olea forest"* as well as a *"Broad-leaved savanna type with Combretum mixtures of probable forest origin" sensu* Kenya Government & Ministry of Overseas Development, UK (1969) intersected by numerous drainage lines and rivers. Remnant forest patches and woodlands occur today on hill tops, hill ridges and hill slopes but are little or not yet studied from the scientific point of view. However, the area still has a higher density and extent of forest, woodland and thickets than the MMNR that has witnessed significant declines in woody vegetation between the 1960's and 1990's (Dublin 1991, Obara 1999). Large areas in the MMNR were destroyed by fire and subsequently by an increased elephant population (Dublin *et al.* 1990).

The vegetation of the MMNR (1510 km^2) has been studied in the year 1999 by Walpole *et al.* (2004: 182, 183, Table 1) resulting in 62 woody plant species. Riverine forests comprise, *e.g. Diospyros abyssinica* F. White (Ebenaceae), *Croton dichogamus* Pax (Euphorbiaceae), *Strychnos henningsii* Gilg (Loganiaceae), *Vepris nobilis* Mziray,*V. trichocarpa* Mziray (Rutaceae); woodlands and riverine thickets include, *e.g. Gymnosporia senegalensis* Loes. (synonym: *Maytenus senegalensis* Excell/ Celastraceae), *Coptosperma graveolens* Degreef (synonym: *Tarenna graveolens* Bremek./ Rubiaceae) and *Combretum molle* R.Br. (Combretaceae). More open wooded grasslands comprise *Commiphora africana* Engl. (Burseraceae), *Acacia brevispica* Harms, *A. gerrardi* Benth., *Dichrostachys cinerea* Wight & Arn. (Mimosoideae), *Grewia bicolor* Juss. and *G. similis* K. Schum. (Malvaceae). Another vegetation study was undertaken *ca.* 25 km northeast of Lolgorien on the Ol Choro Oiroua Wildlife Management and Conservation area by van Essen *et al.* (2002: 79, 80). Their results also found forest communities along drainage lines dominated by *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae) mixed with *Euclea divinorum* Hiern (Ebenaceae), *Croton dichogamus* Pax (Euphorbiaceae), *Warburgia ugandensis* Sprague (Canellaceae) and *Elaeodendron buchananii* Loes. (Celastraceae).

Hence, *K. finchhattoni* **sp. nov.** occurs in small semi-deciduous forest patches, riverine forest and/or riverine woodlands and in thicket habitats that are not dominated by woody Leguminosae. More open woodlands are locally dominated by species of *Acacia* Mill. (Mimosoideae).

Biological traits. The biology of *K. finchhattoni* **sp. nov.** is unknown.

Etymology. The species is named for Denys George Finch Hatton, 3rd son of Earl of Winchilsea and Nottingham, born 24th April 1887 in London, died 14th May 1931 when his plane crashed near Voi (Kenya). Denys came first to B. E. A. Protectorate in 1911 where he reached Mombasa and by train two days later the Norfolk Hotel in Nairobi on 18th March. After a few days he left Nairobi and bought in April — together with his partner Herbert Wreford-Smith — a farm at Sosiani (today Eldoret) and near a tiny settlement known as 'Sixty-Four' (= a survey number that means 64 miles away from the railhead Londiani) to grow flax. In 1912, Denys bought a property at Parklands (near Nairobi by then), became involved in cattle trading with the Somalis and purchased land at Naivasha to ranch cattle and attempt to grow pyrethrum. Since 1925 he considered big game hunting as a source of his income and became an Honorary Game Warden in the same year (Trzebinski 1977: 84). Denys Finch-Hatton — as spelt by Tania (*cf.* etymology of *K. karenae* **sp. nov.**) since May 1918 when she formally first met Denys — was according to her letters a keen photographer. Additionally, Trzebinski (1977: 277, 278) published examples how Denys opposed in articles in *The Times*, *e.g.* on 9th July 1929 wanton killing in the Serengeti and near Lake Natron (Tanganyika Territory), as well as the misuse of hunting licences by simply slaughtering game and reported regularly the latter to appropriate Game Wardens. This suggests that Denys was a protagonist of game preservation and hunting control, *e.g.* expressed in his game counts done in collaboration with Archie Ritchie (Chief Game Warden 1924 — 1948, *cf.* Parker & Bleazard 2001, Appendix II: 341).

Most probably, Denys was the first person in Kenya Colony — according to the opinion of I.L. — who used a plane to report about the slaughterings of game from the air as well as to plan hunting safaris from the air since early 1929 (for 1929, *cf.* Tania pers. comm. to Ingeborg Dinesen of 17th March 1929; Lasson & Selborn 1987: 127) including possibly areas east of the type locality of *K. finchhattoni* **sp. nov.**, *e.g.* suggested by his last safari with John Alexander Hunter in 1931 (later Game Warden in Ukambani and Kajiado 1942 — 1957, *cf.* Parker & Bleazard 2001, Appendix II: 341).

For Tanne, it was always the greatest luck in her life to fly with Denys (Tania pers. comm. to Ellen Dahl on 12th October 1930, *cf.* Lasson 1988: 466; also Trzebinski 1977: 227) in his De Havilland Gipsy plane, called *"Gypsy Moth"*, in particular along the Ngong Hills and above Karen Estate where they lived together between 1925 and 1931 (for the former year, *cf.* Tanne pers. comm. to Thomas Dinesen on 24th February 1926; *cf.* Lasson 1988: 268).

Kayamuhakaia lolgoriensis **sp. nov.**

Figs 6.c., 18.c.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Kenya, Transmara [formerly Trans Mara District], Lolgorien [Narok County], 2000 m [corrected altitude is 1.610 — 1.773 m], April 2000, Lf. ["Lf." = Lichtfang = light trapping], leg. Dr. Politzar, Museum Witt"; genitalia slide number 30/052028 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and dark olive-buff towards tips and around compound eyes; eyes ecru-olive with small black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are tiny and oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae long, 0.43 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and 1.5× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base with 1.3× width of branch, scaled cream laterally, shaft densely scaled cream with fewer scales of dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, two-segmented, basal segment broadly rectangular, upper segment only 1.1× length of basal segment, triangular with rounded tip.

Thorax: Patagia and tegulae with long hair-like scales with a cream base and dark olive towards tips of buckthorn brown forming no collar ring. Metathorax has long hair-like scales of cream and dark olive forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair more narrow and 1.2 mm/1.1 mm, lower pair with spurs of 0.9 mm/1.0 mm in length. Forewing length 13.0 mm, wingspan 29.0 mm. Forewing upperside largely with chamois ground-colour with a light golden glint; a broad dominant, almost rectangular patch of Snuff brown extends from CuA_2 to M_2; end of discal cell with a large patch of ecru-olive; termen with small lunules of brownish-olive; a broad and dominant sub-terminal band of ecru-olive is present, edged light brownish olive inwards; from below lower median and CuA_2 two large patches of ecru-olive extend to dorsum; cilia very long, 1.2 mm, cream with light brownish-olive tips. Underside of forewing is ecru-olive with a light golden glint.

Hindwing upperside mainly chamois, mixed with some ecru-olive scales and with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with a cream or ivory-yellow base with dark olive towards scale tip with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive. Postabdominal structure and genitalia (Fig 18.c.) have papillae anales with short and long setae and with no pronounced belly-like shape near the basal part of the papillae anales; large lobes are present with one lobe as long as the medium broad dorsal width of segment 8 and with one lobe 15% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and slightly narrower ventrally with a horizontal ventral edge; lower half of segment 8 is not dominated by a narrow sclerotized ring-like band as the latter is only thinly sclerotized; the shape of segment 8 is narrowly rectangular (viewed laterally); base of one anterior apophysis is very small and only 0.1× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is 50% longer than the dorsal width of segment 8 and without a broader end, not bent; the dorsal width of segment 8 is not lunule-like bent inwards at centre; the posterior apophyses are only 1.6× as long as anterior apophyses with T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 70% of the whole length of posterior apophysis, the latter are bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is short, namely 30% shorter than one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no membranous plate-like structure; corpus bursae is thinly membranous, without any structures, round in shape and if not pressed and not broken, only 0.5× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. lolgoriensis* **sp. nov**. has a more colourful and contrasting forewing pattern with large parts of chamois that is absent in *K. finchhattoni* **sp. nov.** Further differences between both species are represented in the diagnosis of the latter species.

Although both species occur probably sympatric in the area near Lolgorien, *K. lolgoriensis* **sp. nov**. is morphologically closer to *K. nubifera.* Both species share two-segmented labial palpi as well as anterior apophyses that are much longer than the dorsal width of segment 8, namely 40% longer in *K. nubifera* and 50% longer in *K. lolgoriensis* **sp. nov**. Another similar character is found in the length of the ductus bursae that is shorter than the posterior apophyses, namely 30% shorter in the latter species and at least 25% shorter in *K. nubifera.* Nevertheless, two major differences support a separation into two species: First, the posterior apophyses are 2.3× as long as the anterior apophyses in *K. nubifera* but only 1.6× as long as the anterior apophyses in *K. lolgoriensis* **sp. nov.** Second, the corpus bursae is round and only 0.5× as large as segment 8 in lateral view in the latter species but elongated oval and 1.5× as large as segment 8 in *K. nubifera.*

Distribution. *Kayamuhakaia lolgoriensis* **sp. nov.** is only known from Lolgorien (1°13'52"S 34°48'03"E) located in southwest Kenya (*cf. K. finchhattoni* **sp. nov.**).

Kayamuhakaia lolgoriensis **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of drier montane forest and woodland habitats of the areas in and around Lolgorien, *e.g.* with a relict distribution towards the MMNR.

Habitat. See habitat description for *K. finchhattoni* **sp. nov.**

Biological traits. The biology of *K. lolgoriensis* **sp. nov.** is unknown.

Etymology. The species is named for the type locality Lolgorien (Kenya).

Kayamuhakaia stephanierobertsae sp. nov.

Figs 7.a., 18.d.

Type locality and repository: Kenya, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, female, "Kenya, Kaptagat [Uasin Gishu County and at the border with Elgeyo Marakwet County], 3.4.48 [03rd April 1948], Walter [leg.]"; genitalia slide number 03/052020 I. Lehmann (NMK).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of ivory-yellow, Saccardo's umber towards tips, the latter are cream around compound eyes; eyes sorghum brown with small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are tiny slits, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae very long, 0.46 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and short branches of only 1.1× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base with 1.2× width of branch, scaled cream and dark olive-buff laterally, shaft densely scaled cream with fewer scales of dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular and slightly longer and slightly broader than central segment, the latter is short and broadly oval, segment on top elongated, narrowly egg-shaped and 90% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales with a cream base and dark olive towards tips of cream forming no collar ring. Metathorax has long hair-like scales of cream and dark olive forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair very narrow, needle-like and 0.9 mm/ 0.9 mm, lower pair with broad spurs of 0.9 mm/1.0 mm in length. Forewing length 14.0 mm, wingspan 31.0 mm. Forewing upperside largely with dark olive-buff ground-colour with a light golden glint; a broad dominant, almost rectangular patch of sepia extends from CuA_2 to base of M_2; near lower end of discal cell with a small patch of sepia; termen without lunules; sub-terminal band absent; from below lower median extend three narrow lines of dark olive to dorsum; end of lower median and CuA_2 are cream with a "V-shaped" design in horizontal position; cilia very long, 1.2 mm, alternating dark olive-buff and dark olive. Underside of forewing is dark olive-buff with a light golden glint.

Hindwing upperside is dark olive-buff with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with a cream or ivory-yellow base with dark olive and Saccardo's umber towards scale tip with a light golden glint; abdominal tuft short with 15% length of abdomen, with long hair-like scales of cream and Saccardo's umber. Postabdominal structure and genitalia (Fig 18.d.) have papillae anales with short and long setae and with a little pronounced belly-like shape near the basal part of the papillae anales; large lobes are present with one lobe as long as dorsal width of segment 8 and with one lobe 25% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and 30% broader ventrally with a horizontal ventral edge; lower half of segment 8 is not dominated by a narrow sclerotized ring-like band, the latter is only thinly sclerotized; the shape of segment 8 is broadly rectangular (viewed laterally in a not pressed condition); anterior apophyses narrow and only 50% as broad as posterior apophyses, base of one anterior apophysis is very small and less than 0.1× the size of one lobe of papillae anales; the distal part of the anterior apophysis is as long as the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is lunule-like bent inwards at centre; the posterior apophyses are 2.1× as long as anterior apophyses with a T-shaped base that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of this base is 60% of the whole length of posterior apophysis, the latter are strongly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is short and 40% shorter than one posterior apophysis, thinly membranous, without any structures (Note: the intact ductus bursae regarding its length is not seen in Fig 18.d.); below the base of ductus bursae occurs a membranous plate-like structure; corpus bursae is thinly membranous, without any structures, round and if not pressed only 0.6× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. *Kayamukakaia stephanierobertsae* **sp. nov.** differs from all other females herein with two character combinations: First, the anterior apophyses are as long as the dorsal width of segment 8. Second, the posterior apophyses are 2.1× as long as the anterior apophyses.

Nevertheless, the female of *K. stephanierobertsae* **sp. nov.** is superficially similar in antennae length and wing size to *K. finchhattoni* **sp. nov.** and *K. lolgoriensis* **sp. nov**. Significant differences comprise: First, the branches towards the tip of antenna are among the shortest in *Kayamuhakaia* in *K. stephanierobertsae* **sp. nov.** Second, the shape of segment 8 in the postabdominal structure is broadly rectangular in the latter species and broader ventrally if compared to its dorsal width. In *K. finchhattoni* **sp. nov.** and *K. lolgoriensis* **sp. nov.** the ventral part of segment 8 is narrower than the dorsal part. Third, the three-segmented labial palpi of *K. stephanierobertsae* **sp. nov.** are shared with *K. finchhattoni* **sp. nov.** but the segment on top is longer in the former species. Fourth, the ductus bursae is much shorter than the posterior apophyses in *K. stephanierobertsae* **sp. nov.** and *K. lolgoriensis* **sp. nov.** with 40% and 30%, respectively; the ductus bursae is at least 5.0× as long as the ventral part of segment 8 in the latter species but only 2.0× as long as the ventral part of segment 8 in *K. stephanierobertsae* **sp. nov.**

Distribution. *Kayamuhakaia stephanierobertsae* **sp. nov.** is only known from Kaptagat (0°26’N 35°27’E) located in western Kenya *ca.* 25 km southeast of Eldoret as well as *ca.* 2 km to the West of the Kaptagat Forest Reserve. The area belongs to the *“Afromontane archipelago-like regional centre of endemism” sensu* White (1983: 161).

Due to its unique morphological characters *K. stephanierobertsae* **sp. nov.** is classified as *Afromontane endemic* as well as endemic species of the Elgeyo Hills.

Habitat. Kaptagat (elevation 2.321 — 2.437 m) is located in the Elgeyo Hills. The nearby Kaptagat Forest Reserve is 12.980 ha in size and was gazetted in 1941, *cf.* The World Bank (1987: 67, 69). The type locality is possibly located near the forest edge or on the undulating plateau areas with steep slopes and upland grasslands that occur to the North, West and South, *e.g.* 0°26'08"N 35°29'07"E. Mixed farm areas of maize and wheat are intercropped with planted trees or planted forests, including exotic and indigenous species, *e.g. Acacia mearnsii* De Wild. (Mimosoideae), *Balanites aegyptiaca* Delile (Zygophyllaceae), *Hesperocyparis lusitanica* Bartel (synonym: *Cupressus lusitanica* Mill./ Cupressaceae), species of *Eucalyptus* L' Hérit. and *Syzygium guineense* DC. (Myrtaceae), *Grevillea robusta* A. Cunn. (Proteaceae), *Pinus radiata* D. Don (Pinaceae) and *Vepris nobilis* Mziray (Rutaceae).

The average annual rainfall for the Kaptagat Forest catchment area is 624.9 — 1560.4 mm (Kibii *et al.* 2021) and for the North Nandi Forest Reserve, 10.500 ha in size and located *ca.* 40 km to the West of Kaptagat, the average annual rainfall is 1600 — 2000 mm (Kabanze *et al.* 2023).

A detailed floristic survey was done for the North Nandi Forest by Girma *et al.* (2014: 128, 137). Their data of 27 plots, established within an altitudinal range of 2.020 — 2.089 m, indicate that common species comprise *Syzygium guineense* DC. (Myrtaceae) and *Croton macrostachyus* Hochst. (Euphorbiaceae) in the overstorey mixed with *Ehretia cymosa* Thonn. (Boraginaceae), *Turraea holstii* Gürke (Meliaceae), *Campylospermum vogelii* Farrou (synonym: *Ouratea hiernii* Exell /Ochnaceae) and *Vangueria madagascariensis* J.F.Gmelin (Rubiaceae) in the understorey. Kabanze *et al.* (2023) stated that biodiversity is high in the gazetted North Nandi Forest comprising 628 plant species.

The Kenya Water Towers (2020) mentioned for the remaining natural forest on the Elgeyo Hills that *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae) is the most dominant tree species together with *Juniperus procera* Hochst. (Cupressaceae), species of *Podocarpus* L' Hérit. (probably *P. falcatus* Mirb.) and *Nuxia congesta* Fres. (Stilbaceae). This species composition indicates an *"Undifferentiated Afromontane forest" sensu* White (1983: 165) with a similar species composition that occurs on the southern slopes of the Cherangani Hills, *e.g.* in Sogotio Forest Reserve located *ca.* 40 km to the North of Kaptagat (*cf.* Bennun & Njoroge 1999: 187). However, natural forest declined within several gazetted forest blocks, including Kaptagat Forest Reserve, by 4.099 ha during 1990 — 2019 (Kenya Water Towers 2020).

Hence, *K. stephanierobertsae* **sp. nov.** occurs in forest habitats that are not dominated by woody Leguminosae.

Biological traits. The biology of *K. stephanierobertsae* **sp. nov.** is unknown.

Etymology. The species is named for Stephanie Roberts, the wife of Michael Boyce Roberts, who both formerly lived and worked on the Ole Naishu Ranch. In September 2025, they moved to the Ol Ari Nyiro Ranch (Kenya).

The author is very grateful for her support in various ways on the Lolldaiga Hills Ranch in March 2016 as well as May and June 2017 (*cf. K. wellsi* **sp. nov.**).

Kayamuhakaia juliusmathiui **sp. nov.**

Figs 7.b., 19.a.

Type locality and repository: Kenya, the State Museum of Natural History, Stuttgart, Germany (SMNS).

Material examined. Holotype, female, "Kenya – Western [formerly Western Province], Kakamega Forest N.R. [incorrect since the whole Kakamega Forest with 23.632 ha as gazetted in 1933 is not protected as Nature Reserve], Isecheno [Isecheno Nature Reserve / N.R., Kakamega County], Camp site nr. Guesthouse [possibly the campsite near Isecheno Forest Office 0°14'12"N 34°52'04"E / elevation 1.619 m], 1600 m, 28.1.2004 at light, 19.00-22.00 h, J. Holstein [Joachim Holstein] & A. Zahm leg."; on a second label: "SMNS – Lep. 2004 – 04", genitalia slide number 11/012021 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream-buff with dark olive-buff towards tips, the latter are cream around compound eyes; eyes light brownish-olive with small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short, 0.33 length of forewing with branches 0.8× width of shaft on lower 20% of antenna and long branches of 1.6× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base with 1.5× width of branch, scaled cream laterally, shaft densely scaled cream with fewer scales of dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment longest, broadly rectangular, twice as long as central segment and slightly broader as central segment, the latter is elongated rectangular, segment on top elongated and narrowly rectangular, 90% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales with cream-buff base and dark olive towards tips, the latter are cream, forming no collar ring. Metathorax has long hair-like scales of Isabella colour forming a little pronounced scale-crest. Forelegs with rudimentary needle-like epiphysis, 0.6 mm long. Hindlegs with two pairs of spurs, upper pair narrow and 0.8 mm/0.7 mm, lower pair 0.8 mm/0.6 mm in length. Forewing length 15.0 mm, wingspan 34.0 mm. Forewing upperside largely with Isabella colour with a light golden glint; a rectangular patch of buckthorn brown is weak extending from CuA_2 to CuA_1; termen with weak lunules of buffy olive; sub-terminal band and terminal band weak and buffy olive; cream near end of lower median and CuA_2 showing the "Y-shaped" design in horizontal position; half of 1A+2A cream; cilia very long, 1.1 mm, Isabella colour with cream tips. Underside of forewing is cream-buff with a golden glint.

Hindwing upperside is largely of Isabella colour suffused with scales of buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with cream-buff base with dark olive-buff towards scale tip, the latter cream, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream-buff and dark olive-buff. Postabdominal structure and genitalia (Fig 19.a.) have papillae anales with short and long setae and with a little pronounced belly-like shape near the basal part of the papillae anales; medium large lobes are present with one lobe as long as 80% of the dorsal width of segment 8 and with one lobe 15% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and of same width ventrally with a horizontal ventral edge that has a large triangular slit posteriorly; lower half of segment 8 is not dominated by a narrow sclerotized ring-like band, the latter is only thinly sclerotized; the shape of segment 8 is broadly rectangular (viewed laterally in a not pressed condition); anterior apophyses as broad as posterior apophyses, base of one anterior apophysis is medium large with 0.7× the size of one lobe of papillae anales; the distal part of the anterior apophysis is 15% longer than the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is not lunule-like bent inwards at centre; the posterior apophyses are long, 2.3× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 40% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is broad and very long with 3.0 mm, that is 40% longer than the posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a membranous plate-like structure; corpus bursae is thinly membranous, without any structures, oval with slightly rectangular shape if not pressed and not broken, 1.5× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. juliusmathiui* **sp. nov.** represents a species with a unique combination — including five characters — that is not similar to any other species presented herein: First, Isabella colour is largely dominant on forewing and hindwing. Second, the short antennae have 0.33 length of forewing. Third, the branches have 0.8× width of shaft on lower 20% of antenna that is relatively long if compared to the other species and have 1.6× width of shaft towards tip of antenna. Fourth, the forelegs have a rudimentary needle-like epiphysis. Fifth, the very long ductus bursae that is 40% longer than the posterior apophysis and hence, among the longest in species of *Kayamuhakaia*. This very long ductus bursae is in combination with the short antennae and the broadly rectangular segment 8 similar to *K. kismayuensis* **sp. nov.** In the latter species the ductus bursae is *ca.* 20% longer than the posterior apophysis, the antennae are short with 0.38 length of forewing. Similar short antennae as well as the presence of a rudimentary epiphysis are only shared between *K. juliusmathiui* **sp. nov.** and *K. karenae* **sp. nov.** Both species share also very long posterior apophyses with 2.1× length of anterior apophyses in the latter species and 2.3× length in *K. juliusmathiui* **sp. nov.** Nevertheless, the former species can be separated from the latter by its triangular segment 8 and a ductus bursae that is as long as the posterior apophysis. Noteworthy, *K. mountkenyaensis* **sp. nov.** has a ductus bursae that is *ca.* 30% longer than the posterior apophysis but it has also a triangular segment 8.

Distribution. *Kayamuhakaia juliusmathiui* **sp. nov.** is only known from Kakamega Forest located in western Kenya and *ca.* 5 km northwest from the South Nandi Forest (at the nearest point just south of Chepsonoi) as well as *ca.* 6 km to the West of North Nandi Forest (at the nearest point just south of Lukhusi) and *ca.* 42 km to the North of Kisumu and Lake Victoria, respectively. The area belongs to the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 180) as well as to the *"Victoria Basin Forest-Savanna Mosaic" sensu* Burgess *et al.* (2004: 20, 21, 291).

Due to its morphological similarities to one Zanzibar-Inhambane endemic species from coastal Somalia as well as due to fewer similarities shared with two Afromontane endemic species (Kikuyu Escarpment Forest and Mount Kenya), *K. juliusmathiui* **sp. nov.** is classified as *Lake Victoria /Zanzibar-Inhambane linking* as well as endemic species to Kakamega Forest.

Habitat. Kakamega Forest (11.848 ha in size, *cf.* Althof 2005: 16, 17 + Table 2) was used for gold mining officially from mid-1932 until 1964 as well as for both, clear-felling and selective logging from 1933 until at least 1956 (Mitchell 2004: 32) and hence, is largely a secondary forest and of middle age today with very young secondary forest in the northeastern part, *e.g.* Mitchell (2004: 33), Althof (2005: 64, Fig 55). Nevertheless, it represents one of Kenya's *KBAs* (UNDP 2021: 24) comprising for example the area with the richest butterfly fauna in Kenya. Larsen (1991: 73, 80) estimated between 350 and 400 butterfly species; at least 487 butterfly species occur (Holstein *et al.* 2010: 34) or *ca.* 53% of Kenya's total butterfly fauna including 169 species in the northeastern forest part (Namu *et al.* 2008: 49). In contrast and based on present data, Kakamega forest and nearby areas do not represent the richest Kenyan Metarbelidae fauna neither in regard to the number of genera nor in regard to the number of species if compared, *e.g.* to the Shimba Hills and nearby coastal forests where in total at least ten genera comprising at least 14 species occur including a significant number of coastal endemic genera and species (*cf.* Table 1 with Table 2 + Discussion on microrefugia herein; Lehmann in prep.).

Althof (2005) analysed 212 woody plant species and found that 41% are of Guineo-Congolian origin, *e.g. Monodora myristica* Dunal (Annonaceae) and 33% are Afromontane species, *e.g. Prunus africana* Kalkman (Rosaceae), *Olea capensis* L. (Oleaceae). Hence, the forest was classified as transitional between Afromontane forest and Guineo-Congolian lowland rain forest (*cf.* Althof 2005: 61, 62). Fischer *et al.* (2010: 135) recorded 986 vascular plant species in Kakamega Forest representing 15.2% of Kenya's 6506 vascular plant species and hence, less than the

Shimba Hills area where 1396 indigenous plant species in 686 genera occur (Luke 2005: 9). Among those species represent 10.9% an Afromontane origin and 10.3% are linked to the Guineo-Congolian lowland rain forest. In context with the "linking species" *K. juliusmathiui* **sp. nov.** a statement of Fischer *et al.* (2010: 138) is of importance, namely that some plant species that occur in coastal Kenya occur further inland only in Kakamega Forest, *e.g. Antiaris toxicaria* Lesch., *Ficus bubu* Warb. (Moraceae), *Alchornea laxiflora* Pax & K. Hoffm., *Mallotus oppositifolius* Müll.Arg. (Euphorbiaceae), *Monanthotaxis buchananii* Verdc. (Annonaceae) and an unknown species of *Fernandoa* Seem. (Bignoniaceae) that is closely related to *Fernandoa magnifica* Seem. from coastal Kenya.

According to the analysis of these nine authors, Kakamega Forest was classified as *"multi-story, dry peripheral semi-evergreen Guineo-Congolian transitional rainforest* [with Afromontane affinities]" *sensu* Fischer *et al.* (2010: 133).

The type locality of *K. juliusmathiui* **sp. nov.** is Isecheno Forest (elevation for Isecheno N.R. is 1.547 — 1.636 m) which was particularly logged between 1940 and 1943 comprising large numbers of trees of *Maesopsis eminii* Engl. (Rhamnaceae), *Olea capensis* L. and *Diospyros abyssinica* F. White (Ebenaceae), *cf.* Mitchell (2004: 31, 35, 43; Althof 2005: 87). Althof (2005: 77, 78, 90, Fig 49) stated that those parts of Isecheno Forest that she investigated had a high abundance of middle-aged individuals of *Funtumia africana* Stapf (Apocynaceae) indicating past and recent disturbances. Many individuals of this tree species were locally found in the Shimba Hills forest by Quentin Luke and Ingo Lehmann in 2005 (*cf.* Beentje 1994: 479) and hence, representing a link of Isecheno Forest to a Kenyan coastal forest where, *e.g. K. haberlandorum* occurs (*cf.* Table 2).

Celtis mildbraedii Engl. (Cannabaceae) was found to be locally common in Isecheno Forest by Althof (2005: 76). She defined Isecheno Forest as "middle-age secondary forest" characterized by the "*Strombosia scheffleri* – plant community" comprising species of *Acalypha* L. (Euphorbiaceae), *Englerophytum oblanceolatum* T.D.Penn. (synonym: *Bequaertiodendron oblanceolatum* Heine & J.H.Hemsl. /Sapotaceae), *Sparrea gomphophylla* X.G.Fu & T.S.Yi (Cannabaceae), *Croton megalocarpus* Hutch. (Euphorbiaceae), *Dracaena fragrans* Ker Gawl. (Asparagaceae), *Funtumia africana* Stapf (Apocynaceae), *Ficus exasperata* Vahl (Moraceae), *Mimulopsis arborescens* C.B. Clarke (Acanthaceae), *Strombosia scheffleri* Engl. (Olacaceae) and *Trilepisium madagascariense* DC. (Moraceae), *cf.* Althof (2005: 77, 78).

Hence, *K. juliusmathiui* **sp. nov.** occurs in forest habitats that are not dominated by woody Leguminosae (Fabaceae), although the latter is among the three most species rich plant families comprising 31 genera and 60 species in Kakamega Forest (Fischer *et al.* 2010: 135).

Biological traits. The biology of *K. juliusmathiui* **sp. nov.** is unknown.

Etymology. The species is named for the Kenyan Julius Mwenda Mathiu (born on 15th October 1980 in Meru County) for his substantial support in measuring and determining plant species on various Sample Sites of I.L. on the

Lolldaiga Hills Ranch and Wildlife Conservancy in March 2016, May as well as June 2017.

Julius became first actively involved in nature conservation when he was employed by the Ngare Ndare Forest Trust (also known as Engare Ngare Forest / 5.540 ha in size/ Meru County) in 2006. As a keen conservationist Julius completed various courses, *e.g.* in the Kenya Wildlife Service Field Training School Manyani (Tsavo West National Park/ Taita-Taveta County) including paramilitary training against poaching in 2010; on primatology at the German Primate Center (Göttingen) in 2014; on entomology and botany on Suyian Conservancy (Laikipia County) in 2015 (Julius Mathiu pers. comm. to I.L. in March 2016).

Kayamuhakaia yiruchengae **sp. nov.**

Figs 7.c., 19.b.

Type locality and repository: Kenya, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Kenya, No. 455 – Mt. Elgon N.P. [Mount Elgon National Park, formerly Western Province], Kimothon river, 3.200 m [= among the highest elevations for Metarbelidae!; probably 1°05'18"N 34°38'33"E, Trans Nzoia County], subalpin [subalpine] mossy forest, at light, 1992 01.11 – 22 [= 11th — 22nd January 1992], leg. A. Lobmayer"; on second label: "Museum Witt München"; genitalia slide number 14/032020 I. Lehmann (MWM).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and ivory-yellow with dark olive-buff towards scale tips around compound eyes; eyes sorghum brown with small black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are elongated oval, a pair of projections is absent, a horizontal dorsal ridge is rudimentary on lower fronto-clypeus; antennae short, 0.32 length of forewing with branches 0.3× width of shaft on lower 20% of antenna and very long branches of 2.5× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base with 2.0× width of branch, few are scaled cream laterally, shaft densely scaled cream with fewer scales of dark olive-buff dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular, central segment 1.3× length of basal segment, elongated rectangular, segment on top elongated and narrowly rectangular, 40% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales with cream base and dark olive towards ivory-yellow tips, forming no collar ring. Metathorax has long hair-like scales of cream with dark olive tips forming a little pronounced scale-crest. Forelegs with a rudimentary needle-like epiphysis, 0.4 mm long. Hindlegs with two pairs of spurs, upper pair narrow and 1.0 mm/0.9 mm, lower pair 1.5 mm/1.1 mm in length. Forewing length 17.5 mm, wingspan 38.5 mm. Forewing upperside largely cream with a light golden glint; a dominant and broad rectangular patch of Mummy brown extends from CuA_2 to R_4; termen without lunules; sub-terminal band weak and Mummy brown; below centre of lower median a Mummy brown line to dorsum; below base as well as below end of CuA_2 occurs a pure white patch; CuA_2 narrowly pure white; below centre of CuA_2 occurs a Mummy brown patch to dorsum; cilia very long, 1.1 mm, cream. Underside of forewing is cream with a golden glint.

Hindwing upperside is largely cream suffused with scales of ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with cream base and dark olive-buff towards scale tip, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 19.b.) have papillae anales with short and long setae and without a pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe 1.5× width of the narrow dorsal width of segment 8 and with one lobe 10% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow, also ventrally narrow and with the same width dorsally and ventrally with a horizontal ventral edge; lower half of segment 8 is not dominated by a narrow sclerotized ring-like band, the latter is only thinly sclerotized; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses as broad as posterior apophyses, base of one anterior apophysis is as large as one lobe of papillae anales; the distal part of the anterior apophysis is 70% longer than the dorsal width of segment 8 and without a broader end, not bent; the dorsal width of segment 8 is not lunule-like bent inwards at centre; the posterior apophyses are long, 2.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 60% of the whole length of posterior apophysis, the latter are not bent upwards (if not pressed); a small knee-like shape of posterior apophysis is present at 40% of its length. The ductus bursae is broad and long with 1.9 mm, almost as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a small thinly membranous plate-like structure; corpus bursae is thinly membranous, without any structures, pear-shaped if not pressed and not broken, small with 0.8× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. yiruchengae* **sp. nov.** shares two characters in the postabdominal structure with *K. hermannstaudei* **sp. nov.**, namely the anterior apophyses are 75% longer than the dorsal width of segment 8 in *K. hermannstaudei* **sp. nov.** and 70% longer in *K. yiruchengae* **sp. nov.**, comprising in both species a segment 8 with a narrow rectangular shape including a narrow dorsal as well as narrow ventral base. The most significant differences between both species comprise: First, the anterior apophyses are strongly bent downwards and very narrow in *K. hermannstaudei* **sp. nov.** but straight and as broad as the posterior apophyses in *K. yiruchengae* **sp. nov.** Second, the labial palpi are three-segmented in the latter species but two-segmented in *K. hermannstaudei* **sp. nov.** Third, a rudimentary epiphysis is absent in the latter species but present in the former. In regard to the latter character an epiphysis is also present in *K. karenae* **sp. nov.** in combination with short antennae as well as anterior apophyses that are 70% longer than the dorsal width of segment 8.

Unique characters of *K. yiruchengae* **sp. nov.** comprise: First, the forewing pattern that is significantly more contrasting, largely much lighter with cream and pure white parts that are absent in all other species. Second its large wing size in combination with longest branches on the antenna on its upper one-third with 2.5× width of shaft. Third the longest lower pair of tibial spurs in the hindlegs with 1.1 and 1.5 mm in length.

Distribution. *Kayamuhakaia yiruchengae* **sp. nov.** is only known from a mosaic of subalpine vegetation on Mount Elgon (altitude 4.321 m) and hence, its habitat represents one of the highest elevations for a species of Metarbelidae.

Mount Elgon is located *ca.* 110 km northeast of Lake Victoria on the Kenya — Uganda border and within the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

Due to its morphological similarities to two Afromontane endemic species (Kikuyu Escarpment Forest and Mount Kenya), *K. yiruchengae* **sp. nov.** is classified as *Afromontane endemic* and as endemic species of Mount Elgon. Most probably this new species occurs on Mount Elgon also in areas that are located in Uganda.

Habitat. Mount Elgon — a name derived from the Masai word *"Il-goon"* or *"Ol-doinyo loo-'l-goon"* meaning the *"mountain of breasts"* (*cf.* Hollis 1905) — represents one of Kenya's *KBAs* (UNDP 2021: 21) and is a relatively young volcano that first erupted *ca.* 20 Ma (Burke & Gunnell 2008: 27).

Its subalpine vegetation (altitude range *ca.* 3.000 m — 3.300 m) is mainly found in the Moorland Zone that is part of the *"Ericaceous Belt" sensu* Hedberg (1951: 182) including relicts of the *"Hagenia-Hypericum Zone" sensu* Hedberg (1951: 174). Both comprise a vegetation mosaic of bogs, tussock grassland, bushland and small areas of subalpine evergreen forest**.** The holotype was collected in the latter as the label data indicates. Subalpine forest patches on Mount Elgon are characterized by low tree species diversity and low tree height of up to 15 m (Hitimana *et al.* 2004, 2010). The latter authors used the term *"upper montane forest"* for the same altitude range as mentioned above but without presenting any tree species for this forest type on Mount Elgon as their Sample Sites were situated on lower altitudes in *"moist lower montane forest"* at an elevation of 1.500 — 2.450 m. However, subalpine forest patches almost certainly comprise *Hagenia abyssinica* J. F. Gmelin (Rosaceae) occurring in isolated groves (Hedberg 1951: 174), *Myrsine melanophloeos* R.Br. (Primulaceae), *Hypericum revolutum* Vahl (Hypericaceae), *Erica mannii* Beentje and *E. arborea* L. (Ericaceae); the latter record is based on Fries & Fries (1924: 689) with *Discopodium eremanthum* Chiov. (Solanaceae) in the understorey. As the label data also indicates is the habitat of the holotype rich in epiphytic mosses occurring on trees and shrubs suggesting a high annual rainfall of possibly 1700 — 1900 mm.

Hence, *K. yiruchengae* **sp. nov.** occurs in wetter subalpine forest habitats that are not dominated by woody Leguminosae (Fabaceae).

Biological traits. The biology of *K.yiruchengae* **sp. nov.** is unknown.

Etymology. The species is named for Yi-ru Cheng who was born on Taiwan in October 1977. Yi-ru first had a professional training in medicine as an Undergraduate in the National Taiwan University, but later decided to become a field biologist. She received her Master's degree in Wildlife Biology at the University of Montana (Missoula, USA) in 2008, later pursuing successfully her Ph.D. at Columbia University (New York City, USA) on the social behavior of *Pseudonigrita arnaudi* (Bonaparte), the Grey-headed Social Weaver (Ploceidae), based on comprehensive field studies on the Laikipia Plateau in 2017 (Yi-ru Cheng pers. comm. to I.L. in 2017).

The author is grateful to Yi-ru for helping in collecting moths as well as for fruitful discussions on wildlife conservation issues at Mpala Research Center (Kenya) in June 2017.

Yi-ru works as a Postdoctoral Researcher on the evolution of nests and eggs in birds at the Biodiversity Research Center Academia Sinica, Taiwan (Yi-ru Cheng pers. comm. to I.L. in October 2023).

Kayamuhakaia maasi sp. nov.

Figs 8.a., 19.c.

Type locality and repository: Uganda, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Uganda, Kabarole, Fort Portal [Kabarole or Fort Portal – the latter is incorrect], Nkuruba lake nature reserve [= Lake Nkuruba Nature Reserve, located *ca.* 14 km south of Kabarole and *ca.* 5 km west of Kibale National Park, Western Region, Kabarole District, collecting Site most probably in forest near the Community Campsite as well as near the southern shore of Lake Nkuruba, 0°31'09"N 30°18'07"E, altitude range 1.509 — 1.526 m] 01.12.2019 [= 01st December 2019, leg. unknown] Coll. [= collection] Golovizin V."; on a second label: "coll. R. Fiebig"; genitalia slide number 30/062028 I. Lehmann (ZSM).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and smoke grey with light brownish olive towards tips around compound eyes; eyes ecru-olive with small black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are small slits, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short with 0.35 length of forewing with branches 0.3× width of shaft on lower 15% of antenna and branches of 1.4× width of shaft towards tip, branches are narrow elongated (viewed laterally), not widely separated at base of branch, few are scaled cream laterally, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular, central segment 1.1× length of basal segment, broadly oval, segment on top small, elongated and narrowly oval, 30% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales of smoke grey with cream base and dark olive towards tips, forming no collar ring. Metathorax has long hair-like scales of white with black tips forming a pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair narrow and 0.9 mm/0.6 mm, lower pair 0.9 mm/0.8 mm in length. Forewing length 10.0 mm, wingspan 23.0 mm. Forewing upperside largely olive-buff with a silvery glint; a dominant and broad rectangular patch of black extends from CuA_2 to M_3 and below half of CuA_2 to dorsum; CuA_2 on upper and lower end pure white, half of CuA_2 black; termen without lunules; sub-terminal band weak, dark olive-buff and zigzag-shaped; cilia very long, 1.0 mm, alternating greyish olive and white, some scales dark olive. Underside of forewing is ivory-yellow with a light golden glint.

Hindwing upperside is largely greyish olive with a silvery glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with cream and greyish olive, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive. Postabdominal structure and genitalia (Fig 19.c.) have papillae anales with short and long setae and with a pronounced belly-like shape near the basal part of the papillae anales; medium large lobes are present with one lobe 0.6× (or 60%) width of the dorsal width of segment 8 and with one lobe 15% the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad, ventrally more narrow and with a horizontal ventral edge; lower half of segment 8 is dominated by a narrow sclerotized ring-like band; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses as broad as posterior apophyses, base of one anterior apophysis is as large as one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is long with 50% longer than the dorsal width of segment 8 and without a broader end, slightly bent downwards; the dorsal width of segment 8 is not lunule-like bent inwards at centre; the posterior apophyses are long and 1.3× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 60% of the whole length of posterior apophysis, the latter are only slightly bent upwards (if not pressed); a small knee-like shape of posterior apophysis is absent. The ductus bursae is broad, 2.0× as broad as anterior apophyses and long, namely with 1.3 mm as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a small thinly membranous plate-like structure; corpus bursae is thinly membranous, without any structures, elongated oval-shaped and slightly rectangular, very large with 2.5× as large as segment 8 in lateral view if not pressed and not broken.

Male. Unknown.

Diagnosis. The female of *K. maasi* **sp. nov.** has a unique combination of two characters: First, the forewing pattern is dominated by a large black rectangular patch extending from dorsum to M_3 on a largely olive-buff forewing colour. Second, the intact corpus bursae (this is not seen in Fig 19.c.) is among the largest in *Kayamuhakaia* with 2.5× the size of segment 8. The size of the corpus bursae is only slightly smaller in *K. haberlandorum* and *K. neemambeyuae* **sp. nov.** All three species share also an anterior apophysis with a similar length that is 30% longer than the dorsal width of segment 8 in *K. haberlandorum*, 40% longer than the dorsal width of segment 8 in *K. neemambeyuae* **sp. nov.** and 50% longer in *K. maasi* **sp. nov.** The length of antennae is the shortest in *K. maasi* **sp. nov.** and closest to *K. haberlandorum* with 0.36 length of forewing.

Distribution. *Kayamuhakaia maasi* **sp. nov.** is only known from Lake Nkuruba Nature Reserve located in the *"Lake Victoria regional mosaic" sensu* White (1983: 179) as well as in the *"Victoria Basin Forest-Savanna Mosaic" sensu* Burgess *et al.* (2004: 20, 21, 291) and in the *"northern portion of the Albertine Rift Region" sensu* Plumptre *et al.* (2007: 181). Almost certainly the new species occurs also in the forest of Kibale National Park located *ca.* 5 km to the East of Lake Nkuruba since both forest areas were once connected (*cf.* Hamilton *et al.* 2001: Fig 4.1).

Kibale National Park (KNP) is 766 km^2 in size and the altitude range is 1.110 m — 1.590 m. The long-term average annual rainfall is 1475 mm, highest with 1622 mm at Kanyawara (*cf.* Struhsaker 1997: 16, 29 + Appendix 1 — 3) with increasing rainfall of up to 300 mm per year due to climate change. The latter fact is based on one of the very few long-term studies in Africa on the fruiting phenology of common tree species comprising two data sets for 1970 — 1983 and 1990 — 2002 (*cf.* Chapman *et al.* 2005).

Due to its morphological similarities with two Zanzibar-Inhambane endemic species (coastal Somalia as well as coastal Kenya) and due to its habitat that shares plant species with wetter Kenyan coastal forests as well as with forests of the Eastern Arc Mountains as described below*, K. maasi* **sp. nov.** is classified as *Lake Victoria/ Zanzibar-Inhambane linking* as well as endemic species of the areas in and near Lake Nkuruba Nature Reserve and including Kibale Forest (Uganda).

Habitat. Forest disappeared from most of what is now Uganda during colder and drier periods associated with the northern ice ages and hence, there are no postulated forest refuges in Uganda as there has been little or no lowland forest before 12,000 yr B.P. (*e.g.* Hamilton *et al.* 2001: 60, 63, Table 4.3). At the end of the last ice age, *ca.* 12,500 yr B.P., the rainfall increased and forests began to return, *e.g.* Kelman (2004: 291) with largest extensions of wetter forest types in areas near Lake Nkuruba prior to 6,500 — 4,100 yr B.P. and extensions of drier montane forest types 3,000 — 1,000 yr B.P. (Ssemmanda & Vincens 2002: 519, 520; *cf.* also Hamilton *et al.* 2001: Fig 4.1). Hence, the natural forest Sites adjacent to Lake

Nkuruba as well as in KNP are of relatively young age and forest Sites most probably mainly originated after 7,100 yr B.P. (*cf.* Ssemmanda & Vincens 2002: 517). Due to these facts their character is transitional at present between *"Drier peripheral semi-evergreen Guineo-Congolian rain forest"* — with *Aningeria altissima* Aubrév. & Pellegr. (Sapotaceae) as one characteristic species for Uganda (White 1983: 79, 181), *"Afromontane rain forest"* as well as *"Transitional rain forest" sensu* White (1983: 164, 181) comprising, *e.g. Parinari excelsa* Sabine (Chrysobalanaceae) and *Strombosia scheffleri* Engl. (Olacaceae), *cf.* Struhsaker (1997, Appendix 4: 357). Vegetation studies were undertaken by researchers of the Kibale Forest Project (1970 — 1993) resulting in a number of woody plant species that exceeds 300 species in the KNP (Struhsaker 1997: 33) indicating a high diversity, *e.g.* near Kanyawara research camp located *ca.* 9 km southeast of Lake Nkuruba. Hamilton *et al.* (2001: 61) mentioned 209 tree species for Kibale Forest representing 49% of the total number of tree species for Uganda. Noteworthy, natural forests that are located within the altitude range of 1.110 m — 1.590 m such as adjacent to Lake Nkuruba and in KNP are meanwhile rare in Uganda.

Undisturbed mature forest near Kanyawara is characterized by *Markhamia lutea* K. Schum. (synonym: *Markhamia platycalyx* Sprague/ Bignoniaceae), *Sparrea gomphophylla* Y.G.Fu & T.S.Yi (synonym: *Celtis durandii* Engl.), *Celtis africana* Burm.f. (Cannabaceae), *Diospyros abyssinica* F. White (Ebenaceae), *Funtumia africana* Stapf (synonym: *Funtumia latifolia* Schlechter/ Apocynaceae), *Parinari excelsa* Sabine (Chrysobalanaceae), *Strombosia scheffleri* Engl. (Olacaceae), *Vepris nobilis* Mziray (Rutaceae), *Uvariopsis congensis* Robyns & Ghesquiere (Annonaceae), *Lovoa swynnertonii* Baker f. (Meliaceae), *Aningeria altissima* Aubrév. & Pellegr. (Sapotaceae) and *Symphonia globulifera* L.f. (Clusiaceae). The largest living specimens were found among the latter two species with a circumference between 220 — 314 cm at breast height (Struhsaker 1997: 42 — 47 + Appendix 4: 356).

Noteworthy, *Lovoa swynnertonii* — a lowland and mid-altitude rain forest species (Styles & White 1991: 59) — is also known from central Kenya as well as from wetter Kenyan coastal forests, *e.g.* from the Shimba Hills (Luke 2005: 64); *Diospyros abyssinica* is known from the type locality as well as other collecting Sites of *K. haberlandorum* (Beentje 1994: 445, 446; Lehmann & Kioko 2005: 147; Luke 2005: 67; Ngumbau *et al.* 2020: 81).

One forest fragment with 0.6 ha in size was studied adjacent to Lake Nkuruba in June 2000 (Colin Austin Chapman pers. comm. to I.L. in October 2024). According to these results for the holotype locality, the most common tree species comprise the Afromontane linking species *Albizia grandibracteata* Taub. (Mimosoideae), the Guineo-Congolian linking species *Sparrea gomphophylla* Y.G. Fu & T.S. Yi and the African linking species *Celtis africana* Burm.f.(Cannabaceae) as well as the African linking species and ecological transgressor *Diospyros abyssinica* F. White (Ebenaceae). Other species include *Markhamia lutea* K. Schum. (Bignoniaceae), *Pseudospondias microcarpa* Engl. (Anacardiaceae), *Erythrina abyssinica* Lam. (Papilionoideae), *Funtumia africana* Stapf (Apocynaceae), *Prunus* L. spp. (Rosaceae), *Ficus saussureana* DC. (Moraceae) and *Olea welwitschii* Gilg & G. Schellenb. (synonym: *Olea capensis* subsp. *welwitschii* Friis & P.S. Green/

Oleaceae). The latter tree species is one of the most characteristic species of *"Afromontane rain forest"* (White *et al.* 2001: 421). Less common are species such as *Noronhia africana* Hong-Wa & Besnard (Oleaceae), *Acacia hockii* De Wild. (Mimosoideae), *Kigelia africana* subsp. *moosa* Bidgood & Verdc. (Bignoniaceae), *Uvariopsis congensis* Robyns & Ghesquiere (Annonaceae) and *Ehretia cymosa* Thonn. (Boraginaceae).

This tree species composition suggests a forest type that was classified by Hamilton (1984: 12, Fig 2) as *"Medium-Altitude Moist Semi-deciduous Forest"* that was mapped for areas near Lake Nkuruba during the 1950s and hence, possibly indicates little or no disturbance until the year 2000.

Hence, *K. maasi* **sp. nov.** occurs on a relatively young forest Site indicating also that this new Metarbelidae species is among a group of "younger species". Its habitat comprises dominant tree species that indicate a transitional character between *"Drier peripheral semi-evergreen Guineo-Congolian rain forest"*, *"Transitional rain forest"* and *"Afromontane rain forest"*. It is also of interest here, that Newmark (2002: 92) stated that Kibale Forest "shares … many species [not only plants] …" with the Eastern Arc Mountains in eastern Tanzania and southeast Kenya (*cf.* diagnosis of *K. maasi* **sp. nov.** that presents a similar result regarding the southern Somalia coast and the Kenya coast).

Biological traits. The biology of *K.maasi* **sp. nov.** is unknown.

Etymology. The species is named for the radiologist Professor Dr. Rainer Maas who was born in Blankenese (Hamburg/ Germany) in May 1950. He has been working as an independent doctor in Hamburg since January 2000 and completed his habilitation in 2013 (Rainer Maas pers. comm. to I.L. in September 2022). The author is very grateful to Professor Dr. Rainer Maas for long-term, thoughtful advices on various health problems but in particular for his unique ideas on a rare and difficult to find serious infection that was later indeed detected and successfully treated. His placid, careful and somehow authochtonous character gave every conversation and every of his medical reports a special outcome.

Kayamuhakaia gitegaensis **sp. nov.**

Figs 8.b., 19.d., 29.a.

Type locality and repository: Burundi, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, female, "Coll. Mus. Tervuren, Burundi: Gitega [formerly Kitega; today Gitega Province, Gitega District; collecting Site most probably at Gitega School for Nursing 3°25'05"S 29°56'11"E, altitude range for

Gitega 1.598 — 1.740 m], 5 – X – 1967 [= 05th October 1967], Dr. M. Fontaine [Maurice Fontaine leg.]"; genitalia slide number 28/102014 I. Lehmann (RMCA). Paratype, female, "Coll. Mus. Tervuren", same locality as holotype, "26 – IX – 1967 [= 26th September 1967], Dr. M. Fontaine [leg.]"; genitalia slide number 01/042020 I. Lehmann (genitalia preparation is missing).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and deep olive-buff with light brownish olive tips around compound eyes; eyes sorghum brown (ecru-olive in paratype) with small black patches; a pair of pits is absent (rudimentary in paratype) on lower fronto-clypeus, pits behind labial palpi are small oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae very long, 0.50 length of forewing (0.48 in paratype) with branches 0.3× width of shaft on lower 30% of antenna and branches of 1.5× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base of branch, few are scaled cream laterally, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular and 1.3× length of central segment, the latter is broadly oval, segment on top elongated and narrowly oval, 70% as long as central segment in holotype and paratype.

Thorax: Patagia and tegulae with long hair-like scales of deep olive-buff with cream base and brownish olive towards cream tips, forming no collar ring. Metathorax has long hair-like scales of cream with brownish olive and cream tips forming a pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair narrow and 0.6 mm/0.5 mm, lower pair 0.8 mm/0.9 mm in length. Forewing length is 13.0 mm (14.5 mm in paratype), wingspan 28.0 mm (31.0 mm in paratype). Forewing upperside variable in colours: largely of Isabella colour (ecru-olive in paratype) with a silvery glint; a dominant and broad rectangular patch of Saccardo's umber (Mummy brown in paratype) extends from CuA_2 to M_3 (from CuA_2 to R_5 in paratype); CuA_2 narrowly white; end of lower median narrowly white; termen without lunules; sub-terminal band broad, ecru-olive and edged on both sides with Saccardo's umber from near apex to end of CuA_2, bent inwards between M_1 and R_5; cilia very long, 1.2 mm, deep olive-buff with tips of buffy olive. Underside of forewing is deep olive-buff with a light golden glint; costa narrowly light brownish olive.

Hindwing upperside is largely ecru-olive suffused with many scales of Isabella colour (also in paratype) and with a light golden glint; cilia and underside as in forewing with few scales with white tips.

Note: The forewing venation of the holotype (Fig 29.a.) has a unique anomaly if compared to more than 1000 studied species of Metarbelidae, namely a very long stalked CuA_1 on both forewings.

Abdomen: Mainly with hair-like scales of cream with brownish olive towards tip, all scale tips cream, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and brownish olive. Postabdominal structure and genitalia (Fig 19.d.) have papillae anales with short and long setae and with a pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe 0.6× width of the dorsal width of segment 8 and with one lobe *ca.* 7% the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and slightly bent lunule-like inwards anteriorly, with a narrow sclerotized edge, ventrally of same width as horizontal dorsal edge; lower half of segment 8 has a narrow sclerotized ring-like band that is not dominant; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses as broad as posterior apophyses, base of one anterior apophysis as large as one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is 35% longer than the dorsal width of segment 8 and without a broader end, slightly bent upwards (in a not pressed condition); the posterior apophyses are long, namely 2.2× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 55% of the whole length of posterior apophysis, the latter are only slightly bent upwards; a small knee-like shape of posterior apophysis is absent. The ductus bursae is broad, 3.0× as broad as anterior apophyses as well as long with 2.1 mm, namely as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a thinly membranous triangular shaped plate-like structure; corpus bursae is thinly membranous, without any structures, with an almost straight distal end resulting in an almost rectangular shape, medium large with 0.9× as large as segment 8 in lateral view if not pressed and not broken.

Male. Unknown.

Diagnosis. The females of *K. gitegaensis* **sp. nov.** share three characters with *K. finchhattoni* **sp. nov.**: First, the antennae are very long in both species and among the longest in *Kayamuhakaia* with 0.48 length of forewing in the latter species and 0.50 length of forewing (0.48 in paratype) in *K. gitegaensis* **sp. nov**. Second, both species share three-segmented labial palpi with the basal segment longest, namely 1.3× length of central segment. Third, the similar length of the posterior apophyses that are 2.0× as long as anterior apophyses in *K. finchhattoni* **sp. nov.** and 2.2× as long as anterior apophyses in *K. gitegaensis* **sp. nov.** The two most striking differences between both species comprise a long ductus bursae which is 10% longer than the length of one posterior apophysis in *K. finchhattoni* **sp. nov.**, but it is as long as one posterior apophysis in *K. gitegaensis* **sp. nov.** Second, in the hindwing venation are M_1 and Rs separated (Fig 29.a.) or originate from the same basal point in *K. gitegaensis* **sp. nov.** but are long stalked in *K. finchhattoni* **sp. nov.**

Distribution. *Kayamuhakaia gitegaensis* **sp. nov.** is only known from Gitega, located on the Central Plateau of Burundi and *ca.* 200 km southwest of Lake Victoria in the *"Lake Victoria regional mosaic" sensu* White (1983: 179).

Kayamuhakaia gitegaensis **sp. nov.** is classified as *Lake Victoria/ Afromontane linking* as well as endemic species to the Central Plateau of Burundi.

Habitat. The area of the present Gitega (average annual rainfall 1179 mm) was almost certainly once covered by a *"Transitional rain forest" sensu* White (1983:

181) that largely occurred on the higher western parts of Burundi as well as in the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 181). The natural vegetation was largely destroyed and relicts are seriously degraded today due to the large town. Nevertheless, small patches of forest occur and comprise Afromontane tree species such as *Alangium chinense* Harms (Cornaceae), *Gambeya gorungosana* Liben (synonym: *Chrysophyllum gorungosanum* Engl./ Sapotaceae) and *Strombosia scheffleri* Engl. (Olacaceae). These patches are mixed with riverine forests occurring along the numerous stream drainages in valleys near Gitega and comprise more widespread species such as *Syzygium guineense* DC. (Myrtaceae) and *Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae). About 20 km to the East and Northeast of the holotype locality wooded grassland occurs on altitudes between 1.350 — 1.840 m comprising *Combretum collinum* Fresen., *C. molle* R. Br. (Combretaceae), *Cussonia arborea* Hochst. (Araliaceae) with smaller trees of *Entada abyssinica* Steud. (Mimosoideae), *Hymenocardia acida* Tul. (Phyllanthaceae), *Protea madiensis* Oliv. (Proteaceae) and mainly on rocky hillsides *Parinari curatellifolia* Planch. (Chrysobalanaceae) as well as *Pericopsis angolensis* van Meeuwen (Papilionoideae). The wooded grasslands near Gitega owing their existence probably to fire and cultivation (Masharabu 2011).

Hence, *K. gitegaensis* **sp. nov.** occurs in wetter forest habitats that are locally dominated by woody Leguminosae (Fabaceae) and represent, if still present, a mixture of, *e.g.* Guineo-Congolian and Afromontane tree species.

Biological traits. The biology of *K.gitegaensis* **sp. nov.** is unknown.

Etymology. The species is named for the type locality Gitega (Burundi).

***Kayamuhakaia fontainei* sp. nov.**

Figs 8.c., 8.d., 20.a., 20.b.

Type locality and repository: Burundi, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, male, "Coll. Mus. Tervuren, Burundi: Gitega [formerly Kitega; today Gitega Province, Gitega District; collecting Site most probably at the Gitega School for Nursing 3°25'05"S 29°56'11"E, altitude range for Gitega 1.598 — 1.740 m], 2 – X – 1967 [= 02nd October 1967], Dr. M. Fontaine [Maurice Fontaine leg.]"; genitalia slide number 21/012020 I. Lehmann (RMCA). Paratype, female, "Coll. Mus. Tervuren", same locality as holotype, "4 – XII – 1967 [= 04th December 1967], Dr. M. Fontaine [leg.]"; genitalia slide number 25/012020 I. Lehmann (RMCA).

Description, male. *Head*: rough-scaled, with dense, short hair-like scales of Saccardo's umber with cream around compound eyes; eyes light brownish olive with small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.41 length of forewing, bipectinate, with branches of 5.0× width of shaft, branches scaled laterally with scales of Saccardo's umber, branches at base widely separated with 2.0× width of branch, shaft densely scaled Saccardo's umber and cream dorsally; labial palpi Saccardo's umber, three-segmented, all segments of equal length, basal segment broadest with 1.4× width of central segment, the latter is oval, segment on top narrow and elongated oval.

Thorax: Patagia with scales of deep olive-buff and Saccardo's umber towards tips, the latter are cream, not forming any collar ring; tegulae with longer hair-like scales of deep olive-buff with a light golden glint, scale tips are cream. Metathorax with long hair-like scales of deep olive-buff forming a pronounced scale-crest. Epiphyses are absent. Hindlegs with fine hair-like scales of deep olive-buff with a light golden glint; two pairs of tibial spurs, 0.9 mm/0.8 mm (upper pair) and 1.0 mm/0.9 mm (lower pair) in length, lower pair is slightly broader. Forewing length is 11.0 mm and wingspan 24.5 mm. Forewing elongated and visibly longer than hindwing, upper-side largely tawny-olive with a light golden glint; termen narrowly buffy olive with triangular-shaped lunules of Saccardo's umber, costa without striae; a pronounced broad patch of tawny-olive from CuA_2 to R_2, edged by a broad subterminal band of buffy olive towards termen; end of lower median and CuA_2 narrowly pure white and forming a "V" in horizontal position, other veins not distinctly coloured; below lower median and CuA_2 occur two large patches of buffy olive to dorsum, more or less rectangular-shaped; from near lower end of CuA_2 to near apex a broad buffy olive band that is edged on both sides Saccardo's umber; cilia long, 0.9 mm, buffy olive; base as well as end of discal cell with a patch of buffy olive. Underside of forewing Isabella colour with a golden glint.

Hindwing upperside light brownish olive suffused with scales of Isabella colour with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly deep olive-buff with a light golden glint mixed with hair-like scales of ivory-yellow; abdominal tuft with long scales of cream-buff, scales are decorative with long hair-like base and a medium broad tip, tuft long with 30% length of abdomen. Genitalia (Fig 20.a.) with tegumen *ca.* 0.2 — 0.5× basal width of vinculum; saccus very broad and long, 0.75× length of ventral width of valva; uncus medium broad, basal part 50% broader than upper part of uncus, basal part with width *ca.* 0.9× as long as basal width of valva, uncus bifid, tips acuminate, with a large lunule-like shape of the emargination that is 40% as long as uncus length, uncus without holes dorsally. The thinly sclerotized juxta is rectangular, large and 80% the size of saccus. The valva is large, *ca.* 2.5× larger than saccus, rectangular-shaped, horizontal costal margin is oblique near the base of the semi-transtilla and rounded distally with some setae, semi-transtilla only as large as 25% of juxta, without long sclerotized setae, distal edge of valva is S-shaped and as long as the ventral edge, the latter has few short setae and a small broadly rectangular-like appendice distally; 30% of valva thinly membranous dorsally with a sclerotized oblique structure ventrally of the thinly membranous part with few short setae — this structure is long, *ca.* 2.0× in length as the horizontal base of semi-transtilla; lower two-thirds of inner valva strongly sclerotized. The sacculus is very narrow and ends in the rectangular-like appendice ventral distally. Phallus is long, tube-like and medium broad with 2.3× length of saccus and without any structures.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and sepia towards tips around compound eyes; eyes sorghum brown with small black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small narrow slits, a pair of projections is absent, a horizontal dorsal ridge is rudimentary on lower fronto-clypeus; antennae very long, 0.50 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and branches of 1.3× width of shaft towards tip, branches are narrow elongated (viewed laterally), not widely separated at base and not scaled, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular and 1.4× length of central segment, the latter is broadly rectangular, segment on top rectangular, 60% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales of dark olive-buff with cream base, sepia towards tip, forming no collar ring. Metathorax has long hair-like scales of same colours with a pronounced scale-crest. Epiphyses are absent. Hindlegs with two pairs of spurs, upper pair narrow and 1.0 mm/0.9 mm, lower pair 0.9 mm/0.8 mm in length. Forewing length is 11.0 mm, wingspan 23.5 mm. Forewing upperside largely dark olive-buff with a light golden glint; a dominant and broad rectangular patch of Saccardo's umber extends from base of CuA_2 to base of M_3; CuA_2 narrowly cream at base; end of lower median narrowly cream and forming a short "V" in horizontal position; termen without lunules; sub-terminal line slightly wavy and Saccardo's umber from near apex to end of CuA_2; cilia long, 1.0 mm, deep olive-buff with tips of dark olive-buff. Underside of forewing is deep olive-buff with a light golden glint; costa narrowly light brownish olive.

Hindwing upperside is largely dark olive-buff and with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales of cream with sepia towards tip, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and sepia. Postabdominal structure and genitalia (Fig 20.b.) have papillae anales with short and long setae and with a pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe 0.6× width of the dorsal width of segment 8 and with one lobe *ca.* 10% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and slightly bent inwards anteriorly, ventrally of same width as dorsally with a horizontal ventral edge; lower half of segment 8 without a sclerotized ring-like band; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses slightly narrower than posterior apophyses, base of one anterior apophysis small, 0.3× as large as one lobe of papillae anales; the distal part of the anterior apophysis is 25% longer than the dorsal width of segment 8 and without a broader end, not bent upwards (in a not pressed condition); the posterior apophyses are long, 2.0× as long as anterior apophyses with a T-shaped base that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of this base is 75% of the whole length of posterior apophysis, the latter are only slightly bent upwards; a small knee-like shape of posterior apophysis is absent, the end is acuminate. The ductus bursae is broad, 3.0× as broad as anterior apophyses and long with 2.0 mm, *ca.* 30% longer as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a thinly membranous triangular shaped plate-like structure; corpus bursae is thinly membranous, without any structures, broadly rounded, large with 1.2× as large as segment 8 in lateral view if not pressed and not broken.

Diagnosis. The male of *K. fontainei* **sp. nov.** has a unique character, namely the absence of epiphyses. It shares one remarkable character with the males of *K. wellsi* **sp. nov.** in the antennae that are very long in the latter species with 0.53 (in holotype) and 0.44 — 0.47 length of forewing but 0.41 length of forewing in *K. fontainei* **sp. nov.** Nevertheless, the branches of the antennae are among the longest in *Kayamuhakaia* with 3.5× — 4.0× width of shaft in *K. wellsi* **sp. nov.** and 5.0× width of shaft in *K. fontainei* **sp. nov.** The branches of antennae are widely separated at base in both species with 2.0× width of branch in the latter species, but 2.5× in *K. wellsi* **sp. nov.** The males can be easily separated as the latter species is much smaller in wing size and has epiphyses that are absent in *K. fontainei* **sp. nov.** Additionally, the valvae of *K. fontainei* **sp. nov.** have a small broadly rectangular-like appendice at the ventral edge distally that is lunule-like in *K. wellsi* **sp. nov.** Several characters are shared with *K. petermuriithii* **sp. nov.** such as a similar length of antennae, rectangular-shaped valvae, an S-shaped distal margin of valvae as well as acuminate uncus tips. The males of both species can be separated as the latter species has epiphyses and shorter branches of antennae.

The female of *K. fontainei* **sp. nov.** has a unique character combination, namely very long antennae and a very long ductus bursae that is 30% longer than the posterior apophyses. The female shares very long antennae with the larger females of *K. gitegaensis* **sp. nov.** as their length is 0.50 of forewing (0.48 in paratype of *K. gitegaensis* **sp. nov.**) in both species. The most striking difference comprises the genitalia that has an almost rectangular corpus bursae in *K. gitegaensis* **sp. nov.** but an almost rounded corpus bursae in *K. fontainei* **sp. nov.** Additionally, the ductus bursae is longer than the posterior apophyses in the latter species but as long as the posterior apophyses in *K. gitegaensis* **sp. nov.** The corpus bursae is larger than segment 8, namely 1.2× as large as segment 8 in lateral view in *K. fontainei* **sp. nov.**, smaller in the former species with 0.9× as large as segment 8. The very long antennae are also shared with the females of *K. nubifera* but the ductus bursae is 25% shorter than the posterior apophyses in the latter species.

Distribution. *Kayamuhakaia fontainei* **sp. nov.** is only known from Gitega (Burundi) where it occurs most probably sympatric with *K. gitegaensis* **sp. nov.**

Based on its morphological similarities with three Afromontane linking species (*cf.* diagnosis), *K. fontainei* **sp. nov.** is classified as *Lake Victoria/ Afromontane linking* as well as endemic species to the Central Plateau of Burundi.

Habitat. As described for *K. gitegaensis* **sp. nov.**

Hence, *K. fontainei* **sp. nov.** occurs in wetter forest habitats that are locally dominated by woody Leguminosae (Fabaceae) and represent, if still present, a mixture of, *e.g.* Guineo-Congolian and Afromontane tree species.

Biological traits. The biology of *K.fontainei* **sp. nov.** is unknown.

Etymology. The species is named for Dr. Maurice Fontaine who was born on 12th February 1913 at Marcinelle (Charleroi, Belgium), died on 9th February 1994. Maurice Fontaine was a medical doctor at Leuven University (Region Flandern, Belgium) and specialized in neuro-psychiatry at the universities of Paris (France) and Antwerpen (Region Flandern). After some years of practice in Belgium, he started a colonial carrier as a doctor in the Province of Kasaï (today in the Democratic Republic of the Congo/ DRC), later at Léopoldville (today Kinshasa / DRC) and in Uele (today Isiro/ DRC) and finally in Burundi where he founded a school for nurses at Kitega (today probably called "École Paramédicale de Gitega"). Dr. Fontaine was one of its most outstanding teachers during 10 years. He was also a specialist of the Lepidoptera of the Belgian fauna as well as on the African fauna and started his carrier at the age of 6 stating: "This is what I am going to do for the rest of my life!" Maurice Fontaine followed music courses at a very high level in harmony, fugue, counterpoint, orchestration and composition. He leaves a musical heritage which comprises more than 100 musical works with pieces for piano, chambre music, melodies and symphonic music of which one became a master piece: his symphonic poem "*Africa*". During his life, he has donated *ca.* 10.000 specimens of insects to the RMCA (Hecq 1994) including various new species of new genera of Metarbelidae described or dealt with by Lehmann, *e.g.* 2011, 2014, 2019b: 263, 286.

Note: The original text as written by Hecq was translated into English for I.L. by the Lepidopterists Willy De Prins (Leefdaal, Belgium) and Dr. Jurate De Prins (Royal Belgian Institute of Natural Sciences, Brussels, Belgium) in December 2013.

***Kayamuhakaia killmannae* sp. nov.**

Figs 8.e., 20.c., 29.b.

Type locality and repository: Rwanda, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, female, "Rwanda, P.N. Nyungwe [= Nyungwe National Park, altitude range 1.482 — 2.944 m, *cf.* Fischer & Killmann 2008: 13 who mention "1.400 m" as lowest elevation], Kitomba [locality not found by I.L., altitude not mentioned on label, I.L. assumes that the term "Kitomba" refers to the "Nyungwe Forest" and not to any location in the Nyungwe National Park], 07.2008 [July 2008], Eric Vingerhoedt [leg.]"; genitalia slide number 21/112015 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense, long hair-like scales of cream and dark olive towards tips around compound eyes; eyes Saccardo's umber with small black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are narrow slits, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short, 0.32 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and branches of 1.5× width of shaft towards tip, branches are narrow elongated (viewed laterally), not widely separated at base of branch and not scaled, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, basal segment broadly rectangular and of same length as central segment, the latter is oval and slightly narrower, segment on top egg-shaped, 40% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales of dark olive-buff with cream base and sepia towards tips, forming no collar ring. Metathorax has long hair-like scales of same colours with a little pronounced scale-crest. Epiphyses are needle-like, rudimentary, 0.2 mm long. Hindlegs with one pair of spurs, narrow and 1.1 mm/0.8 mm long. Forewing length 20.5 mm, wingspan 43.5 mm. Forewing upperside largely dark olive-buff with a light golden glint; a dominant and broad rectangular patch of Saccardo's umber extends from CuA_2 to costal margin; CuA_2 narrowly sepia; termen with sepia lunules; sub-terminal line rudimentary with patches of Saccardo's umber from near apex to end of CuA_1; cilia long, 1.0 mm, dark olive with tips of dark olive-buff. Underside of forewing is deep olive-buff with a light golden glint.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales with cream and dark olive-buff towards tip, with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and buffy olive. Postabdominal structure and genitalia (Fig 20.c.) have papillae anales with short and long setae and with a slightly pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe as broad as the dorsal width of segment 8 and with one lobe *ca.* 15% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and bent inwards anteriorly, ventrally more narrow as dorsally with a horizontal ventral edge and with a ring-like band that is more sclerotized on lower half of segment 8; the shape of segment 8 is triangular (viewed laterally in a not pressed condition); anterior apophyses S-shaped and slightly narrower than posterior apophyses, base of one anterior apophysis small, 0.5× as large as one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of the anterior apophysis is short and as long as the dorsal width of segment 8, without a broader end (in a not pressed condition); the posterior apophyses are long, 3.0× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to base of papillae anales, the length of the T-shaped base is 75% of the whole length of posterior apophysis, the latter are bent upwards (if not pressed below glass); a small knee-like shape of posterior apophysis is absent, the end is rounded. The ductus bursae is broad, 3.0× as broad as anterior apophyses and long with 1.9 mm, *ca.* 10% shorter as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a thinly membranous triangular shaped plate-like structure; corpus bursae is thinly membranous, without any structures, pear-shaped or slightly oval, large with 1.5× as large as segment 8 in lateral view if not pressed and not broken.

Male. Unknown.

Diagnosis. The female of *K. killmannae* **sp. nov.** is the largest species of *Kayamuhakaia* at present and furthermore comprises two unique characters: First, short and S-shaped anterior apophyses in combination with very long posterior apophyses that are 3.0× as long as the anterior apophyses. Second, only one pair of tibial spurs occurs on the hindlegs. The short antennae are shared with species that occur on Mount Kenya, in the Kikuyu Escarpment Forest as well as on Mount Elgon, namely with *K. yiruchengae* **sp. nov.** The latter species shares a rudimentary needle-like epiphysis on the forelegs as well as a long ductus bursae that is more or less as long as the posterior apopyses with *K. killmannae* **sp. nov.** Both species differ in the length of branches of antennae towards tip that are 1.5× width of shaft in the latter species but 2.5× width of shaft in *K. yiruchengae* **sp. nov.** The shape of segment 8 is also different since it is narrowly rectangular in the latter species but triangular in *K. killmannae* **sp. nov.**

Note: The venation of *K. killmannae* **sp. nov.** has two unusual cross-bars on the left forewing and left hindwing, namely between R_2 and R_3 near the apex as well as between Sc + R_1 and Rs near the apex. Such cross-bars — in regard to the same position on the wing — are not known from other species of Metarbelidae (Fig 29.b.).

Distribution. *Kayamuhakaia killmannae* **sp. nov.** is only known from Nyungwe Forest (formerly called Rugege Forest, Nyungwe National Park, Rwanda) located in the *"central portion of the Albertine Rift Region" sensu* Plumptre *et al.* (2007: 181) and in the "*Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161). The National Park was established in 2004 and comprises *ca.* 1000 km^2 including both Cyamudongo and Nyungwe forests.

Kayamuhakaia killmannae **sp. nov.** is classified as *Afromontane endemic* and as endemic species of Nyungwe Forest and ?the nearby and isolated Cyamudongo Forest (*ca.* 300 ha). The latter forest almost certainly formed part of Nyungwe Forest more than *ca.* 100 years ago and both are among the most diverse and important montane forests in East Africa (Fischer & Killmann 2008: 10, 14).

Habitat. Nyungwe Forest was probably a montane forest refugial area during the last glacial period 21,000 — 12,000 yr B.P. (*e.g.* Hamilton & Taylor 1991: Fig 3) and hence, still comprises at least 47 local endemic flowering plant species and at least 280 Albertine Rift endemics (Fischer & Killmann 2008: 10). Noteworthy, there is a distinction between the western and eastern part of the forest with a boundary going through the eastern slopes of the Bigugu massif (east of Pindura junction *cf.* Fischer & Killmann 2008: 13). The altitudinal stratification is as follows:

The *"montane forest at lower altitude (1.500 — 2.100 m)" sensu* Fischer & Killmann (2008: 13) is mainly restricted to the western part of Nyungwe Forest and primary forest is dominated by *Parinari excelsa* Sabine (Chrysobalanaceae), *Carapa grandiflora* Sprague (Meliaceae) and *Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae).

The *"montane forest at middle altitudes (2.100 — 2.600 m)" sensu* Fischer & Killmann (2008: 15) is particularly well developed near Uwinka and primary forest is dominated by *Beilschmiedia rwandensis* R. Wilczek, *Kuloa michelsoni* Trofimov (synonym: *Ocotea michelsonii* Robyns & R. Wilczek/Lauraceae), *Syzygium guineense* DC. (Myrtaceae), *Macaranga kilimandscharica* Pax (Euphorbiaceae) and *Balthasaria schliebenii* Verdc.(Pentaphylacaceae; synonym: *Melchiora schliebenii* Kobuski /Theaceae).

In the eastern part of Nyungwe Forest occurs at the same altitude largely a secondary forest dominated by *Macaranga kilimandscharica* Pax and *Neoboutonia macrocalyx* Pax (Euphorbiaceae). In the southeastern part, this secondary forest is dominated by *Sinarundinaria alpina* C.S. Chao & Renvoize (Gramineae) mixed with *Hagenia abyssinica* J.F.Gmelin (Rosaceae) and *Polyscias fulva* Harms (Araliaceae).

The *"upper montane forest (2.600 — 2.800 m)" sensu* Fischer & Killmann (2008: 16) is dominated by *Syzygium guineense* DC. subsp. *parvifolium* F. White (Myrtaceae), *Podocarpus latifolius* R. Br. (Podocarpaceae) and *Psychotria mahonii* C.H.Wright (Rubiaceae).

As the collecting Site of the holotype of *K. killmannae* **sp. nov.** is unknown, it can at least be concluded that only *"montane forest at lower altitude"* is locally dominated by woody Leguminosae (Fabaceae).

Biological traits. The biology of *K. killmannae* **sp. nov.** is unknown.

Etymology. The species is named for Dr. Dorothee Killmann (University of Koblenz-Landau/ Germany) who was born in 1972. Dorothee studies tropical ecosystems in eastern Africa since 2001. Her impressive botanical research in Nyungwe National Park — in collaboration with Professor Dr. Eberhard Fischer (*cf.* Lehmann & Dalsgaard 2023: 166) — resulted not only in a well illustrated book on plant species of this area but confirmed also that Nyungwe Forest is one of the biologically most important montane forests in Central and East Africa comprising, *e.g.* the source of the White Nile as well as the largest peat bog — Kamiranzovu — in Africa.

Kayamuhakaia philipokwaroi **sp. nov.**

Figs 9.a., 20.d.

Type locality and repository: Rwanda, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, female, "Rwanda, P.N. Nyungwe [= Nyungwe National Park, altitude range 1.482 — 2.944 m; *cf.* Fischer & Killmann 2008: 13 who mention "1.400 m" as lowest elevation], Pindura 1.850 — 2.200 m [corrected altitude: 2.375 — 2.412 m/ 2°28'31"S 29°13'41"E, Southern Province, Nyamagabe District], 15. — 27.09.2007 [September 2007], Ph. Leonard [leg.]"; genitalia slide number 25/122016 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and dark olive-buff towards tips around compound eyes; eyes sorghum brown with small black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae broken at length of 3.2 mm and 4.3 mm, with branches 0.3× width of shaft on lower 30% of antenna and branches of 1.0× width of shaft at 3.2 mm and 4.3 mm of antennae, branches are broad and not elongated (viewed laterally), not widely separated at base, not scaled, shaft densely scaled deep olive-buff dorsally; labial palpi half of eye-diameter in length, three-segmented, basal segment elongated, rectangular and 1.5× longer as central segment, the latter is elongated oval and slightly narrower, segment on top broadly egg-shaped, 50% as long as central segment.

Thorax: Patagia and tegulae with long hair-like scales of Isabela colour, chamois at base, forming no collar ring. Metathorax has long hair-like scales of same colours with a little pronounced scale-crest. Hindlegs with two pairs of spurs, narrow, upper pair is 1.3 mm/1.0 mm, lower pair 0.9 mm/0.8 mm in length. Forewing length 13.0 mm, wingspan 28.0 mm. Forewing upperside largely chamois mixed with Isabella colour with a light golden glint; a dominant and broad rectangular patch of buffy olive is edged narrowly Saccardo's umber and extends from CuA_2 to base of R_2; termen with few faded lunules of buffy olive; sub-terminal line weak and buffy olive from near apex to end of CuA_2; cilia long, 0.9 mm, with Isabella colour and a golden glint. Underside of forewing is deep olive-buff with a golden glint.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales of chamois with dark olive-buff towards tip, with a light golden glint; abdominal tuft 25% length of abdomen, with long hair-like scales of chamois and buffy olive. Postabdominal structure and genitalia (Fig 20.d.) have papillae anales with short and long setae and with a pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe 60% as broad as the dorsal width of segment 8 and with one lobe *ca.* 15% the size of papillae anales (viewed ventrally). Segment 8 is dorsally medium broad and not bent inwards anteriorly, ventrally as broad as dorsally with a horizontal ventral edge; segment 8 with a narrow ring-like band that is more sclerotized on lower half of segment 8; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses straight and as broad as posterior apophyses, base of one anterior apophysis large, 3.0× as large as one lobe of papillae anales; the distal part of the anterior apophysis is medium long and 70% longer than the dorsal width of segment 8, with a broader rectangular end (in a not pressed condition); the posterior apophyses are long, 2.1× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 65% of the whole length of posterior apophysis, the latter are slightly bent upwards; a small knee-like shape of posterior apophysis is absent, the end is rectangular. The ductus bursae is narrow, 1.5× as broad as anterior apophyses and long with 2.0 mm, almost as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a thinly membranous triangular shaped plate-like structure; corpus bursae is thinly membranous, without any structures, broadly oval-shaped, large with 1.7× as large as segment 8 in lateral view if not pressed and not broken.

Male. Unknown.

Diagnosis. The female of *K. philipokwaroi* **sp. nov.** has one unique character combination: The base of one anterior apophysis is the largest among the species of *Kayamuhakaia*, it is 3.0× as large as one lobe of papillae anales in combination with a broadly oval-shaped corpus bursae that is 1.7× as large as segment 8.

Two characters are shared with *K. hermannstaudei* **sp. nov.**: First, the large and broadly oval-shaped corpus bursae that is 1.5× the size of the narrowly rectangular segment 8 in the latter species but 1.7× the size in *K. philipokwaroi* **sp. nov.** Second, the long anterior apophyses are 70% longer than the dorsal width of segment 8 in the latter species but 75% longer in the former species. Different characters between both species comprise: First, the labial palpi are two-segmented in *K. hermannstaudei* **sp. nov.** but three-segmented in *K. philipokwaroi* **sp. nov.** Second, the upper pair of tibial spurs on the hindleg is long in the latter species with up to 1.3 mm but short with up to 0.7 mm in *K. hermannstaudei* **sp. nov.** Third, one lobe of the papillae anales is only larger than the base of anterior apophysis in four species of *Kayamuhakaia*, namely 20% larger in the latter species, 30% larger in *K. philipokwaroi* **sp. nov.**, 20% larger in *K. bokatolaensis* **sp. nov.** and 40% larger in *K. mbalensis* **sp. nov.**

Distribution. *Kayamuhakaia philipokwaroi* **sp. nov.** is only known from Nyungwe Forest near Pindura, located *ca.* 5 km east of Uwinka in the Nyungwe National Park.

Kayamuhakaia philipokwaroi **sp. nov.** is classified as *Afromontane endemic* as well as endemic species to Nyungwe Forest and ?the nearby Cyamudongo Forest.

Habitat. *"Montane forest at middle altitudes (2.100 — 2.600 m)" sensu* Fischer & Killmann (2008: 15), *cf.* habitat description for *K. killmannae* **sp. nov.**

Biological traits. The biology of *K. philipokwaroi* **sp. nov.** is unknown.

Etymology. The species is named for the Kenyan Philip Okwaro who was born and raised in western Kenya. Philip became a ranger in 1979 when he was first posted — via the Kenya Wildlife Department — to the Masai Mara National Reserve and later to the Amboseli National Park in1983. During his time at school he already began to observe and admire what nature has provided and he became aware that a ranger plays a vital role among those people who represent a professional hierarchy in the active conservation of flora and fauna (Okwaro 1990: 8). Philip's determination and courage to protect wildlife as an invaluable natural resource is much needed in many more people living in a present world with a daily declining species as well as habitat diversity on our planet.

Kayamuhakaia bokatolaensis **sp. nov.**

Figs 9.b., 21.a.

Type locality and repository: Democratic Republic of the Congo, the Royal Museum for Central Africa, Tervuren, Belgium (RMCA).

Material examined. Holotype, female, "Coll. Mus. Congo, Tshuapa: Bokatola [formerly Belgian Congo; today Democratic Republic of the Congo/ DRC, Équateur Province, 0°38'14.56"S 18°47'54.88"E], altitude not mentioned on label [altitude range is 346 — 356 m], IX 61 or 64 [in handwriting = September, collected possibly in 1964 or 1961?], R. P. Hulstaert [= R.P.G. Hulstaert for Father Gustaaf Hulstaert leg., *cf.* Lehmann 2011: 40]"; genitalia slide number 12/012020 I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream and dark olive towards tips, the latter are deep olive-buff around compound eyes; eyes sorghum brown with small sepia spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are large oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae long, 0.42 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and branches of 2.0× width of shaft towards tip, branches are narrow elongated (viewed laterally), widely separated at base, not scaled, shaft densely scaled deep olive-buff dorsally; labial palpi less than half of eye-diameter in length, two-segmented, basal segment broadly rectangular and 0.6× longer as segment on top, the latter is broadly egg-shaped and slightly narrower.

Thorax: Patagia and tegulae with long hair-like scales of dark olive with a cream base and a cream tip, forming no collar ring. Metathorax has long hair-like scales of same colours with a little pronounced scale-crest. Hindlegs with two pairs of spurs, narrow, upper pair is 1.1 mm/0.9 mm, lower pair 1.0 mm/0.8 mm in length. Forewing length 15.5 mm, wingspan 34.5 mm. Forewing upperside largely chamois with a light golden glint; a dominant and broad rectangular patch of snuff brown is edged narrowly Saccardo's umber on both sides and extends from CuA_2 to costa with the outer edge forming a wavy sub-terminal line to near apex; a broad ecru-olive band occurs along termen; lunules absent; end of lower median and CuA_2 cream, forming a "V" in horizontal position; cilia long, 1.1 mm, with chamois and dark olive-buff tips as well as a golden glint. Underside of forewing is deep olive-buff with a golden glint.

Hindwing upperside is cream buff mixed with scales of chamois with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly with hair-like scales of chamois with a cream base, with a light golden glint; abdominal tuft 25% length of abdomen, with long hair-like scales of chamois and cream. Postabdominal structure and genitalia (Figs 21.a.) have papillae anales with short and long setae and without a pronounced belly-like shape near the basal part of the papillae anales; small lobes are present with one lobe as broad as the dorsal width of the narrow segment 8 and with one lobe *ca.* 10% the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and not bent inwards anteriorly, ventrally *ca.* 60% narrower than dorsally with a horizontal ventral edge; segment 8 with a narrow ring-like band that is thinly sclerotized; the shape of segment 8 is narrowly rectangular (viewed laterally in a not pressed condition); anterior apophyses bent upwards and as broad as posterior apophyses, base of one anterior apophysis medium large, 1.2× as large as one lobe of papillae anales; the distal part of the anterior apophysis is medium long and 75% longer than the dorsal width of segment 8, with an acuminate end (in a not pressed condition); the posterior apophyses are long, 1.6× as long as anterior apophyses with a T-shaped base (in horizontal position) that occurs on a medium large intersegmental membrane, extending ventrally to near base of papillae anales, the length of the T-shaped base is 60% of the whole length of posterior apophysis, the latter are strongly bent upwards (if not pressed below glass); a small knee-like shape of posterior apophysis is absent, the end is acuminate. The ductus bursae is medium broad, 3.5× as broad as anterior apophyses and long with 1.9 mm, slightly longer as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs a thinly membranous triangular shaped plate-like structure; corpus bursae is thinly membranous, without any structures, rounded in shape, large with 1.4× as large as segment 8 in lateral view if not pressed and not broken.

Male. Unknown.

Diagnosis. The female of *K. bokatolaensis* **sp. nov.** has one unique character combination: The branches of the long antennae are 2.0× width of shaft towards tip of antenna in combination with small lobes of the papillae anales with one lobe as broad as the dorsal width of segment 8.

Kayamuhakaia aberdarensis **sp. nov.** shares three characters with *K. bokatolaensis* **sp. nov.**: First, the long antennae with at least 0.45 length of forewing in the former species and 0.42 in the latter. Second, two-segmented labial palpi are present. Third, a large rounded corpus bursae that is 1.4× the size of segment 8 in the latter species but 1.7× the size of segment 8 in *K. aberdarensis* **sp. nov.** Differences between both species are not only the larger forewing size in *K. bokatolaensis* **sp. nov.** in combination with chamois coloured forewings that are largely dark olive-buff in the smaller sized *K. aberdarensis* **sp. nov.** but also the large lobes of papillae anales with one lobe 30% the size of papillae anales in the latter species but small lobes with one lobe *ca.* 10% the size of papillae anales in *K. bokatolaensis* **sp. nov.** Furthermore, the distal part of the anterior apophysis is short, only 20% longer than the dorsal width of segment 8 in *K. aberdarensis* **sp. nov.** but 75% longer than the dorsal width of segment 8 in *K. bokatolaensis* **sp. nov.** Noteworthy, the venation of the forewing as well as hindwing is closest to the venation figured of the male of *K. haberlandorum* (*cf.* Fig 28.a.) although R_5 is well separated at base from a relatively long stalked R_3+R_4 in the forewing.

Distribution. *Kayamuhakaia bokatolaensis* **sp. nov.** represents an important record for *Kayamuhakaia* in *"Congolia"* (17°50' — 32°E, 3°N — 6°S) *sensu* White (1978: 258). It is only known from Bokatola located in the *"Guineo-Congolian regional centre of endemism" sensu* White (1983: 71) and in the central Congo Basin *ca.* 36 km south of the Equator, *ca.* 90 km to the East of the central Congo River as well as *ca.* 80 km to the East of Lake Tumba and *ca.*12 km to the South of the Ruki River. Noteworthy, the lowland area of Bokatola is located only *ca.* 30 km to the East of a large submontane area with an elevation range of 700 — 1.000 m.

Kayamuhakaia bokatolaensis **sp. nov.** is classified as *Guineo-Congolian/ Afromontane linking* species (*cf.* diagnosis and *K. aberdarensis* **sp. nov.**) as well as endemic species to the *"Central Congolian Lowland Forests"* ecoregion *sensu* Blom & Schipper (2004: 243, 244) and might occur in the adjacent *"Eastern Congolian Swamp Forests"* ecoregion *sensu* Blom & Schipper (2004: 241, 242).

Habitat. Bokatola is located to the South and to the East of the arc formed by the Congo River — that originated in the Cretaceous possibly between 90 — 71 Ma (*cf.* Burke & Gunnell 2008: 8, 37) — as well as in a lowland area within interfluvial forest blocks that are dominated by *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) and *ca.* 80 km to the East of the *"Sangha River Interval" sensu* White (1978: 261) and as figured by Rietkerk *et al.* (1996: 619, Fig 1). The latter includes widespread tree species more or less throughout the interval while Guinea and Congolian endemics are absent. At present large swamps cover the area with swamp forests. The interval separates *"Lower Guinea"* and *"Congolia" sensu* White (1978: 258) — the latter occurs from the Congo River in the West to the Kivu centre and the western shore of Lake Victoria in the East. The collecting Site belongs at least to a *"small scale* [fluvial lowland forest] *refuge area" sensu* Leal (2001: 1073, 1077) that persisted during ice ages. This view is supported by a modified map on postulated large forest refuge areas, or *"macrorefugia"*, presented by Leal (2001: 1075). The average annual rainfall of the alluvial plain of the Central Congo Basin is between 1600 — 2000 mm with no dry season close to the Equator. A large part of this landscape is permanently flooded or at least during the flood period. *"Guineo-Congolian swamp forest and riparian forest" sensu* White (1983: 82, 83) occur along the poorly-defined drainage basins. The Ruki River — like other slowly flowing rivers in this lowland area — forms numerous alluvial islands covered with wet evergreen levee forests dominated by *Gilbertiodendron dewevrei* J. Leónard and *Daniellia pynaertii* De Wild. (Caesalpinioideae, *cf.* Blom & Schipper 2004: 241, 242). Swamp forests are also dominated by numerous Annonaceae, *e.g. Isolona hexaloba* Engl.& Diels as well as Ebenaceae, *e.g. Diospyros gilletii* De Wild. The *"Mixed moist semi-evergreen Guineo-Congolian rain forest"* is characterized by species such as *Prioria oxyphylla* Breteler (synonym: *Oxystigma oxyphyllum* J. Leónard) and *Scorodophloeus zenkeri* Harms (Caesalpinioideae) as well as by species of *Entandrophragma* C.DC., *e.g. E. angolense* C.DC., *E. utile* Sprague (Meliaceae). Noteworthy, the Caesalpinioideae are particularly rich in species which belong to endemic genera.

Hence, the habitat of *K. bokatolaensis* **sp. nov.** is dominated by woody Leguminosae (Fabaceae), in particular by Caesalpinioideae.

Biological traits. The biology of *K. bokatolaensis* **sp. nov.** is unknown.

Etymology. The species is named for the type locality Bokatola (DRC).

***Kayamuhakaia tombutynskii* sp. nov.**

Figs 9.c., 21.b.; Aurivillius (1910: 49, 2 ♀♀ not figured, but with 1 ♀ in Fig 9.c. herein, *cf.* "Note" below)

Type locality and repository: Tanzania, the Swedish Natural History Museum, Stockholm, Sweden (NRM).

Note: Two female specimens were published by Aurivillius (1910: 49) as „Metarbela nubifera BAKER?". Both females are presented herein as *Kayamuhakaia tombutynskii* **sp. nov.** (*cf. K. nubifera* that is considered herein as Nairobi endemic).

Material examined. Holotype, female, "[Mount] Kilimandjaro [spelling herein: "Kilimanjaro" *sensu* Burton & Speke (1858) and Wakefield (1870); today Tanzania, Kilimanjaro Region], Sjöstedt.1905—6 [Sjöstedt leg. 1905 — 1906]", on a second tiny label "1 nov [in handwriting, 01st November 1905 or 1906]", on a third large label in handwriting possibly written by Aurivillius: "Metarbela nubifera Baker?", genitalia slide number 15/042020 I. Lehmann.

Paratypes: female, same locality as holotype, "Sjöstedt.1905 — 6", on a second tiny label "5 mars [in handwriting, 05th March 1905 or 1906]"; genitalia slide number 21/012021 I. Lehmann (NRM); female, same locality as holotype, on a second label "Kibonoto 1300 — 1900 m [today Tanzania, Kilimanjaro Region, Siha District, also known as Kibongoto or Kibogoto]", on a third tiny label "13 nov [in handwriting, 13th November 1905 or 1906]"; abdomen is missing and hence, there was no genitalia dissection possible (paratype in NRM).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream with brownish olive towards tip, scale tips are pale olive-buff (white in paratype with missing abdomen); eyes sepia with small black spots; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are narrowly elongated oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae very long, 0.46 length of forewing (in paratype 0.47, in second paratype with missing abdomen 0.42) with branches 0.3× width of shaft on lower 30% of antenna and 1.5 — 1.7× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.2× width of branch, scaled cream laterally, shaft densely scaled cream dorsally; labial palpi less than half of eye-diameter in length, three-segmented, with basal segment broader and of same length as central segment, both are rectangular-shaped, upper segment egg-shaped and 80% length of central segment.

Thorax: Patagia and tegulae with long hair-like scales of cream with brownish olive towards tip, scale tips are pale olive-buff (white in paratype with missing abdomen) and forming no collar ring. Metathorax with long hair-like scales of same colours forming a little pronounced scale-crest. Epiphyses are absent. Hindlegs with fine hair-like scales of dark olive-buff and cream with two pairs of spurs, upper pair 1.1 mm/0.9 mm, lower pair 1.0 mm/0.8 mm in length. Forewing length 12.5 mm, wingspan 28.0 mm (in paratype 14.0 mm, wingspan 32.0 mm; in paratype with missing abdomen 11.5 mm, wingspan 26.5 mm). Forewing upperside with a dark olive-buff ground-colour with a light golden glint and suffused with scales of brownish olive; a dominant rectangular patch of Saccardo's umber and of brownish olive extends from CuA_2 to R_3 (also in paratypes), the latter has a light golden glint; CuA_2 is not distinctly marked (also in paratypes); above base of 1A+2A occurs no oval shaped patch in holotype and paratypes; a terminal band is brownish olive from near apex to the end of CuA_2; the end of discal cell is not distinctly coloured; termen without lunules; cilia very long, 1.1 mm, deep olive-buff with tips of light brownish olive and a light golden glint. Underside of forewing is dark olive-buff with a light golden glint.

Hindwing upperside is ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 21.b.) have papillae anales with short and long setae and large lobes with one lobe 80% as long as the dorsal width of segment 8 and with one lobe 25% of the size of papillae anales (viewed ventrally). Segment 8 is dorsally broad and only slightly narrower ventrally, as broad as the length of anterior apophyses, with a thinly sclerotized ventral band; the shape of segment 8 is rectangular; base of one anterior apophysis is only 0.3× the size of one lobe of papillae anales; the distal part of the anterior apophysis is short and as long as the dorsal width of segment 8 and without a broader end, bent near base downwards (also in paratype); the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are long, 2.0× as long as anterior apophyses with T-shaped base (in horizontal position) that occurs on an intersegmental membrane, extending ventrally to the base of papillae anales, the length of the T-shaped base is 50% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is long, namely as long as one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like structure; corpus bursae is small, thinly membranous, without any structures, oval (slightly pear-shaped in paratype), and if not pressed and not broken 0.7× as large as segment 8 (0.6× as large as segment 8 in paratype) in lateral view.

Male. Unknown.

Diagnosis. The females of *K. tombutynskii* **sp. nov.** are similar in size, length of antennae, wing pattern and in the postabdominal structure to *K. aberdarensis* **sp. nov.** Both species differ in a unique character combination: The former species has three-segmented labial palpi combined with an oval-shaped or slightly pear-shaped corpus bursae that is much smaller than segment 8 in lateral view while the females of *K. aberdarensis* **sp. nov.** have two-segmented labial palpi combined with a rounded corpus bursae that is almost twice as large as segment 8. A second but much smaller species that shares three, and possibly more significant characters with *K. tombutynskii* **sp. nov.**, is *K. kismayuensis* **sp. nov.**: First, the anterior apophyses are 10% longer than the dorsal width of the rectangular segment 8 in the latter species but are of the same length with the dorsal width of a rectangular segment 8 in *K. tombutynskii* **sp. nov.** Second, the corpus bursae is oval in both species. Third, the corpus bursae is small in both species with 0.7× as large as segment 8 in the latter species and 0.8× as large as segment 8 in *K. kismayuensis* **sp. nov.**

Distribution. *Kayamuhakaia tombutynskii* **sp. nov.** is only known from Mount Kilimanjaro, the highest mountain in Africa (elevation 5.895 m/ average annual rainfall is 3000 mm at 2.100 m on the central southern slope, decreasing at higher and lower elevations) and is located in north-central Tanzania on the frontier with Kenya.

Based on morphological similarities in the genitalia shared with one Zanzibar-Inhambane/Lake Victoria linking species, *K. tombutynskii* **sp. nov.** is classified as *Afromontane /Zanzibar-Inhambane linking* as well as endemic species of Mount Kilimanjaro.

Habitat. Kibonoto — based on a map presented by Sjöstedt (1909: 80) — represents an area located on the southwestern slopes of the mountain following more or less the east side of the Sanya River, *e.g.* 3°08’18”S 37°05’15”E. Hence, different collecting Sites exist between 1.000 — 1.900 m. As the label of one paratype indicates was this female collected in the cultural zone (usually below 1.700 m) with an average rainfall of 1000 — 1400 mm. The cultural zone was also noted by Gillman (1949: 22) with conspicuous banana groves and vegetable gardens and is still dominated by Chagga home gardens comprising additionally numerous indigenous tree species such as *Albizia schimperiana* Oliv., *A. petersiana* Oliv.

(Mimosoideae), ?*Rauvolfia caffra* Sond. (Apocynaceae), *Cordia africana* Lam. (Boraginaceae) and *Markhamia lutea* K. Schum. (Bignoniaceae). Noteworthy, woody legumes of the genus *Albizia* Durazz. comprise 45% of all tree specimens in the Chagga home gardens (Hemp 2006a, b; Lehmann *et al.* 2023: 78 — 79, Fig 24 d.). Kibonoto as well as most of the cultural zone of the southwestern slopes between 1.300 and 2.000 m were once covered by submontane *Croton-Calodendrum* forests as well as lower montane *Cassipourea* forests (Hemp 2006b, *cf.* for more habitat details Lehmann *et al.* 2023: 101) that belong to the *"Dry transitional montane forest" sensu* White (1983: 166, 167).

Hence, the habitat of *K. tombutynskii* **sp. nov.** is certainly dominated by woody Leguminosae (Fabaceae).

Biological traits. The biology of *K. tombutynskii* **sp. nov.** is unknown.

Etymology. The species is named in honour for the primatologist, conservationist and Honorary Warden of Uganda National Parks (life-time appointment since 1992), Thomas (Tom) Michael Butynski, Ph.D. (born in March 1948), for his outstanding and successful conservation projects in Africa, *e.g.* his research on Stuhlmann's Blue Monkey (*Cercopithecus mitis stuhlmanni* Matschie) in the frame of the Kibale Forest Project (Uganda) as Post-doctoral Researcher on Primate Ecology of the Rockefeller University (New York, USA). In this context, additionally Tom not only played a major role in administrating this project during six years (1978 — 1984) but was also dealing with problems of poaching and timber theft in Kibale Forest. His crucial role during the war of 1979 was much appreciated by other scientists and staff members (Struhsaker 1997: xx). Outstanding is his work on African primates, *e.g.* as the Senior Editor of Volume II of *Mammals of Africa* (2013). After the publication of this standard work on African mammals he recorded — together with primatologist Yvonne de Jong, Ph.D. — for the first time the Mount Kilimanjaro Guereza (*Colobus guereza caudatus* Thomas) in Kenya, namely in the Kitobo Forest Reserve (1.6 km^2) as well as Loitokitok Forest Reserve (4.2 km^2) in 2014. Both forests are isolated today and are located *ca.* 20 km and *ca.* 10 km from Mount Kilimanjaro. Before, Kenya's now most threatened primate species was only known from Mount Kilimanjaro and Mount Meru (Butynski & de Jong 2015; Finch 2023).

The author is very grateful to Tom for his long-term and significant encouragement in various ways, *e.g.* supporting — together with Quentin Luke (Nairobi) — the publishing of the first completed research results on the diversity and endemism of Lepidoptera (*e.g.*156 butterfly species + 266 identified larger moth species) as well as plants (*e.g.* 174 plant species including 99 endemics) recorded on 20 Sample Sites plus four Transect Sites in Kaya Muhaka, Kaya Kinondo and Kaya Diani during 1994 — 2003, *cf.* Lehmann & Kioko (2005: 131, 133, 136, 137). By then, Tom was a member of the Editorial Committee of the *Journal of East African Natural History* and represented Conservation International (USA). Three years later, Tom supported my ideas on Metarbelidae — together with Benny Bytebier (Nairobi), Lorna Depew (Nairobi), Marc De Meyer (Tervuren), Jurate De Prins (Tervuren) and Ian Gordon (Nairobi) — in regard to the first two comprehensive publications of 16 new species of Metarbelidae from Kenya, Tanzania and Uganda in the same journal (Lehmann 2008, 2009), although the Metarbelidae were largely unknown to scientists and not yet accepted as a family at this time! In 2015 and 2016, Tom encouraged I.L. with substantial help — together with Yvonne de Jong (Nanyuki) — to undertake successful fieldwork on the Laikipia Plateau in the frame of the Doctoral Dissertation on the family Metarbelidae. This fieldwork was done, *e.g.* on the Lolldaiga Hills Ranch and Wildlife Conservancy during 2016 — 2018 when Tom was Director of the Lolldaiga Hills Research Programme and Sustainability Centre of Eastern Africa (*cf.* Lehmann *et al.* 2018; Lehmann 2019b: 353, 392).

All light-trappings as well as the studies on the vegetation undertaken by I.L. in collaboration with Tom — together with Mike Roberts, Julius Mathiu and Robert Wells — were done often near groups of elephant, buffalo or hyenas and hence, they represent for I.L. an unforgettable and unique experience until present that encourages to persevere, *e.g.* on the work with Metarbelidae.

***Kayamuhakaia kilimanjaroensis* sp. nov.**

Figs 10.a., 21.c.

Type locality and repository: Tanzania, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Tanzanie. [Tanzania] M. [Mount] Kilimanjaro [Kilimanjaro Region], 1520 m (Ph. Darge) [Darge leg.], 22-X-2004 [22nd October 2004] S: 03°05.881', E: 037°04.419' [this forest locality is east of Kimambo Garden, altitude range is 1.558 — 1.616 m, Siha District]", genitalia slide number 031/082029B I. Lehmann.

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of dark olive-buff with scale tips of pale olive-buff; eyes sorghum brown with small black spots; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are narrow slits, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short, 0.36 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and 1.5× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.5× width of branch, scaled cream laterally, shaft densely scaled cream with scale tips of dark olive-buff dorsally; labial palpi half of eye-diameter in length, three-segmented, with basal segment broader and of same length as central segment, rectangular-shaped, central segment oval, upper segment small, narrowly egg-shaped and 40% length of central segment.

Thorax: Patagia and tegulae with long hair-like scales with cream and light brownish olive towards tip, scale tips are pale olive-buff forming no collar ring.

Metathorax has a pronounced scale-crest of hair-like scales with a decorative broader tip of Mummy brown. Epiphyses are absent. Hindlegs are missing. Forewing length 11.0 mm, wingspan 24.0 mm. Forewing upperside largely of Isabella colour with a light golden glint; a dominant rectangular patch of Saccardo's umber is present from CuA_2 to base of R_5; below the centre of CuA_2 is a small pure white patch edged Mummy brown; CuA_2 is not distinctly marked; above base of 1A+2A occurs no oval shaped patch; a terminal band is absent; end of discal cell is not distinctly coloured; termen with small lunules of Saccardo's umber; cilia long, 0.9 mm, buffy-olive with tips of Isabella colour and a light golden glint. Underside of forewing is dark olive-buff with a light golden glint.

Hindwing upperside is dark olive-buff with a light golden glint; cilia are deep olive buff and as long as in forewing; underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a light golden glint, a pronounced scale-crest with decorative hair-like scales with broad tips of Mummy brown is present on metathorax; abdominal tuft short with 20% length of abdomen, with long hair-like scales of cream and dark olive-buff. Postabdominal structure and genitalia (Fig 21.c.) have papillae anales with short and long setae and small lobes with one lobe as long as the dorsal width of segment 8 and with one lobe 15% the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and has a well visible dorsal gap; width ventrally the same as dorsally with a very narrow thinly sclerotized ventral band; the shape of segment 8 is narrowly rectangular, vertically 15% longer as the posterior apophysis; base of one anterior apophysis is 0.5× the size of one lobe of papillae anales; the distal part of the anterior apophysis is short and 30% longer as the dorsal width of segment 8 and without a broader end, not bent downwards; the dorsal width of segment 8 is long bent inwards at centre (*ca.* 70% of dorsal width and viewed dorsally); the posterior apophyses are long, 2.0× as long as anterior apophyses with T-shaped base (in horizontal position) that occurs on an intersegmental membrane, extending ventrally to the base of papillae anales, the length of the T-shaped base is 50% of the whole length of posterior apophysis, the latter are not bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is short, namely 70% of the length of one posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no plate-like structure; corpus bursae is very large, thinly membranous, without any structures, round in shape, and if not pressed and not broken 2.5× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female of *K. kilimanjaroensis* **sp. nov.** has a unique character combination: First, the antennae are short. Second, a pure white small patch occurs below CuA_2 on a largely Isabella coloured forewing. Third, the short ductus bursae is 30% shorter as the postererior apophyses. The very large and round corpus bursae that is 2.5× as large as segment 8 in lateral view as well as the short antennae are shared with *K. maasi* **sp. nov.** These three characters are different to *K. tombutynskii* **sp. nov.** with its very long antennae, oval-shaped corpus bursae that is small with 0.7× as large as segment 8 in lateral view. Short antennae, a narrow rectangular segment 8, a distal part of the anterior apophyses that is 30% longer than the dorsal width of segment 8 as well as a large corpus bursae that is 2.0× as large as segment 8 in lateral view are shared with *K. haberlandorum*. The latter species can be separated from *K. kilimanjaroensis* **sp. nov.** as it has a pear-shaped corpus bursae and a longer ductus bursae that is as long as the posterior apophyses.

Distribution. *Kayamuhakaia kilimanjaroensis* **sp. nov.** is only known from Mount Kilimanjaro. Due to its four morphological similarities to one Zanzibar-Inhambane endemic species, *K. kilimanjaroensis* **sp. nov.** is classified as *Afromontane/Zanzibar-Inhambane linking* as well as endemic species to Mount Kilimanjaro and its adjacent submontane areas. *Kayamuhakaia kilimanjaroensis* **sp. nov.** might occur sympatric with *K. tombutynskii* **sp. nov.**

Habitat. As the label indicates was the female collected in the cultural zone (usually below 1.700 m, *cf.* habitat description for *K. tombutynskii* **sp. nov.**). Hence, the habitat of *K. kilimanjaroensis* **sp. nov.** is certainly dominated by woody Leguminosae (Fabaceae).

Biological traits. The biology of *K. kilimanjaroensis* **sp. nov.** is unknown.

Etymology. The species is named for Mount Kilimanjaro. The spelling of this mountain herein as *"Kilimanjaro"* or *"Kilima Njaro"* is based on Burton & Speke (1858: 194), Krapf (1860: 287) as well as Wakefield (1870: 330). Noteworthy, although Wakefield mentioned the mountain (= *"mlima"* in KiSwahili) several times he did not present any meaning for the word "Njaro" but meanings for many other localities and mountains nearby. Osmaston (1989: 7) using the same spelling in his detailed study about the glaciers on Mount Kilimanjaro presented the meaning *"Shining mountain"*. Pavitt (1989: 47) stated that "njaro" literally means something "shining white" in the Chagga language.

Hence, *"Kilima Njaro"* is the *"White shining mountain"* as named by the Chagga tribe.

Kayamuhakaia rupimangatae **sp. nov.**

Figs 10.b., 21.d.

Type locality and repository: Tanzania, the Zoological State Collection, Munich, Germany (ZSM).

Material examined. Holotype, female, "Tanzanie: [Tanzania] Mt. [Mount] Meru [Arusha Region], Miriakamba Hut [Arusha National Park, Meru District] 2.500 m [altitude range 2.483 — 2.510 m, 3°13'46.15"S 36°47'57.63"E], forèt de montagne

[=montane forest], (Ph. Darge) [Darge leg.], 19-I-2005 [19th January 2005]", genitalia slide number 20/042020 I. Lehmann (ZSM).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of cream mixed with long hair-like scales of buffy olive around compound eyes; eyes ecru-olive with black spots; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae 0.39 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and 1.5× width of shaft towards tip, branches are medium broad (viewed laterally), widely separated at base with 1.1× width of branch, scaled cream laterally, shaft densely scaled cream dorsally; labial palpi half of eye-diameter in length, three-segmented, with segment on top narrowly rectangular and 60% as long as central segment, with central segment rectangular and 1.3× as long as basal segment, the latter is 1.4× broader than central segment and rectangular.

Thorax: Patagia and tegulae with long hair-like scales of buffy olive and dark olive-buff towards tip, tips cream forming no collar ring. Metathorax with long hair-like scales of same colour as well as of Saccardo's umber forming a little pronounced scale-crest. Forelegs have a rudimentary epiphysis of 0.2 mm in length. Hindlegs with fine hair-like scales of dark olive-buff and a light golden glint with two pairs of narrow spurs, upper pair rudimentary 0.3 mm/0.2 mm, lower pair 1.0 mm/0.9 mm in length (hindlegs broken during preparation). Forewing length 18.0 mm, wingspan 38.5 mm. Forewing upperside with buffy olive as well as deep olive-buff ground-colour with a light golden glint; a dominant almost rectangular patch of Snuff brown extends from CuA_2 to R_5; CuA_2 is narrowly marked cream; above base of 1A+2A occurs no oval shaped patch; a terminal band is weak and of Saccardo's umber; end of discal cell not distinctly coloured; termen with few weak lunules of Saccardo's umber; cilia long, 1.1 mm, buffy olive with a light golden glint. Underside of forewing is dark olive-buff with a light golden glint.

Hindwing upperside is buffy olive with a golden glint and not suffused with scales of Saccardo's umber; cilia and underside as in forewing.

Abdomen: Mainly buffy olive mixed with hair-like scales of cream with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of buffy olive. Postabdominal structure and genitalia (Fig 21.d.) have papillae anales with short and long setae and small lobes with one lobe 80% as long as the narrow dorsal width of segment 8 and with one lobe less than 10% the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and of same width ventrally with a very narrow sclerotized ring-like band that represents the lower central edge of segment 8; the shape of segment 8 is narrowly rectangular (viewed laterally), vertically 20% longer as the long posterior apophysis; base of one anterior apophysis is 0.9× the size of one lobe of papillae anales; the distal part of the anterior apophysis is 50% longer than the narrow dorsal width of segment 8 and without a broader end, not bent; the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are very long, 2.0× as long as anterior apophyses with T-shaped base that occurs on a large intersegmental membrane, extending ventrally to near base of papillae anales, the length of this base is 50% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is short, namely as long as 50% as one posterior apophysis (if not pressed below glass), thinly membranous, without any structures; below the base of the ductus bursae occurs a large rectangular plate-like structure that is 3.0× as large as one lobe of papillae anales; corpus bursae is thinly membranous, without any structures, elongated oval-shaped if not pressed and not broken, not as large as segment 8 in lateral view, namely ca. 10% smaller in size.

Male. Unknown.

Diagnosis. The female of *K. rupimangatae* **sp. nov.** has the following unique character combination: First, rudimentary epiphyses on the forelegs. Second, the upper pair of tibial spurs on the hindlegs is rudimentary. Third, the ductus bursae is short with half length of the posterior apophyses. A similar short ductus bursae, a narrowly rectangular segment 8 and short antennae are shared with *K. kilimanjaroensis* **sp. nov.** Both species can be separated since the corpus bursae is round and 2.5× larger than segment 8 in the latter species but elongated oval-shaped and 10% smaller as segment 8 in *K. rupimangatae* **sp. nov.** A small corpus bursae, short antennae and a short upper pair of tibial spurs on the hindleg are shared with *K. kismayuensis* **sp. nov.**

Distribution. *Kayamuhakaia rupimangatae* **sp. nov.** is only known from the eastern slopes of Mount Meru that are located *ca.* 50 km southwest of Mount Kilimanjaro. The area belongs to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161). Due to its morphological similarities to one Afromontane/Zanzibar-Inhambane linking species as well as to one Zanzibar-Inhambane/Lake Victoria linking species, *K. rupimangatae* **sp. nov.** is classified as *Afromontane/Zanzibar-Inhambane linking* as well as endemic species to Mount Meru.

Habitat. Mount Meru (elevation 4.566 m) is the third-highest mountain in Tanzania and represents — as Mount Kilimanjaro — a young volcano that developed mainly 2 Ma within the Northern Tanzanian Divergence Zone (NTDZ) of the EARS (Dawson 1992). Above an altitude of 1.800 m *"Undifferentiated Afromontane Forest" sensu* White (1983: 165) occurs on the eastern and wetter slopes comprising species of *Podocarpus* L' Hér. (Podocarpaceae), *Juniperus procera* Hochst. (Cupressaceae), *Astropanax volkensii* Lowry, G.M. Plunkett, Gostel & Frodin (synonym: *Schefflera volkensii* Harms/Araliaceae), *Ilex mitis* Radlk. (Aquifoliaceae) and *Prunus africana* Kalkman (Rosaceae); Andreas Hemp pers. comm. to I.L. in 2013, *cf.* Lehmann *et al.* (2023: 73, Fig 20 c. [not 20 b.] with text to Fig 20 b. [misprint by *Zootaxa*] + 97, 100). The average annual rainfall on the collecting Site is *ca.* 1000 — 1300 mm.

Hence, the habitat of *K. rupimangatae* **sp. nov.** is not dominated by woody Leguminosae (Fabaceae).

Biological traits. The biology of *K. rupimangatae* **sp. nov.** is unknown.

Etymology. The species is named for Rupi Mangat who was born in Nairobi in November 1961. Since 1991, Rupi has been associated with the Wildlife Clubs of Kenya, the first conservation programme in Africa formed in 1968. She has been the editor of *Komba* magazine since 1993 — published by the Wildlife Clubs of Kenya. Rupi writes also about travel for *Saturday magazine* and environmental articles for *The East African* — both published by Nation media — as well as for *Swara* magazine — published by the East African Wildlife Society (Nairobi). Her special interest in nature conservation is "writing about it with the aim to create public awareness about why we need to save spaces for species" (Rupi Mangat pers. comm. to I.L. in 2023).

Kayamuhakaia triangularis (Gaede, 1929) **comb. nov.**

Figs 10.c., 26.a., 26.b., 29.c.

Type locality and repository: Tanzania, the Natural History Museum and Leibniz Institute for Evolution and Biodiversity Research, Berlin, Germany (ZMHU, formerly ZMHB).

Original combination: "*Metarbela triangularis* n. sp." Gaede, M. (1929): *21. Family: Metarbelidae.* In: *Seitz, A. (ed.) The Macrolepidoptera of the World*, Vol. 14, p. 508: "Type 1 ♀: [Tanzania] — East Africa, [wingspan] 26 mm."

Material examined. "Type", male [not a female as published by Gaede], comprising the label data: "D.O. Afrika [for "Deutsch Ost-Afrika" = German East Africa/ today Tanzania] Daressalam [misspelling of the original "Dar Salam", *cf.* Shaykh Al-Amin 1995: 20; "Dâr es Salâm" *sensu* Kersten 1879: 33; today Dar es-Salaam / Dar es-Salaam Region] II. 1909 [= February 1909], Reuss S.G. [leg.]", on second label in handwriting: "*Metarbela triangularis Type* det. M. Gaede"; third label genitalia slide number 08/122009 I. Lehmann (ZMHB).

Re-Description, male. *Head*: rough-scaled, with dense, short hair-like scales of ecru-olive and buffy olive with a light golden glint around compound eyes; eyes cinnamon-brown with black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are small, narrowly oval, a horizontal dorsal ridge is absent; antennae 0.40 length of forewing, bipectinate, with branches 3.5× width of shaft, branches scaled laterally with scales of ecru-olive, branches at base not widely separated with 0.9× width of branch, shaft densely scaled ecru-olive dorsally with a light golden glint; labial palpi ecru-olive with a light golden glint.

Thorax: Patagia with buffy olive as well as ecru-olive scales with a light golden glint, not forming any collar ring; tegulae with longer hair-like scales of ecru-olive with a light golden glint, some scales with pale olive tips. Metathorax with long hair-like scales of buffy olive mixed with cream scales forming a pronounced scale-crest. Epiphyses are present. Hindlegs have fine hair-like scales of cream and ecru-olive with a light golden glint; only one pair of tibial spurs present that is 1.0 mm/

0.9 mm long. Forewing length is 12.5 mm and wingspan 27.5 mm. Forewing upperside largely cream-buff mixed with pale yellow-orange (faded) with a light golden glint; termen narrowly cream-buff with small triangular-shaped lunules of buffy olive; costa pale yellow-orange (faded) with small striae of buffy olive; a pronounced broad patch of pale yellow-orange (faded) from CuA_2 to costa is strongly bent inwards between M_2 and R_5; lower median, base of CuA_1 and the entire CuA_2 are narrowly white forming a "Y" in horizontal position, the end of 1A+2A is also narrowly white, other veins not distinctly coloured; below lower median and CuA_2 occur four small patches of Saccardo's umber; from lower end of CuA_2 to near apex occurs a narrow cream-buff band that is edged on both sides broadly buffy olive mixed with light greyish vinaceous scales; cilia long with 1.0 mm, pale yellow-orange (faded). Underside of forewing is ivory yellow with a light golden glint.

Hindwing upperside is ivory yellow mixed with light buff and with a light golden glint; cilia ivory yellow, underside of hindwing is light buff.

Abdomen: Mainly pale olive-buff mixed with hair-like scales of ecru-olive with a light golden glint; abdominal tuft with long scales of pale olive-buff and cream, scales decorative with long hair-like base and a medium broad tip of buffy olive, tuft long with 30% length of abdomen. Genitalia (Figs 26.a., 26.b.) with tegumen *ca.* 0.5—0.7× basal width of vinculum; saccus broad and long with 0.8× length of ventral width of valva; uncus narrow and elongated, basal part 35% broader than upper part of uncus with one large rounded hole, bifid at tip with a small lunule-like shape of the emargination that is 20% as long as uncus length and 25% as broad as uncus basal width, uncus tips acuminate. The valva is large rectangular and elongated, *ca.* 6.0× larger than saccus (in ventral view), costal margin is slightly lunule-like and pointed distally with few setae, semi-transtilla small, ventral edge with a dominant lunule-like appendice distally, distal margin slightly S-shaped and as long as ventral edge; 80% of valva thinly membranous from central part to ventral part with a short lunule-like sclerotized oblique structure with few setae near the central part. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long and narrow with 2.5× length of saccus and without any structures.

Female. Unknown.

Diagnosis. The male of *K. triangularis* has the following unique character combination: First, the forewing upper-side has a pronounced broad patch of pale yellow-orange that is unusually large and extends from CuA_2 to costa and is strongly bent inwards between M_2 and R_5. Second, the hindlegs have only one pair of tibial spurs. Third, the valvae are elongated rectangular with a slightly S-shaped distal margin that is as long as the ventral edge. The forewing pattern and its colour are similar to *K. huchtemanni* **sp. nov.** (*cf.* diagnosis below). More significant are three characters, namely a large rectangular valva with S-shaped distal margin and antennae with 0.40 length of forewing that are shared with *K. petermuriithii* **sp. nov.** as well as *K. kimbozensis* **sp. nov.**

Distribution. *Kayamuhakaia triangularis* is only known from an area in or close to Dar Salam (today Dar es-Salaam) located at the coast of the Indian Ocean and *ca.* 70 km southeast of Bagamoyo. The area between Bagamoyo and Dar es-Salaam belongs to the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 185), to the *"Swahilian regional centre of endemism" sensu* Clarke (1998: 62) as well as to the *"Usaramo floristic area" sensu* Hawthorne (1984: 97).

Due to its three significant morphological similarities that are shared with one Afromontane/Zanzibar-Inhambane linking species as well as with one Zanzibar-Inhambane endemic, *K. triangularis* is classified as *Zanzibar-Inhambane endemic* as well as endemic species to the *Swahilian regional centre of endemism.*

If not yet extinct, *K. triangularis* is certainly endemic to the lowland coastal forest patches in and near Dar es-Salaam.

Habitat. It is very likely that the habitat of the collecting Site of the holotype does no longer exist and that *K. triangularis* is highly threatened or already extinct.

Hawthorne (1984: 96, 143 — 146) stated that the Mogo Forest Reserve, formerly called the "Sachsenwald" by the Germans, was once located close to Dar es-Salaam and it was well–known to visiting and resident botanists, *e.g.* to Engler, at the time when the holotype of *K. triangularis* was collected. About 70 years later, Hawthorne found only a tiny forest patch remaining located *ca.* 5 — 7 km west of the present city centre of Dar es-Salaam and called "Gongolamboto Burial Grove" or "Gongolamboto Cemetery" (elevation 86 m, 6°52'59"S 39°09'12"E). The remaining tree species were two large trees of *Brachystegia spiciformis* Benth. (Caesalpinioideae) and *Blighia unijugata* Baker (Sapindaceae) with smaller trees of *Baphia kirkii* Baker (Papilionoideae) and *Trilepisium madagascariense* DC. (Moraceae). A well developed liana canopy of *Saba comorensis* Pichon (Apocynaceae) and *Tiliacora funifera* Oliv. (Menispermaceae) was present. Noteworthy, in the shrub layer Hawthorne recorded the Critically Endangered shrub species *Stephanostema stenocarpum* K. Schum. (Apocynaceae) as well as *Pancovia holtzii* Gilg (Sapindaceae), *Antiaris toxicaria* Lesch. (Moraceae) and *Microcos conocarpa* Burret (synonym: *Grewia conocarpa* K. Schum./ Malvaceae). Based on this plant species composition as well as based on his detailed fieldwork in the nearby Pugu Hills forests he concluded that the "Sachsenwald" was very likely a wetter or moist forest type comprising a matrix of swampy and more open tree layers with *Hymenaea verrucosa* Gaertn. (Caesalpinioideae) and *Baphia kirkii* Baker (Papilionoideae) with adjacent woodland on higher land dominated by *Brachystegia spiciformis* Benth. and *Afzelia quanzensis* Welw. (Caesalpinioideae). Similar are few lowland coastal forest patches and their peripheral zones in the northern part of Pande Hill Forest Reserve located between Bagamoyo and Dar es-Salaam and first studied botanically by Hawthorne.

Hence, the habitat of *K. triangularis* certainly was or still is dominated by woody Leguminosae (Fabaceae), in particular by Caesalpinioideae.

Biological traits. The biology of *K. triangularis* is unknown.

Kayamuhakaia kimbozensis **sp. nov.**

Figs 11.a., 22.a.

Type locality and repository: Tanzania, the Natural History Museum, University of Oslo, Norway (NHMO).

Material examined. Holotype, male, "Tanzania, Morogoro District [Morogoro Region], Kimboza For. Res. [Kimboza Catchment Forest Reserve] 300 m [altitude range 226 — 445 m, *ca.* 7°01'19.42"S 37°48'27.10"E], 7.iV.1992 [07th April 1992] leg. L. Aarvik [Leif Aarvik]", genitalia slide number 05/012020 I. Lehmann. Paratype, male, "Tanzania, 37°48'E 7°01'S, Yuvu River [misspelling of Ruvu River], Kimboza Forest Res., 9.ii.1994 [09th February 1994] leg. Frontier ["Frontier Tanzania Marine and Wildlife Projects"], coll. ZMUC"; on second label: "Coll. ZMUC Copenhagen Denmark"; on third label: genitalia slide number 20/012020 I. Lehmann (ZMUC).

Description, male. *Head*: rough-scaled, with dense, short, hair-like scales of Saccardo's umber (in holotype) or Dresden brown (in paratype),scales with cream base and with a light golden glint between and around compound eyes; eyes light brownish olive with or without black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small, narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.39 (in holotype) and 0.41 (in paratype) length of forewing, bipectinate, with branches 3.0× width of shaft, branches scaled laterally cream, at base widely separated with 1.2× width of branch, shaft densely scaled cream and dark olive-buff dorsally with a light golden glint; labial palpi Saccardo's umber with a light golden glint and less than half of eye-diameter, three-segmented, central segment 1.3× length of basal segment and narrowly rectangular, basal segment 1.2× broader and rectangular, segment on top narrowly rectangular and 40% length of central segment.

Thorax: Patagia with scales of Saccardo's umber, tips cream, scale base cream with light golden glint, not forming any collar ring; tegulae with longer hair-like scales of Saccardo's umber with a cream scale tip and a light golden glint. Metathorax with long hair-like scales of Saccardo's umber or Dresden brown (in paratype) mixed with scales of deep olive, all with cream-buff tip forming a pronounced scale-crest. Forelegs have a narrow tube-like epiphysis that is 1.0 mm in length. Hindlegs with fine hair-like scales of Saccardo's umber with a light golden glint; two pairs of tibial spurs are present, 1.1 mm/1.2 mm (upper pair) and 0.8 mm/0.9 mm (lower pair) in length. Forewing length 11.5 mm (10.5 mm in paratype) and wingspan is 26.0 mm (25.0 mm in paratype). Forewing upperside largely cream mixed with scales of Saccardo's umber with a light golden glint; termen broadly buffy olive with small triangular-shaped lunules of Saccardo's umber; costa cream with scales of Dresden brown; a pronounced broad patch of raw umber (in holotype) or Dresden brown (in paratype) from CuA_2 to costa is strongly bent inwards between M_2 and R_5; end of lower median, base of CuA_1 and the entire CuA_2 are narrowly white forming the "Y" in horizontal position, other veins not distinctly coloured; below lower median two spots of sepia; below CuA_2 occur two large patches of buffy olive, broadly and narrowly edged with Saccardo's umber; from lower end of CuA_2 to near apex occurs a narrow buffy olive band that is edged on both sides broadly with Saccardo's umber; cilia long with 1.0 mm, dark olive-buff with tips of Saccardo's umber. Underside of forewing is deep olive-buff with a light golden glint.

Hindwing upperside is buffy olive suffused with dark olive-buff with a light golden glint; cilia deep olive-buff, underside of hindwing is in forewing.

Abdomen: Mainly Saccardo's umber mixed with hair-like scales of Dresden brown and buffy olive with a light golden glint; abdominal tuft with long scales of buffy olive, tuft 25% length of abdomen. Genitalia (Fig 22.a., lateral view) with tegumen *ca.* 0.3× basal width of vinculum, the latter is large and broadly rounded in ventral view; saccus broad and long with 15% longer than length of ventral width of valva; uncus medium broad and elongated, basal part 50% broader than upper part of uncus without any hole, bifid at tip with a lunule-like shape of the emargination that is 15% as deep as uncus length and 30% as broad as basal width of uncus, tips of uncus are acuminate. The valva is large rectangular and not elongated, *ca.* 3.5× larger than saccus, costal margin is straight and rounded distally with few setae, dorsal edge is strongly bent upwards to semi-transtilla, the latter is small but has a skin-like appendice with a small sclerotized stick-like appendice in holotype and paratype, ventral edge with a dominant lunule-like appendice that only slightly extends distally, distal edge slightly S-shaped and 10% longer as ventral edge; 30% of valva thinly membranous, mainly below semi-transtilla with a long narrow band-like sclerotized oblique structure with setae near the central part. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long, narrow and 2.3× length of saccus, without any structures.

Female. Unknown.

Diagnosis. The males of *K.kimbozensis* **sp. nov.** have the following unique character combination: First, slightly elongated forewings that extend beyond the hindwings. Second, the valvae have a sclerotized small stick-like appendice on the skin-like appendice of the semi-transtilla. Third, the broad saccus is 15% longer than the ventral width of valva. A large rectangular valva with an S-shaped distal margin is shared with *K. petermuriithii* **sp. nov.** as well as with *K. triangularis*. The latter species differs from both former species since it has only one pair of tibial spurs to the hindlegs and no stick-like appendice on the skin-like appendice of the semi-transtilla. The latter stick-like appendice is also absent in *K. petermuriithii* **sp. nov.** A further difference between *K. kimbozensis* **sp. nov.** and *K. petermuriithii* **sp. nov.** is the wide emargination of the uncus that is 60% as broad as the basal width of uncus in *K. petermuriithii* **sp. nov.** but 30% in *K. kimbozensis* **sp. nov.**

Distribution. *Kayamuhakaia kimbozensis* **sp. nov.** is only known from the lowland area of the Kimboza Catchment Forest Reserve (405 ha in size) located south of Kibungo Mission. The average annual rainfall is high with 1683 — 1700 mm with additional groundwater availability to the trees (Lovett & Pócs 1993: 33; Clarke & Dickinson 1995: 98, 101). Hence, Kimboza is a lowland groundwater forest type (Styles & White 1991: 11 — 12, Lovett 1998: 65) located *ca.* 25 km southeast of Morogoro town (Fig 35.c.), *ca.*12 km east of the Uluguru Mountains (Fig 35.b.; Eastern Arc Mountains) but still near its eastern foothills and *ca.*135 km west of Dar es-Salaam. Kimboza Forest belongs to the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 186) who classified the forests on the lower parts of the eastern Uluguru Mountains as *"Zanzibar-Inhambane lowland rain forest"*.

Hawthorne (1984: 97— 99) excluded Kimboza Forest from the *"Usaramo floristic area"* but stated that several plant species which are restricted to the southern coast of Tanzania are recorded from Kimboza Forest.

Due to its morphological similarities to one Afromontane/Zanzibar-Inhambane linking species as well as to one Zanzibar-Inhambane endemic species, *K. kimbozensis* **sp. nov.** is classified as *Zanzibar-Inhambane endemic* and as endemic species to the isolated Kimboza Forest (Tanzania).

Habitat. Kimboza is a relict forest patch on limestone karst and dolomitic marble. The forest is exceptionally rich botanically (*cf.* Lovett & Wasser 1993: 39, 40, 70 — 72, 78) comprising plant species that are endemic to Kimboza Forest, *e.g.* the treelet *Turraea kimbozensis* Cheek (Meliaceae), Styles & White (1991: 11 — 12) as well as the tree *Necepsia castaneifolia* subsp. *kimbozensis* A. Bouchat & J. Léonard (Euphorbiaceae), Smith (1987: 218 — 220).

Lovett & Pócs (1993: 33 — 34) as well as Clarke & Dickinson (1995: 98) stated that large trees of *Khaya anthotheca* C. DC. (Meliaceae) and *Milicia excelsa* C.C. Berg (Moraceae) — both Guineo-Congolian linking species (White *et al.* 2001: 363, 395) — were once common in Kimboza until the early 1970s but disappeared due to logging causing a great damage to the forest.

The remaining large tree species are up to 40 m high emergents, *e.g. Aningeria pseudoracemosa* J.H. Hemsl. (Sapotaceae/ almost disappeared), *Antiaris toxicaria* Lesch. (Moraceae), *Cynometra ulugurensis* Harms (Caesalpinioideae), *Elaeis guineensis* Jacq. (Arecaceae/ up to 20 m tall), *Sterculia appendiculata* K. Schum. (Malvaceae), *Newtonia paucijuga* Brenan and *Parkia filicoidea* Welw. (Mimosoideae). The latter two species might be dominant in the habitat of the paratype and occur on the stream bank of the Ruvu River together with a species of *Pandanus* Parkinson (Pandanaceae) as well as *Barringtonia racemosa* Spreng. (Lecythidaceae), CELP (2007: 50, 68). *Cussonia zimmermannii* Harms (Araliaceae) and *Lingelsheimia sylvestris* Radcl.-Sm. (Phyllanthaceae) occur in a similar forest type that can be found in Jozani Forest on Zanzibar Island, located in the Indian Ocean (Clarke & Dickinson 1995: 98). Smaller trees comprise, *e.g. Lettowianthus stellatus* Diels (Annonaceae), *Cola greenwayi* Brenan (Malvaceae), *Dialium holtzii* Harms (Caesalpinioideae) and the endemic shrub *Garcinia bifasciculata* N. Robson (Clusiaceae), Lovett & Pócs (1993: 33). Hence, the habitat of *K. kimbozensis* **sp. nov.** is dominated by woody Leguminosae (Fabaceae) and locally by Caesalpinioideae.

Postulated microrefugium: Kimboza Forest

The local dominance of Caesalpinioideae, *e.g.* *Cordyla africana* Lour., *Scorodophloeus fischeri* J. Léonard, the endemic *Cynometra ulugurensis* Harms; a high number of other endemic species in flora (*cf.* text above and CELP 2007: 52) and fauna, *e.g.* the Kimboza Forest endemic Turquoise Dwarf Gecko (*Lygodactylus williamsi* Loveridge, *cf.* Spawls *et al.* 2002: 112) as well as one Z-I endemic species of *Kayamuhakaia* indicate that this forest relict must have survived several arid phases in history supported by its locality in a high rainfall area with additional groundwater availability to the trees. Hence, Kimboza Forest is considered herein as microrefugium. In regard to Metarbelidae further data is needed to confirm this conclusion by I.L., *e.g.* regarding the first and third characteristic pattern defined for microrefugia (*cf.* Discussion herein + Table 2).

Biological traits. The biology of *K. kimbozensis* **sp. nov.** is unknown.

Etymology. The species is named for Kimboza Forest (Tanzania) established as a Catchment Forest Reserve in 1964.

***Kayamuhakaia aarviki* sp. nov.**

Figs 11.b., 22.b.; determined as close to "cf. Metarbela latifasciata Gaede" by Lehmann (2009: Table 1)

Type locality and repository: Tanzania, the Natural History Museum, University of Oslo, Norway (NHMO).

Material examined. Holotype, male, "Tanzania, Morogoro District [Morogoro Region] & Town [garden inside of Morogoro town/ *ca.* 6°50'09.09"S 37°39'10.93"E] 550 — 600 m [altitude range for town area is 463 — 746 m], 15.xi.1992 [15th November 1992] leg. L. Aarvik [Leif Aarvik]", genitalia slide number 05/092020 I. Lehmann. Paratype, male, same locality, "29.xi.1992 [29th November 1992] leg. L. Aarvik"; genitalia slide number 25/032020 I. Lehmann (NHMO).

Description, male. *Head*: rough-scaled, with dense hair-like scales of Isabella colour (also in paratype) with cream scale base and a golden glint between and around compound eyes; eyes sorghum brown without black spots; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are small oval, a horizontal dorsal ridge is absent; antennae medium long, 0.42 (in holotype) and 0.39 (in paratype) length of forewing, bipectinate, with branches 3.0× — 3.5× width of shaft, branches scaled laterally with scales of cream, branches at base widely separated with 1.3× width of branch, shaft densely scaled Isabella colour with a golden glint; labial palpi with scales of Isabella colour with a golden glint and half of eye-diameter, three-segmented, central segment 1.6× length of basal segment, narrowly oval, basal segment not broader and rectangular, segment on top narrowly egg-shaped and 15% length of central segment (also in paratype).

Thorax: Patagia with long scales of Isabella colour with a golden glint, not forming any collar ring; tegulae with longer hair-like scales of Isabella colour with a cream base and a golden glint (also in paratype). Metathorax with long hair-like scales of Isabella colour and ivory yellow with a light golden glint forming a pronounced scale-crest. Forelegs have a broad tube-like and very long epiphysis that is 1.6 mm in length (1.5 mm in paratype). Hindlegs with fine hair-like scales of cream with deep olive-buff towards tip with a light golden glint; two pairs of tibial spurs are present (also in paratype) that are 1.2 mm / 1.0 mm long (upper pair) and 1.1 mm / 0.8 mm (lower pair). Forewing length 12.5 mm (11.5 mm in paratype) and wingspan 27.0 mm (26.0 mm in paratype). Forewing upper-side largely cream mixed with scales of Isabella colour with a light golden glint; termen broadly buffy olive mixed with scales of Saccardo's umber with small triangular-shaped lunules of Saccardo's umber; costa cream with four striae near wing base of sepia; a pronounced broad patch of Isabella colour (also in paratype) from CuA_2 to costa is strongly bent inwards between M_2 and R_5; end of lower median, base of CuA_1 and the entire CuA_2 are narrowly white forming a "Y" in horizontal position, other veins not distinctly coloured; below lower median and below CuA_2 occur two dominant and large almost rectangular patches of black mixed with sepia broadly edged with cream and Isabella colour (also in paratype); from lower end of CuA_2 to near apex occurs a broad buffy olive band that is edged on both sides broadly with Saccardo's umber; cilia long with 1.0 mm, olive-buff (deep olive-buff with tips of Saccardo's umber in paratype). Underside of forewing is olive-buff with a light golden glint. Hindwing upperside olive-buff (deep olive-buff in paratype) with a light golden glint; cilia olive-buff, underside of hindwing is in forewing.

Abdomen: Mainly Isabella colour mixed with hair-like scales of ivory-yellow with a light golden glint; abdominal tuft with long scales of Isabella colour, tuft 25% length of abdomen. Genitalia (Fig 22.b.) with tegumen *ca.* 0.5× basal width of vinculum, the latter is large and broadly triangular in ventral view; saccus broad and long with 25% longer than ventral width of valva in a not pressed condition; uncus broad and not elongated, basal part 30% broader than upper part of uncus with a lunule-like hole at centre (also in paratype), bifid at tip with a lunule-like shape of emargination that is 20% as long as uncus width and 15% as deep as uncus length, uncus tips mucronate. The valva is rectangular and not elongated, *ca.* 3.5× larger than saccus, costal margin is straight and rounded distally with few setae, dorsal edge is strongly bent upwards to semi-transtilla, the latter is small but has a skin-like appendice without any sclerotized stick-like appendices in holotype and paratype, ventral edge of valva short, *ca.* 20% shorter than distal edge, with a dominant lunule-like appendice that slightly extends distally; distal margin of valva slightly S-shaped. About 20% of valva thinly membranous mainly below semi-transtilla with a long narrow band-like sclerotized oblique structure with setae near the central part. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long, narrow and 2.5× length of saccus, without any structures.

Female. Unknown.

Diagnosis. The species represents a unique character with the very long saccus that is 25% longer than the ventral edge of valva. Additionally, the males of *K. aarviki* **sp. nov.** have two unique character combinations: First, very long, broad epiphyses (at least 1.5 mm long) in combination with tips of uncus that are mucronate. Second, the rectangular valvae have a slightly S-shaped distal margin that is 20% longer than the ventral edge of valva. Several characters of *K. aarviki* **sp. nov.** are shared with *K. haberlandorum*, *e.g.* the length of antennae as well as mucronate uncus tips. The difference between both species is that in the latter species the distal edge of valva is slightly C-shaped and 15% shorter than the ventral edge. A similar length of antennae as well as the S-shaped distal margin that is 10% longer than the ventral edge are shared between *K. aarviki* **sp. nov.** and *K. petermuriithii* **sp. nov.** The latter species has a needle-like epiphysis, a wide emargination of uncus that is 60% as broad as uncus width and acuminate uncus tips. Three major differences exist to *K. kimbozensis* **sp. nov.**: First, below the lower median and below CuA_2 occur two dominant, large and almost rectangular patches of black mixed with sepia in *K. aarviki* **sp. nov.** that are absent in *K. kimbozensis* **sp. nov.** Second, the epiphysis is only 1.0 mm in length and narrow in *K. kimbozensis* **sp. nov.** Third, the uncus tips are acuminate in the latter species but mucronate in *K. aarviki* **sp. nov.**

Distribution. *Kayamuhakaia aarviki* **sp. nov.** is only known from the lowland as well as submontane town area of Morogoro (463 — 746 m; average annual rainfall is 800 — 1500 mm, *cf.* CELP 2007: 55) located *ca.* 160 km west of Dar es-Salaam and *ca.* 2 km west from the northwestern foothills of the Uluguru Mountains (Eastern Arc Mountains). As Morogoro is located in their western rain shadow and below an elevation of 750 m it belongs to the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 186). White (1983: 186) included only the eastern foothills of the Uluguru Mountains in the *"Zanzibar-Inhambane regional mosaic"*, *e.g.* due to their higher average annual rainfall. Platts *et al.* (2011) used a 500 m elevation contour for the Eastern Arc Mountains. According to the latter contour line the type locality in Morogoro town belongs to the Eastern Arc Mountains but due to its low elevation mentioned above not to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161).

The proximity of Morogoro to the eastern foothills of the Uluguru Mountains — *ca.* 25 km to Kimboza Forest as the crow flies — explains why *K. aarviki* **sp. nov.** shares morphological characters with a Z-I species of the Kenya coast as well as with a species of the Taita Hills (Eastern Arc Mountains). Nevertheless, this short distance mentioned above contributes to major morphological differences with *K. kimbozensis* **sp. nov**.

Due to its morphological similarities to one Afromontane/Zanzibar-Inhambane linking species as well as to one Zanzibar-Inhambane endemic species, *K. aarviki* **sp. nov.** is classified as *Zambezian /Zanzibar-Inhambane linking* as well as endemic species of the Morogoro area.

Habitat. The natural vegetation in and near Morogoro has been largely replaced by buildings and cultivation (Fig 35.c.). Burtt (1942: 114, Phot. 13, 48) described and presented pictures of woodlands (possibly below 600 m elevation) at Morogoro before their destruction occurred, *e.g.* "*Combretum* [Loefl./Combretaceae] savannah ... with *Acacia nigrescens* (co-dominant) [Oliv., synonym of *Senegalia nigrescens* P.J.H. Hurter/ Mimosoideae]..." and "... *Combretum zeyheri* [Sond./

Combretacee]-*Ostryoderris* [Dunn, synonym of *Aganope* Miq./Papilionoideae]-*Terminalia sericea* [Cambess., synonym of *Terminalia argentea* Mart./Combretaceae] woodland".

At present, the remaining forest patches and woodlands are disturbed by charcoal making or regular fires. Some intact vegetation survived in the Nguru Ya Ndege Catchment Forest Reserve (2.407 ha in size) located *ca.* 10 km northwest of Morogoro at an elevation between 700 and 1.357 m. It indicates that above the 600 m elevation contour line once largely occurred a diverse dry semi-evergreen forest or *"Zambezian dry evergreen forest" sensu* White (1983: 89), including areas near Morogoro, and comprising, *e.g. Afzelia quanzensis* Welw. (Caesalpinioideae), *Commiphora madagascariensis* Jacq. (Burseraceae), *Obetia radula* Baker (Urticaceae) and *Euphorbia murielii* N.E.Br. (synonym: *Euphorbia candelabrum* Trémaux/ Euphorbiaceae). This forest type disappeared largely. In relicts still occurs a drier type of *"Zambezian miombo woodland" sensu* White (1983: 92) between an elevation of 600 and 1.100 m dominated by *Brachystegia tamarindoides* Welw. subsp. *microphylla* Ckikuni, *Julbernardia globiflora* Troupin (Caesalpinioideae), *Diplorhynchus condylocarpon* Pichon (Apocynaceae), *Aganope stuhlmannii* Adema and *Pterocarpus angolensis* DC. (Papilionoideae). Below 600 m, a dry *Combretum*-woodland is and was present, respectively (*cf.* Burtt 1942: 114, Phot. 13, 48), dominated by *Combretum collinum* Fresen., *C. adenogonium* Steud., *C. zeyheri* Sond. (Combretaceae), *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae) and *Sclerocarya birrea* Hochst. subsp. *afra* Kokwaro (Anacardiaceae), CELP (2007: 56, 57, 63, 64).

The holotype as well as paratype were collected by Leif Aarvik in his garden (Fig 35.c.) on an elevation of 526 m and located inside the Morogoro town area. The vegetation in and adjacent to his garden still includes patches of natural vegetation of a drier type of *"Zambezian miombo woodland"* with several trees of *Brachystegia* Benth. as well as relicts of a former *"Riparian woodland" sensu* (White 1983: 95) including, *e.g.* species of *Acacia* Mill. (Mimosoideae; Leif Aarvik pers. comm. to I.L. in 2008).

Hence, the habitat of *K. aarviki* **sp. nov.** is still dominated by relicts of a natural flora including woody Leguminosae (Fabaceae), in particular Caesalpinioideae.

Noteworthy, Eastern Arc forest types occur in the Uluguru Mountains usually only above 1.200 m (Fig 35.b.), *e.g.* the Mindu Catchment Forest Reserve (2.285 ha in size) located 6 km west of Morogoro (CELP 2007: 55; *cf.* also Lovett 1993: 38, 39). These forest types comprise one of the largest numbers of narrow endemic East African plant species (Beentje *et al.* 2006).

Biological traits. The biology of *K. aarviki* **sp. nov.** is unknown.

Etymology. The species is named for the Lepidopterist Leif Aarvik (Oslo, Norway) who not only collected the holotype and paratype but also sent his collection of Tanzanian Metarbelidae to I.L. for a detailed study including rare species and important records (*cf.* Lehmann & Dalsgaard 2023: 148).

***Kayamuhakaia mbalensis* sp. nov.**

Figs 11.c., 22.c.

Type locality and repository: Zambia, the Natural History Museum, London, UK (NHMUK, formerly BMNH).

Material examined. Holotype, female, "Zambia: Mbala [Northern Province, Mbala District, *ca.* 8°51'09"S 31°21'25"E], 16.iii.1975 [16th March 1975], Locust Cont. Ctr. [Locust Control Centre; no altutide mentioned on label] B.M. 1975 — 261 [B.M.= British Museum]"; on second label: "DRW. [= Drawer] 17668", genitalia slide number 023/032011 I. Lehmann (BMNH).

Description, female. *Head*: rough-scaled, with dense and long hair-like scales of deep olive-buff with buffy olive towards scale tips around compound eyes; eyes ecru-olive with small black spots; a pair of rudimentary pits is present on lower fronto-clypeus, pits behind labial palpi are small oval, a pair of projections is absent, a horizontal dorsal ridge is absent on lower fronto-clypeus; antennae short, 0.33 length of forewing with branches 0.3× width of shaft on lower 30% of antenna and 1.2× width of shaft towards tip, branches are medium broad (viewed laterally), not widely separated at base with 0.8× width of branch, scaled deep olive-buff laterally, shaft densely scaled deep olive-buff dorsally; labial palpi half of eye-diameter in length, three-segmented, with segment on top narrowly egg-shaped and 30% as long as central segment, with central segment narrowly rectangular and as long as basal segment, the latter is 1.2× broader than central segment and rectangular.

Thorax: Patagia and tegulae with long hair-like scales of deep olive-buff forming no collar ring. Metathorax with long hair-like scales of deep olive-buff and dark olive-buff towards tip with cream at tip, forming a little pronounced scale-crest. Forelegs are without epiphysis. Hindlegs with fine hair-like scales of deep olive-buff and a light golden glint with two pairs of narrow tibial spurs, upper pair 1.1 mm/0.5 mm, lower pair 1.0 mm/0.8 mm in length. Forewing length is 10.5 mm, wingspan 24.0 mm. Forewing upperside worn: still visible is a cream-buff ground-colour with a light golden glint, a dominant patch extends from CuA_2 to R_5 but is faded; end of discal cell not distinctly coloured; subterminal line narrow and light brownish olive, strongly bent inwards between M_2 and R_5; cilia long, 1.0 mm, ecru-olive with a light golden glint. Underside of forewing is deep olive-buff with a light golden glint.

Hindwing upperside is ecru-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly dark olive-buff mixed with hair-like scales of cream with a light golden glint; abdominal tuft short with 20% length of abdomen, with long hair-like scales of deep olive-buff and buffy olive towards scale tips. Postabdominal structure and genitalia (Fig 22.c.) have papillae anales with short and long setae and small lobes with one lobe 50% as long as the narrow dorsal width of segment 8 and with one lobe less than 10% the size of papillae anales (viewed ventrally). Segment 8 is dorsally narrow and 50% narrower ventrally with a very narrow thinly sclerotized ring-like band that represents the lower central edge of segment 8; the shape of segment 8 is narrowly rectangular (viewed laterally), vertically 30% longer as the long posterior apophysis (in not pressed condition); base of one anterior apophysis is 1.4× the size of one lobe of papillae anales (viewed ventrally in a not pressed condition); the distal part of anterior apophysis is medium long, 50% longer than the dorsal width of segment 8 and without a broader end, not bent (in a not pressed condition); the dorsal width of segment 8 is not bent inwards at centre; the posterior apophyses are very long, 2.0× as long as anterior apophyses with T-shaped base (in horizontal position) that occurs on a large intersegmental membrane, extending ventrally to the base of papillae anales, the length of the former is 40% of the whole length of posterior apophysis, the latter are slightly bent upwards (if not pressed below glass); a knee-like shape of posterior apophysis is absent. The ductus bursae is medium long, namely as long as one posterior apophysis, thickly membranous, without any structures; below the base of the ductus bursae occurs a very large triangular plate-like structure that is thickly membranous and 0.7× as large as the papillae anales in lateral view; corpus bursae is large, thinly membranous, without any structures, broadly elongated oval-shaped if not pressed and not broken, 3.5× as large as segment 8 in lateral view.

Male. Unknown.

Diagnosis. The female genitalia of *K. mbalensis* **sp. nov.** has the following unique character combination: First, a large triangular-shaped and thickly membranous plate-like structure occurs below the base of the ductus bursae that is 0.7× as large as the papillae anales. Second, the new species has the largest corpus bursae among species of *Kayamuhakaia* presented herein with a size of 3.5× as large as segment 8 in lateral view (if not pressed). Third, each pair of the tibial spurs on the hindlegs is very unequal in length. The following characters are shared with *K. maasi* **sp. nov.** as well as with *K. kilimanjaroensis* **sp. nov.**: First, short antennae. Second, a narrowly rectangular segment 8 is present. Third, a large corpus bursae that is 2.5× as large as segment 8 in lateral view in both latter species. Additionally, two characters are shared between *K. mbalensis* **sp. nov.** and *K. maasi* **sp. nov.**, namely the ductus bursae that is as long as the posterior apophysis as well as the length of the anterior apophyses that are 50% longer than the dorsal width of segment 8.

Distribution. *Kayamuhakaia mbalensis* **sp. nov.** is only known from the area of Mbala, formerly Abercorn (altitude range is 1.489 — 1.681 m), located *ca.* 20 km southeast of Lake Tanganyika and near the northeastern edge of the Southern African Plateau and adjacent to the Tanganyika Rift within the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88) and within the *"southern portion of the Albertine Rift Region" sensu* Plumptre *et al.* (2007: Fig 1, 179, 181).

Due to its morphological similarities mainly to one Lake Victoria/Zanzibar-Inhambane linking species as well as, but less, to one Afromontane/Zanzibar-Inhambane linking species, *K. mbalensis* **sp. nov.** is classified as *Zambezian/Lake*

Victoria linking as well as endemic species of the areas in and around Mbala (northeast Zambia).

Habitat. The Mbala district has the highest diversity of woody plant species in Zambia with over 1200 recorded taxa (Fanshawe 1969: 10). Mbala is also among the places of southeast-central Africa with highest diversities of Metarbelidae in regard to the number of genera (Lehmann in prep.).

Around Mbala (average annual rainfall 1240 mm) occur five distinct vegetation types: First, high-grass *"northern wet miombo woodland" sensu* Chidumayo (1997: 8) including *Brachystegia spiciformis* Benth., *B. utilis* Hutch. & Burtt Davy, *B. tamarindoides* Welw., *Julbernardia paniculata* Troupin, *Erythrophleum africanum* Harms (all species Caesalpinioideae) and *Pterocarpus angolensis* DC. (Papilionoideae), Lawton (1963: 51).

Secondly, two distinct types of chipya-woodland with *Burkea africana* Hook. (Caesalpinioideae) and *Parinari curatellifolia* Planch. (Chrysobalanaceae).

Thirdly, undifferentiated *Brachystegia-Isoberlinia* woodlands occur and represent the most likely habitat of the holotype. Burtt (1942: 79) stated that he revisited Abercorn in October 1936 and that all *Brachystegia* "… were in full young leaf and flower between 4500 and 6000 ft. …" in the "… *Brachystegia allenii* [Hutch. & Burtt Davy] and *Isoberlinia globiflora-Brachystegia* woodlands …" that receive "50 to 55 inches" of annual rainfall at Abercorn (Note: *Isoberlinia globiflora* Hutch. is a synonym of *Julbernardia globiflora* Troupin), *cf.* Burtt (1942: Phot. 3, 4, 5, 7).

Fourthly, *Diplorhynchus* Welw. (Apocynaceae) scrub-grassland is present on ironstone soils and soils on the plateau.

Fifthly, small remnants of tropical moist forest occur with *Mitragyna stipulosa* Kuntze (Rubiaceae) and riparian forest, *e.g.* near Kalambo Falls, comprising *Cordia africana* Lam. (Boraginaceae), *Sparrea gomphophylla* X.G.Fu & T.S.Yi (synonym: *Celtis gomphophylla* Baker), *C. africana* Burm.f. (Cannabaceae), *Aphanocalyx richardsiae* Wieringa (Caesalpinioideae), *Aningeria adolfi-friederici* Robyns & Gilbert and *A. altissima* Aubrév. & Pellegr. (Sapotaceae/ Jonathan Timberlake pers. comm. to I.L. in 2009).

Hence, the habitat of *K. mbalensis* **sp. nov.** is dominated by woody Leguminosae (Fabaceae) with species of *Brachystegia* Benth. and *Julbernardia* Pellegr. (Caesalpinioideae) in particular.

Biological traits. The biology of *K. mbalensis* **sp. nov.** is unknown.

Etymology. The species is named after the type locality of Mbala (formerly Abercorn) in northeast Zambia.

Kayamuhakaia mkuwadziensis sp. nov.

Figs 11.d., 22.d.

Type locality and repository: Malawi, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, male, "Ref No 1207, Malawi, Mkuwazi or Mukwadzi Forest Reserve [Northern Region, Nkhata Bay District; also known as Mkuwadzi Hill or Nkuwadzi, *cf.* Chapman & White 1970: 178; White *et al.* 2001: 11] 11°42'S 34°14'E 2000 ft [altitude range 597 — 692 m], 19 — 22 Nov 2001 [November 2001] R.J. Murphy [Raymond James Murphy leg.]", genitalia slide number 02/032020 I. Lehmann (in private collection, holotype will be presented to NMK).

Description, male. *Head*: rough-scaled, with dense, long as well as short hair-like scales of deep olive-buff with cream tip around compound eyes; eyes ecru-olive with small black spots; a pair of pits is rudimentary on lower fronto-clypeus, pits behind labial palpi are narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.39 length of forewing, bipectinate, with branches 3.0× width of shaft, branches scaled laterally deep olive-buff, branches at base not widely separated, shaft densely scaled deep olive-buff and dark olive-buff; labial palpi with scales of sepia and half of eye-diameter long, three-segmented, central segment 1.2× length of basal segment, narrowly oval, basal segment 1.2× broader, rectangular, segment on top narrowly egg-shaped, 25% length of central segment.

Thorax: Patagia with long scales of deep olive-buff with cream tip, not forming any collar ring; tegulae with longer hair-like scales of dark olive-buff and cream-buff with cream base and tip. Metathorax has long hair-like scales of dark olive-buff with a light golden glint, forming a small scale-crest. Forelegs have a narrow tube-like and medium long epiphysis that is 1.1 mm in length. Hindlegs with fine hair-like scales of cream with dark olive-buff towards tip; two pairs of tibial spurs are present with 1.2 mm/1.0 mm (upper pair) and 0.9 mm/0.7 mm (lower pair) in length. Forewing length is 13.0 mm and wingspan 30.0 mm; upperside largely deep olive-buff with a light golden glint and an almost absent pattern; termen broadly buffy olive and without any lunules; costa cream-buff without striae; a pronounced broad patch of Isabella colour from CuA_2 to base of R_4 is strongly bent inwards between M_2 and R_5; end of lower median and the entire CuA_2 are narrowly white, other veins distinctly coloured cream-buff; any black patches below lower median and below CuA_2 are absent; from CuA_2 to near apex is any broad subterminal band absent; any terminal line also absent; cilia long with 0.9 mm, deep olive-buff. Underside of forewing dark olive-buff with a light golden glint.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly deep olive-buff mixed with hair-like scales of ivory-yellow with a light golden glint; abdominal tuft with long scales of deep olive-buff, tuft 25% length of abdomen. Genitalia (Fig 22.d.) with tegumen *ca.* 0.6× basal width of vinculum; saccus medium broad and short with 40% length of ventral width of valva; uncus broad and not elongated, basal part 35% broader than upper part of uncus, bifid at tip, tips acuminate, uncus with a deep lunule-like shape of the emargination that is 45% as broad as basal width of uncus and 25% as deep as uncus length. Valva is large, elongated rectangular, *ca.* 8.0× larger than saccus, costal margin is straight and rounded distally with few setae, dorsal edge is strongly bent upwards towards semi-transtilla, the latter is medium large with some short setae, ventral edge of valva long with same length as distal edge, with a dominant lunule-like appendice that extends distally; distal margin of valva slightly C-shaped. About 15% of valva thinly membranous and mainly below semi-transtilla, with a short narrow band-like sclerotized oblique structure with setae near the central part of valva, this structure is only as long as base of semi-trastilla. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long, narrow, tube-like and 4.0× length of saccus, without any structures.

Female. Unknown.

Diagnosis. The male of *K. mkuwadziensis* **sp. nov.** has the following unique character combination: First, the antennae are medium long. Second, the forewings do not have lunules or any subterminal or terminal band (a pattern is absent). Third, the slightly C-shaped distal margin of valva is as long as the ventral edge of valva. Fourth, the uncus is broad and not elongated. Fifth, the emargination of uncus is broad, namely 45% as wide as the basal width of uncus. Some of these characters are shared with *K. kasikamwiuae* **sp. nov.**, *e.g.* the size of emargination of uncus that is 40% as wide as the basal width of uncus and 20% as deep as the length of uncus with acuminate uncus tips in the latter species. The antennae are also medium long in both species. A major difference exists in the C-shaped distal margin of valva that is 20% longer than the ventral edge in *K. kasikamwiuae* **sp. nov.** but is as long as the ventral edge of valva and less C-shaped in *K. mkuwadziensis* **sp. nov.**

Noteworthy, the medium long antennae of *K. mkuwadziensis* **sp. nov.** are 5.0 mm in length and hence, they are 1.0 mm longer than the longest antennae in specimens of *K. huchtemanni* **sp. nov.**

Distribution. *Kayamuhakaia mkuwadziensis* **sp. nov.** is only known from Mkuwadzi Hill located with its lowland as well as lower submontane areas 10 km to the West of the northwestern shore of Lake Malawi and *ca.*11 km southwest of Nkhata Bay within the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88).

The only specimen represents one of the most important records among species of *Kayamuhakaia* in regard to the northwestern shore of Lake Malawi since it is considered herein as an indicator species for a former *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) that almost certainly once existed on Mkuwadzi Hill and near the Nkhata Bay Lake-shore (*cf.* White *et al.* 2001: 60, 61) and thus formed a small exclave or several exclaves of Zanzibar-Inhambane forest in the Zambezian Region (*cf.* White 1983: 89, 186).

Kayamuhakaia mkuwadziensis **sp. nov.** is classified as *Zambezian/ Zanzibar-Inhambane linking* as well as endemic species of the areas on and adjacent to Mkuwadzi Hill based on the original habitat and its diagnosis with various morphological similarities that are shared with one Zanzibar-Inhambane endemic. It is most probably an endangered species due to the small size of its habitat as well as ongoing small-scale woodland destruction in one of the most densely settled parts of Malawi.

Habitat. Mkuwadzi Hill is located in the high-rainfall belt of Nkhata Bay and receives an average annual rainfall that exceeds 1780 mm (Chapman & White 1970: 178). This hill was "… covered with impenetrable jungle and dense forests …" according to a note of the botanist John Kirk written in a letter to Sir William Hooker dated 02nd December 1861 and cited by Jackson in 1959. Livingstone's Zambezi Expedition has been in the area of Mkuwadzi Hill in 1859 — the same year when they discovered Lake Malawi. Until the late 1960s the natural forests were destroyed — also for silvicultural experiments — with no surviving natural forest patches. Instead, only few patches of *"Zambezian transition woodland" sensu* White (1983: 91) survived and undisturbed habitats of this woodland were described by Chapman & White (1970: 178) as well as by White *et al.* (2001: 57, 61) comprising together *ca.* 600 ha and including mainly *Brachystegia spiciformis* Benth., *Erythrophleum suaveolens* Brenan (Caesalpinioideae), *Pterocarpus tinctorius* Welw. (Papilionoideae) and *Milicia excelsa* C.C. Berg (Moraceae) in the overstorey. Tree species of the understorey comprise the five Guineo-Congolian linking species *Synsepalum brevipes* T.D. Penn., *S. passargei* T.D. Penn. (Sapotaceae), *Antidesma vogelianum* Müll.Arg. (Phyllanthaceae), *Cremaspora triflora* K. Schum. and *Leptactina platyphylla* Wernham (Rubiaceae). Further species include *Shirakiopsis elliptica* Esser (Euphorbiaceae) and shrub species, *e.g. Psydrax horizontalis* Bridson and *Keetia venosa* Bridson (Rubiaceae). Large woody climbers of *Saba comorensis* Pichon and *Landolphia kirkii* Dyer (Apocynaceae) are still a characteristic feature.

An additional note of importance in regard to the distribution of species of *Kayamuhakaia* in *"Congolia"* and the Congo Basin in particular (*cf. K. bokatolaensis* **sp. nov.**) presented Jackson (1968: 12) with his following statement: "At Lake level [altitude range 493 — 509 m east of Mkuwadzi Hill] *Brachystegia spiciformis* — *Erythrophloeum maraviense* [unknown species; most probably *Erythrophleum suaveolens* Brenan a Guineo-Congolian linking species or rather unlikely the suffrutex *Cryptosepalum maraviense* Oliv./Caesalpinioideae] forest of the Nhkata Bay area is perhaps the nearest approach in Malawi to the type *Moist semi-deciduous forest* of the Yangambi scheme of vegetation classification [Agreement of 1956]."

Hence, the original and present habitat of *K. mkuwadziensis* **sp. nov.** is and was respectively, dominated by woody Leguminosae (Fabaceae) and Caesalpinioideae in particular, in a high rainfall lowland as well as lower submontane area similar to the central Congo Basin (1600 — 2000 mm) where "*Mixed moist semi-evergreen Guineo-Congolian rain forest*" *sensu* White (1983: 77) represents the habitat of *K. bokatolaensis* **sp. nov.**

The collecting Site of the holotype is *"… mature* *Brachystegia* woodland, 200 years [old], with many evergreen scrambling climbers and lianas [almost certainly *Saba comorensis* Pichon and *Landolphia kirkii* Dyer/Apocynaceae] *…"* (Raymond James Murphy pers. comm. to I.L. in September 2008).

The type locality represents one of the few surviving patches of *"Zambezian transition woodland"* as described by Chapman & White (1970: 178) including Guineo-Congolian linking species.

Biological traits. The biology of *K. mkuwadziensis* **sp. nov.** is unknown.

Etymology. The species is named after the type locality "Mkuwadzi Hill" (Malawi). The spelling of "Mkuwadzi Hill" is based on Chapman & White (1970: 178 — third paragraph in chapter "Nkhata Bay").

***Kayamuhakaia huchtemanni* sp. nov.**

Figs 11.e., 23.a.

Type locality and repository: Malawi, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, male, "Ref No 1261, Malawi, Mzuzu, Nkhorongo [Northern Region, Mzimba District] 11°23'S 33°59'E 1.375 m [altitude range for Nkhorongo is 1.329 — 1.381 m], 12 Nov 2011 [November 2011] R.J. Murphy [Raymond James Murphy leg.]", genitalia slide number 16/022020 I. Lehmann.

Paratypes (without any female!) comprise 13 males from the same locality and same collector as holotype with the following data: one male, "31 Oct 2008 [October 2008]", no genitalia dissection done (RMCA); two males, "6 Nov 2008 [November 2008]", one male genitalia slide number 024/122029 I. Lehmann (ZFMK) and one male no genitalia dissection done (ZFMK); one male, "12 Nov 2008", genitalia slide number 16B/032029 I. Lehmann (NMK); one male, "15 Nov 2008", genitalia slide number B12/122029 I. Lehmann (ZMH); one male, "28 Oct 2009", no genitalia dissection done I. Lehmann (NHMO); one male, "29 Oct 2009", genitalia slide number 031/122029 (ZMUC); one male, "14 Nov 2009", no genitalia dissection done (ZSM); one male, "14 Nov 2009", genitalia slide number A25/012030 I. Lehmann (in private collection I.L.); one male, "16 Nov 2009", no genitalia dissection done (ZMUC); one male, "16 Nov 2009", genitalia slide number D10/012030 I. Lehmann (in private collection I.L.); one male, "2 Dec 2013 [December 2013]", genitalia slide number 19/012020 I. Lehmann (BMNH); one male, "3 Dec 2013", no genitalia dissection done (BMNH).

Description, male. *Head*: rough-scaled, with dense hair-like scales of deep olive-buff and deep olive towards tip, with a light golden glint; eyes pure black; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are tiny and narrowly oval, a horizontal dorsal ridge is absent; antennae short, 0.35 length of forewing (0.32 — 0.35 in all paratypes), bipectinate, with branches 2.5 — 3.0× width of shaft, branches scaled laterally with scales of deep olive-buff, branches at base not widely separated (also in all paratypes), shaft densely scaled deep olive-buff and dark olive-buff with a light golden glint; labial palpi with scales of deep olive-buff with a light golden glint, half of eye-diameter, three-segmented, basal segment longest, namely 1.3× length of central segment, the latter is narrowly oval, basal segment 1.4× broader and rectangular, segment on top narrowly egg-shaped and 35% length of central segment.

Thorax: Patagia with long scales of deep olive-buff with a cream base and cream scale tip, with a light golden glint, not forming any collar ring; tegulae with longer hair-like scales of dark olive-buff or Isabella colour, all scales with a cream scale tip and a light golden glint. Metathorax has long hair-like scales of dark olive-buff and a light golden glint forming a small scale-crest. Forelegs have a narrow, flat and short epiphysis that is 0.6 mm in length (also in all dissected paratypes). Hindlegs with fine hair-like scales of cream with dark olive-buff towards tip; two pairs of tibial spurs are present that are 1.2 mm/1.0 mm (upper pair) and 1.0 mm /0.7 mm (lower pair) in length. Forewing length is 12.5 mm and wingspan 28.0 mm (forewing length is 11.5 — 14.0 mm and wingspan 26.0 — 31.0 mm in all paratypes). Forewing upper-side largely buffy olive with a light golden glint; termen broadly buffy olive and with lunules of Saccardo's umber; costa broadly cream-buff with short striae of Saccardo's umber; a pronounced broad patch of Isabella colour with a black edge towards termen occurs from half of CuA_2 to base of R_5 and is strongly bent inwards between M_2 and R_5; entire CuA_2 is narrowly cream, other veins distinctly coloured cream-buff; a small black patch occurs below base of lower median and below centre of CuA_2; from near half of CuA_2 to near apex occurs a broad band of Saccardo's umber that is edged to termen buffy olive; a subterminal band is weak and of Saccardo's umber; cilia short with 0.6 mm, buffy olive. Underside of forewing is buffy olive mixed with dark olive-buff, cream buff along costa and with light golden glint.

Hindwing upperside is buffy olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly deep olive-buff mixed with hair-like scales of dark olive-buff and a light golden glint; abdominal tuft with long scales of dark olive-buff with small broad scale tips of deep olive, tuft 35% length of abdomen. Genitalia (Fig 23.a.) with tegumen *ca.* 0.8× basal width of vinculum; saccus medium broad and medium long with 60% length of ventral width of valva (also in paratypes); uncus broad and not elongated, basal part 50% broader than upper part of uncus with a large hole at centre (also in paratypes), bifid at tip, tips acuminate, uncus with a deep lunule-like shape of the emargination that is 25% as broad as the basal width of uncus and 20% as deep as uncus length. The valva is large, not elongated, rectangular, *ca.* 6.0× larger than saccus, costal margin is straight and rounded distally with few setae, dorsal edge is oblique to semi-transtilla, the latter is medium large with some short setae, ventral edge of valva 10% shorter than distal edge, with lunule-like appendice that slightly extends distally; distal margin of valva slightly

C-shaped. About 15% of valva thinly membranous mainly below semi-transtilla with a strongly reduced narrow band-like sclerotized oblique structure with setae near the central part that is shorter in length as base of semi-transtilla. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus long, narrow, tube-like and 5.0× length of saccus, without any structures.

Female. Unknown.

Diagnosis. The males of *K. huchtemanni* **sp. nov.** have a unique combination of characters: First, short antennae with 0.32 — 0.35 length of forewing. Second, the epiphysis is short and less than 0.7 mm in length. Third, the emargination of the uncus is 25% as broad as the basal width of uncus. Fourth, the distal margin of valva is slightly C-shaped and the ventral edge of valva is 10% shorter than the distal edge (*cf.* diagnosis of *K. yvonnedejongae* **sp. nov.**). Although the shape and size of valva is slightly similar in *K. mkuwadziensis* **sp. nov.**, major differences between both species exist: First, the antennae are 1.0 mm longer in the latter species. Second, the epiphysis is also longer with 1.1 mm. Third, the emargination of the uncus is 45% as broad as the basal width of uncus in *K. mkuwadziensis* **sp. nov.**

Kayamuhakaia kimbozensis **sp. nov.** shares with *K. huchtemanni* **sp. nov.** acuminate uncus tips and a similar size of an emargination of uncus that is 30% as broad as the basal width of uncus in the former species. Both species differ as the distal margin of valva is S-shaped and the epiphysis has a length of 1.0 mm in *K. kimbozensis* **sp. nov.**

Distribution. *Kayamuhakaia huchtemanni* **sp. nov.** is only known from Nkhorongo, a suburb of Mzuzu (altitude range 1.255 — 1.381 m), located with its submontane as well as montane areas *ca.* 38 km to the West of the Malawi Rift as part of the EARS and within the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88).

Due to morphological similarities that are shared with one Zanzibar-Inhambane endemic species (*K. kimbozensis* **sp. nov.**), *K. huchtemanni* **sp. nov.** is classified as *Zambezian /Zanzibar-Inhambane linking* as well as endemic species of the areas in and near Mzuzu.

Habitat. The average annual rainfall of Mzuzu is *ca.* 1300 mm. The town is surrounded mainly by a belt of a wetter type of *"Zambezian miombo woodland"* and *"Zambezian transition woodland" sensu* White (1983: 91, 92) that separates the North Vipya Plateau from the South Vipya. Both woodland types are dominated by, *e.g.* the Zambezian endemic tree species *Brachystegia taxifolia* Harms (Caesalpinioideae) while the wetter miombo includes also the Sub-Afromontane endemic tree *Trichoscypha ulugurensis* Mildbr. (Anacardiaceae), the Afromontane near-endemic tree species *Agarista salicifolia* G. Don (Ericaceae) and *Trichocladus ellipticus* Eckl. & Zeyh. (Hamamelidaceae), the Guineo-Congolian linking species *Uapaca guineensis* Müll. Arg. (Phyllanthaceae) as well as the Eastern endemic tree species *Casearia gladiiformis* Mast. (Salicaceae) and *Pterocarpus tinctorius* Welw. var. *tinctorius* (synonym: *Pterocarpus stolzii* Harms/ Papilionoideae), *cf.* White *et al.* (2001: 56, 57, 263, 289, 306).

The habitat of the holotype and paratypes comprises a high tree species diversity of more than 80 species including at least six dominant Caesalpinioideae, *e.g. Brachystegia bussei* Harms, *B. taxifolia* Harms, *B. spiciformis* Benth., *B. floribunda* Benth., *B. utilis* Hutch. & Burtt Davy, *Julbernardia paniculata* Troupin (Caesalpinioideae) and *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae). The Zambezian endemic *Uapaca nitida* Müll. Arg. occurs together with *U. sansibarica* Pax, *U. kirkiana* Müll. Arg. (Phyllanthaceae) as well as *Cussonia arborea* Hochst. (Araliaceae/ Raymond James Murphy pers. comm. to I.L. in September 2008; *cf.* Lehmann *et al.* 2023: 98 + Figure 20b [not 20c] with text to Figure 20c [misprint by *Zootaxa*]).

Hence, the habitat of *K. huchtemanni* **sp. nov.** is dominated by woody Leguminosae (Fabaceae) and in particular by species of *Brachystegia* Benth. (Caesalpinioideae). It certainly represents a relative intact surviving patch of miombo that must have been formerly widespread and was locally bordered directly by forest. Until present these woodlands have been largely replaced in the Northern Region as well as Central Region of Malawi by farmland/shifting cultivation, cash crops, *e.g.* tobacco and coffee, exotic plantations or have been felled for timber, charcoal and firewood (*cf.* Chapman & White 1970: 28, 29, 145, 165; White *et al.* 2001: 56, 57, 58).

Biological traits. The biology of *K. huchtemanni* **sp. nov.** is unknown.

Etymology. The species is named in honour of the physician and cardiologist Dr. med. York-Räto Huchtemann who was born in Hamburg (Germany) in 1961. He studied medicine in the same town between 1980 and 1986 and has been working as an independent doctor in Hamburg since November 2004 (Y.-R. Huchtemann pers. comm. to I.L. in November 2023).

The author greatly appreciates the long-term and thoughtful advices as well as his knowledgeable understanding and constructive encouragement on various health problems of I.L. since 2012 and for his help with numerous requests over this extended period of time.

Kayamuhakaia yvonnedejongae **sp. nov.**

Figs 11.f., 23.b.

Type locality and repository: Malawi, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, male, "Malawi, Lower Mlunguzi River [also known as Mulungusi or Mulunguzi River], Zomba [township, Southern Region, Zomba District] 15°22'S 35°19'E 1.050 m [additional data provided by Raymond Murphy in pers. comm. to I.L. in 2012: 15°22'39"S 35°19'17"E, Forestry Research Institute of

Malawi, translocated from Dedza to the Zomba Silvicultural Research Station in 1975], 08 & 14 Nov 2012 [November 2012] R.J. Murphy [Raymond James Murphy leg.]", genitalia slide number 22/022020 I. Lehmann.

Description, male. *Head*: rough-scaled, with long and short hair-like scales of dark olive-buff with cream towards tip, with a light golden glint; eyes ecru-olive with large black patches; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are tiny slits, a horizontal dorsal ridge is absent; antennae short, 0.33 length of forewing, bipectinate, with branches 2.5× width of shaft, branches scaled laterally cream and at base not widely separated, shaft densely scaled cream with a light golden glint; labial palpi with scales of cream with a light golden glint and half of eye-diameter, three-segmented, central segment longest, namely 1.2× length of basal segment, narrowly oval, basal segment not broader and narrowly rectangular, segment on top narrowly egg-shaped and 25% length of central segment.

Thorax: Patagia with long scales of cream and dark olive-buff, with a light golden glint, not forming any collar ring; tegulae with longer hair-like scales of cream, with some scales with tip of dark olive-buff or cream, with a light golden glint. Metathorax has long hair-like scales of cream with a light golden glint forming a small scale-crest. Forelegs have a very narrow, short epiphysis that is 0.4 mm in length. Hindlegs have fine hair-like scales of cream with dark olive-buff towards tip; two pairs of tibial spurs are present, 0.8 mm/0.6 mm (upper pair) and 1.0 mm/0.8 mm (lower pair) in length. Forewing length is 12.0 mm and wingspan 26.0 mm. Forewing upperside largely buffy olive with a light golden glint; termen broadly buffy olive and without lunules; costa broadly cream with few short black striae; a pronounced broad patch of Isabella colour from half of CuA_2 to base of R_5 is strongly bent inwards between M_2 and R_5, almost touching the end of upper discal cell; all veins not distinctly coloured; a narrowly elongated black patch below half of lower median and below centre of CuA_2; from near half of CuA_2 to near apex occurs a broad band of Saccardo's umber that is edged towards termen buffy olive, the latter represents a sub-terminal band; a broad terminal band is of Saccardo's umber; cilia short with 0.7 mm, dark olive-buff. Underside of forewing is buffy olive with a light golden glint.

Hindwing upperside is buffy olive mixed with scales of light brownish-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly cream mixed with scales of deep olive-buff with a light golden glint; abdominal tuft with long scales of cream and deep olive-buff with small broad scale tips of dark olive, tuft 25% length of abdomen. Genitalia (Fig 23.b.) with tegumen *ca.* 0.8× basal width of vinculum; saccus broad and medium long with 70% length of ventral width of valva; uncus broad and not elongated, basal part 30% broader than upper part of uncus without any hole at centre, bifid at tip, tips elongated and acuminate, uncus with a deep lunule-like shape of the emargination that is 30% as broad as basal width of uncus and 30% as deep as uncus length. The valva is large, not elongated, broadly rectangular, *ca.* 7.0× larger than saccus, costal margin is oblique and rounded distally with few setae, dorsal edge is oblique towards semi-transtilla, the latter is large with some short setae and has a large rectangular thinly membranous appendice, ventral edge of valva is of equal length as distal edge, with a dominant lunule-like appendice that extends distally, its end is opposite of the end of costal margin; distal margin of valva is strongly C-shaped. About 20% of valva thinly membranous, mainly below semi-transtilla and costal margin; valva with strongly reduced narrow band-like and sclerotized oblique structure with setae near the central part, this structure is short, namely as long as base of semi-transtilla. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long, narrow, tube-like and 4.0× length of saccus, with a very narrow base and without any structures.

Female. Unknown.

Diagnosis. A unique character in the male of *K. yvonnedejongae* **sp. nov.** is the very short length of tibial spurs (upper pair) of the hindleg with 0.8 and 0.6 mm. Furthermore, *K. yvonnedejongae* **sp. nov.** has a unique combination of characters: First, an unusually large and elongated areole in the forewing that is as large as 60% of the upper discal cell. The areole is also large in males of *K. huchtemanni* **sp. nov.** and *K. haberlandorum* with up to 50% the size of upper discal cell and 60% in *K. petermuriithii* **sp. nov.** Second, the short antennae have only 0.33 length of forewing. The antennae are longer in the latter two species with at least 0.37 and 0.39 length of forewing but of similar length in *K. huchtemanni* **sp. nov.** with a maximum of 0.35 length of forewing. Third, the strongly reduced epiphysis is only 0.4 mm in length. Fourth, the strongly C-shaped distal margin of valva separates *K. yvonnedejongae* **sp. nov.** from *K. huchtemanni* **sp. nov.** as well as from *K. haberlandorum* where the distal margin of valva is only slightly C-shaped and S-shaped in *K. petermuriithii* **sp. nov.** Fifth, the long extension on the ventral edge of valva distally is 1.7× longer than the length of the emargination between the uncus lobes in *K. yvonnedejongae* **sp. nov.** but in the three species mentioned above this extension is less than 0.9× the length of the emargination between the uncus lobes.

Distribution. *Kayamuhakaia yvonnedejongae* **sp. nov.** is only known from the banks of the Lower Mlunguzi River in Zomba township with an altitude range of 969 — 1.002 m at the Forestry Research Institute of Malawi.

Zomba town is located at the foot of the southern steep scarp of Mount Zomba (2.068 m) and its plateau area (1.423 — 2.009 m) as part of the northern edge of the Shire Highlands. The township is located *ca.* 90 km to the South of the Malawi Rift as part of the EARS, *ca.* 100 km to the Northeast of the Mid-Zambezi-Rift (Roberts *et al.* 2012), *ca.* 30 km to the West of Lake Chilwa and within the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88) while those parts of Mount Zomba that are located above 1.600 m (*cf.* White *et al.* 2001: 62, 64) belong to the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161, 163).

Due to its morphological similarities with one Zanzibar-Inhambane endemic species, one Afromontane/ Zanzibar-Inhambane linking species as well as with one Zambezian/ Zanzibar-Inhambane linking species, *K. yvonnedejongae* **sp. nov.** is classified as *Zambezian/ Zanzibar-Inhambane linking* as well as endemic species to Mount Zomba and its adjacent submontane areas as part of the Shire Highlands.

Habitat. The average annual rainfall of Zomba is 1386 mm but rainfall is increasing with altitude up to 2200 mm at 1.830 m (Chapman & White 1970: 172) and up to 2265 mm on the plateau (Happold & Happold 1987).

The original vegetation on the Zomba Plateau and its species composition was very similar to Mount Mulanje (Chapman & White 1970: 172) with a mosaic of evergreen forests along rivers and in fire protected gullies as well as montane grasslands, *e.g.* with the Zambezian near-endemic *Protea petiolaris* Baker & C.H. Wright (Proteaceae, *cf.* White *et al.* 2001: 440). These grasslands, if still present, are maintained by frequent fires. Afromontane forests occur above 1.600 m but comprise only 600 ha (White *et al.* 2001: 62).

The type locality belongs to the *"Zambezian swamp forest and riparian forest" sensu* White (1983: 91). In riparian forest patches still occur, *e.g.* the two Afromontane endemics *Gambeya gorungosana* Liben (Sapotaceae, *cf.* White *et al.* 2001: 65) and *Cornus volkensii* Harms (synonym: *Afrocrania volkensii* Hutch./ Cornaceae, White *et al.* 2001: 215, 216) as well as the Afromontane near-endemic *Scolopia stolzii* Gilg (Salicaceae) and *Cassipourea malosana* Alston (Rhizophoraceae) — the latter is in particular frequent along the Mlunguzi River above 1.400 m. Additional characteristic tree species along rivers comprise, *e.g.* the Guineo-Congolian linking species *Syzygium owariense* Benth. (Myrtaceae) — including habitats along the Mlunguzi River (*cf.* White *et al.* 2001: 414) — the Eastern endemic *Diospyros zombensis* F. White (Ebenaceae) and the Guineo-Congolian linking species *Khaya anthotheca* C.DC. (Meliaceae). Noteworthy, the large liana *Artabotrys monteiroae* Oliv. (Annonaceae) occurs on Zomba in riparian forest as well as in *"Zanzibar-Inhambane lowland rain forest"* and *"Transitional rain forest" sensu* White (1983: 186, 187) including wetter types of coastal forest in Kenya (*cf.* Ngumbau *et al.* 2020: 32). White *et al.* (2001: 128) stated that this species is "… closely related to the Guineo-Congolian [liana] species, *A. likimensis* De Wild. …"

On and near the type locality along the Mlunguzi River occur, *e.g. Bridelia micrantha* Baill. (Phyllanthaceae); the Afromontane linking species *Parinari excelsa* Sabine (Chrysobalanaceae); the three Guineo-Congolian linking species *Harungana madagascariensis* Lam. (Hypericaceae), *Albizia adianthifolia* W.F. Wight (Mimosoideae) and *Ficus vallis-choudae* Delile (Moraceae); the Afromontane endemic *Acacia abyssinica* Hochst. and the Sub-Afromontane near-endemic *Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae), *cf.* White *et al.* (2001: 193, 244, 285, 310, 312, 317, 393).

The majority of the natural vegetation on Mount Zomba was replaced since 1909 by plantations, *e.g.* with *Widdringtonia nodiflora* Powrie (Cupressaceae). This tree species is naturally absent from Mount Zomba but naturally present on Mount Mulanje (Chapman & White 1970: 172). Additionally, excotic pine species have been largely planted and managed since 1955 including the upper parts of the plateau area and along certain parts of the Mlunguzi River comprising, *e.g. Pinus patula*

Schiede, *P. taeda* L. and *P. elliottii* Engelmann (Pinaceae), *cf.* Chapman & White (1970: 35); Happold & Happold (1987).

Since the natural forest habitats — that comprise some species of woody Leguminosae (Fabaceae) — are small and isolated, *K. yvonnedejongae* **sp. nov.** is almost certainly a threatened species.

Biological traits. The biology of *K. yvonnedejongae* **sp. nov.** is unknown.

Etymology. The species is named in honour of the Dutch primatologist and conservationist Yvonne de Jong Ph.D. (Nanyuki, Kenya) who was born in December 1970. Yvonne studied "Wildlife Management & Zoos, Policy & Education" at the Van Hall Institute (The Netherlands) during 1992 — 1996. She received both, her M.Sc. and Ph.D. on "Primate Conservation" from Oxford Brookes University (Oxford, UK) in 2004 and 2012, respectively. Yvonne is involved in various projects since 2001, *e.g.* in the "Eastern Africa Primate Diversity and Conservation Program" with primate related questions concerning their biogeography, taxonomy, assessments of primates in East Africa for the IUCN Red List of Threatened Species as well as their conservation. She is a member, *e.g.* of the "National Primate Task Force" of the Kenya Wildlife Service (Nairobi) as well as of the "IUCN/SSC Primate Specialist Group" (Gland, Switzerland). In regard to research projects, Yvonne is involved, *e.g.* in the project "Distribution, Abundance, Ecology, and Conservation Status of the Desert Warthog (*Phacochoerus aethiopicus* Pallas) and Common Warthog (*Phacochoerus africanus* Gmelin) in the Horn of Africa" since 2012.

I.L. is very grateful to Yvonne for her invaluable support in fieldwork on Metarbelidae undertaken on the Laikipia Plateau (Kenya) during 2016 — 2018 as well as for discussions about conservation in East Africa that reflect her patience and expertise on wildlife related issues.

***Kayamuhakaia hilarysommerlatteae* sp. nov.**

Figs 12.a., 23.c.

Type locality and repository: Malawi, the National Museums of Kenya, Nairobi, Kenya (NMK).

Material examined. Holotype, male, "Malawi, Ruo River Valley [also known as Ruo Valley], Mt Mulanje [also Mount Mlanje, Southern Region, Mulanje District] 15°58.3'S 35°39.2'E 890 m [correct elevation is 962 m, located along the Ruo River, Mulanje Mountain Reserve], 09 — 12 Nov 2012 [November 2012] R.J. Murphy [Raymond James Murphy leg.]", genitalia slide number 23/022020 I. Lehmann.

Description, male. *Head*: rough-scaled, with long as well as short hair-like scales of dark olive-buff and cream towards tip and a light golden glint; eyes black; a pair of pits is absent on lower fronto-clypeus, pits behind labial palpi are well visible and narrowly oval, a horizontal dorsal ridge is absent; antennae medium long, 0.37 length of forewing, bipectinate, with branches 3.0× width of shaft, branches scaled laterally with scales of dark olive-buff, branches at base widely separated with 1.2× width of branch, shaft densely scaled cream with a light golden glint; labial palpi half of eye-diameter, three-segmented, central segment longest, namely 1.5× length of basal segment, narrowly oval, basal segment not broader and narrowly rectangular, segment on top narrowly egg-shaped and 25% length of central segment.

Thorax: Patagia with long scales of cream and Saccardo's umber with cream scale tip and a light golden glint, not forming any collar ring; tegulae with longer hair-like scales of Saccardo's umber with cream scale base and a light golden glint. Metathorax with long hair-like scales of cream and a light golden glint forming a small scale crest. Forelegs have a rudimentary epiphysis with 0.5 mm in length. Hindlegs have fine hair-like scales of cream with dark olive-buff towards tip; two pairs of tibial spurs are present, 1.1 mm/0.9 mm (upper pair) and 0.8 mm/0.7 mm (lower pair) in length. Forewing length is 13.5 mm and wingspan 29.0 mm; upperside largely buffy olive with a light golden glint, pattern almost absent; termen broadly buffy olive and with small lunules of Saccardo's umber; costa broadly of Isabella colour with short striae of Saccardo's umber; a broad but weak patch of Isabella colour from half of CuA_2 to below costa is strongly bent inwards between M_2 and R_5, almost touching the end of upper discal cell, and is edged Saccardo's umber towards termen; all veins distinctly coloured cream; a narrowly elongated black patch below half of lower median and a smaller black patch below centre of CuA_2; from near half of CuA_2 to near apex occurs a broad band of buffy olive that represents a terminal band; cilia long with 1.0 mm, deep olive-buff. Underside of forewing is buffy olive with a light golden glint and a costa of Isabella colour.

Hindwing upperside buffy olive mixed with scales of light brownish-olive with a light golden glint; cilia and underside as in forewing.

Abdomen: Mainly deep olive-buff mixed with scales of Saccardo's umber with a light golden glint; abdominal tuft with long scales of deep olive-buff, tuft 20% length of abdomen. Genitalia (Fig 23.c.) with tegumen *ca.* 0.8× basal width of vinculum; saccus broad and medium long with 80% length of ventral width of valva; uncus broad and not elongated, basal part 30% broader than upper part of uncus without any hole at centre, bifid at tip, tips mucronate, uncus with a very deep lunule-like shape of the emargination that is 40% as deep as uncus length and 30% as broad as uncus width. The valva is very large, not elongated, broadly rectangular, *ca.* 8.0× larger than saccus, costal margin is oblique and rounded distally with few setae, dorsal edge is oblique to semi-transtilla, the latter is large with some short setae and has a large rectangular thinly membranous appendice, ventral edge of valva is 20% shorter in length if compared to distal margin, with a dominant lunule-like appendice that extends slightly distally, its end is opposite of the end of costal margin; distal margin of valva strongly S-shaped with a deep emargination. About 15% of valva thinly membranous mainly below semi-transtilla and with a pronounced lunule-like more sclerotized structure with setae near the central basal part of valva, this structure is slightly longer as base of semi-transtilla. The sacculus is very narrow and ends in the lunule-like appendice ventral distally. Phallus is long, narrow, tube-like and 3.5× length of saccus, with base and distal end of equal width and without any structures.

Female. Unknown.

Diagnosis. The male of *K. hilarysommerlatteae* **sp. nov.** has a unique combination of characters: First, an unusually narrow and very long areole in the forewing that is as long as upper discal cell and as large as 70% of the upper discal cell. Hence, the areole represents the largest among all males presented herein. Second, a strongly S-shaped distal margin of valva in combination with a short ventral margin of valva that is 20% shorter than the distal edge. Two characters are shared with *K. petermuriithii* **sp. nov.**, namely the S-shaped distal margin of valva and its length which is 10% longer than the ventral margin. Both species can be separated as the latter has small acuminate uncus tips that are mucronate in *K. hilarysommerlatteae* **sp. nov.** The latter species has the largest mucronate uncus tips if compared to all other males herein. Similar shapes of uncus tips occur in *K.haberlandorum* which has small mucronate tips with a small emargination between both tips that is as deep as up to 20% of uncus length but as deep as 40% of uncus length in *K. hilarysommerlatteae* **sp. nov.**

Distribution. *Kayamuhakaia hilarysommerlatteae* **sp. nov.** is only known from fringing forest along the Ruo River occurring near the foot of the southern slopes of Mount Mulanje (2.968 m at its highest elevation).

Mount Mulanje is located *ca.* 60 km southeast of Zomba township, *ca.* 45 km to the South of Lake Chilwa and within the *"Afromontane archipelago-like regional centre of endemism"* but at its foothills *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) still occurs in small patches between 600 — 950 m (White *et al.* 2001: 60, 62). Hence, the lowland as well as lower submontane areas of Mount Mulanje are located within the *"Swahilian/Maputaland regional transition zone" sensu* Clarke (1998: 61, 62).

This new species is certainly rare since Raymond James Murphy collected Metarbelidae in the Ruo Gorge/Ruo River Valley — including the banks of the Ruo River and other areas on Mount Mulanje — in various years between 1997 — 2017 but without any further record of a male or any potential female of *Kayamuhakaia.*

Due to its morphological similarities with one Zanzibar-Inhambane endemic species as well as with one Afromontane/ Zanzibar-Inhambane linking species, *K.hilarysommerlatteae* **sp. nov.** is classified as *Zanzibar-Inhambane endemic* as well as endemic species of the lowland and submontane areas that belong to the *"Swahilian/Maputaland regional transition zone"* on Mount Mulanje.

Almost certainly this species occurred in the Lowlands of the present Lujeri Tea Estate were *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) was once largely present (*cf.* White *et al.* 2001: 60).

Note: The Metarbelidae from Mount Mulanje are deposited in the collection of I.L. and comprise the years 1997, 2004 — 2017.

Habitat. The holotype locality (elevation range 894 — 1.002 m) is close to the banks of the Ruo River (*cf.* map in White *et al.* 2001: 639; Fig 37.a. herein) as well as *ca.* 6 km to the North of Lujeri Tea Estate (elevation range 641 — 849 m).

The average annual rainfall near the foot of the southern slopes of Mount Mulanje and at Lujeri Tea Estate is 2425 mm (Chapman & White 1970: 163) increasing to 3000 mm on its plateau areas (White *et al.* 2001: 13) but rainfall is decreasing to 892 mm, *e.g.* towards the northwest of the mountain.

There was extensive destruction of *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186; equivalent of the *"Lowland rain forest" sensu* White *et al.* 2001: 60) as well as *"Transitional rain forest" sensu* White (1983: 186, 187; equivalent of the *"Mid-altitude rain forest"* between 900 — 1.500 m *sensu* White *et al.* 2001: 63) on the southern slopes of Mount Mulanje where these two forest types were largely present due to the high rainfall (White & Chapman 1970: 165). All these forests have been totally destroyed except for fringing forest on the banks of streams. Only *ca.* 200 ha of *"Zanzibar-Inhambane lowland rain forest"* and 1800 ha of *"Transitional rain forest"* survived (White *et al.* 2001: 62).

Six years later, namely in 2007, the fringing forest of the type locality of *K. hilarysommerlatteae* **sp. nov.** was still described as "grand rain forest with many lianas and creepers" by Raymond James Murphy (pers. comm. to I.L. in September 2007).

Dominant tree species comprise: the Sub-Afromontane near-endemic *Newtonia buchananii* G.C.C. Gilbert & Boutique and the nine Guineo-Congolian linking species *Albizia adianthifolia* W.F. Wight, *Parkia filicoidea* Welw. (Mimosoideae), *Erythrophleum suaveolens* Brenan (Caesalpinioideae), *Treculia africana* Decne., *Ficus vallis-choudae* Delile*, Trilepisium madagascariense* DC. (Moraceae), *Synsepalum brevipes* T.D. Penn., *S. cerasiferum* T.D. Penn. (Sapotaceae) and *Antidesma vogelianum* Müll.Arg.(Phyllanthaceae). Additionally, the two Afromontane endemics *Ochna holstii* Engl. (Ochnaceae), *Chrysophyllum gorungosanum* Engl. (Sa-potaceae) occur as well as two Afromontane near-endemics *Syzygium afromontanum* Byng (synonym: *Syzygium guineense* DC. subsp. *afromontanum* F. White/ Myrtaceae) and *Maytenus acuminata* Loes. (Celastraceae), *cf.* Chapman & White (1970: 170; White *et al.* 2001: 187, 312, 319, 398, 413, 538).

One of the "large and impressive lianas" mentioned by Raymond James Murphy in 2007 is almost certainly *Artabotrys monteiroae* Oliv. (Annonaceae) since it is a characteristic species in *Zanzibar-Inhambane lowland rain forest* as well as *Transitional rain forest* including, *e.g.* wetter types of coastal forest in Kenya (*cf.* Ngumbau *et al.* 2020: 32). In Malawi, this liana has a height of up to 25 m (White *et al.* 2001: 127, 128).

Hence, the forest habitat of *K. hilarysommerlatteae* **sp. nov.** is located in a high rainfall area with various dominant woody Leguminosae (Fabaceae) including Caesalpinioideae as well as species that also occur, *e.g.* in the wetter coastal forests of Eastern Africa. Due to the small size of its habitat this new species is almost certainly at risk of extinction.

<u>Note</u>: Only above 1.500 m occur 5000 ha of various Afromontane forest types up to an elevation of 2.300 m (White *et al.* 2001: 62).

Biological traits. The biology of *K. hilarysommerlatteae* **sp. nov.** is unknown.

Etymology. The species is named in honour of Hilary Charmian Sommerlatte, ne Camm, born in December 1952 in Nyeri (Kenya). Hilary grew up in central Kenya and studied biology at the University of Natal (Republic of South Africa) in 1971 — 1973. After completing her studies she moved to Khartoum (Republic of the Sudan) until 1977 and from there to London (UK) until 1979. She developed a special interest in plants and their potential commercial uses during her second stay in the Republic of the Sudan where her husband Dr. Malte Sommerlatte was an Associate Professor of Wildlife and Head of the Wildlife Unit at the University of Juba (southern Sudan) in 1980 — 1985. During this time, she began her detailed fieldwork on 138 tree and shrub species occurring in the Imatong Central Forest Reserve (1.032 km^2) in southern Sudan, representing after the publications of Jackson (1956) and Friis & Vollesen (1982), another major work on the vegetation of the Imatongs. Her studies resulted in the first field guide about the trees and shrubs of the Imatong Mountains (Sommerlatte & Sommerlatte 1990). While mostly occupied of being a mother of two daughters, Hilary began in 1998 to promote the commercial use of gum producing trees, *e.g. Boswellia neglecta* S. Moore, *Commiphora confusa* Vollesen, *C. kua* Vollesen, *C. kataf* Engl. (Burseraceae) and *Calodendrum capense* Thunb. (Rutaceae) first on the private Game Ranch of the late Dr. David Hopcraft (near Athi River/ *cf.* Lehmann *et al.* 2023: 40, 74, 100) and at Gatuamba House (Naro Moru, *cf.* Figs 33.a., 33.b.) with “Arbor Oils of Africa” — a Kenyan producer of frankincense and myrrh essiatial oils with its collection operation certified organic since 2007.

Hilary always encouraged and supported significantly the interest of I.L. in Kenya and explained its people in various ways for a better understanding of their culture since February, 1987 — in Niedergandern (near Göttingen) by then. The author is also very grateful for her contributions to his first field studies on butterflies and moths in Kenya in regard to the identification of plant species in the habitats of the former on the Athi River-Kapiti Plains, in the Chyulu Hills, in Naro Moru and nearby areas since August, 1989.

Kayamuhakaia vau-alba (Hampson, 1920) **comb. nov.**

Type locality and repository: Malawi, the Natural History Museum, London, UK (NHMUK, formerly BMNH).

Original combination: “*Metarbela vau-alba* n. sp.” Hampson: *Novitates Zoologicae*, Vol. XXVI., January 1920, page 266: “Br. C. Africa — Mt. Mlanje (Neave), 1 ♂ type. *Exp.* 30 mill. [wingspan 30.0 mm]”. The data on the type label was noted by I.L. in December 1996 in the BMNH and is as follows: “Nyasaland. [today Malawi] Mt.

Mlanje [also Mount Mulanje]. iii.VII.1913 [03rd July 1913; elevation unknown] S.A. Neave. [leg.]".

Note: A genitalia dissection of the type — the only available specimen of *vau-alba* — was not allowed by staff members of the BMNH during the studies on this species by I.L. in December 1996. Hence, the genitalia is unknown to I.L. However, the type represents a male.

Female. Unknown.

Diagnosis. The type of *K. vau-alba* is similar in size, antennae and wing pattern to the male of *K. nubifera* described herein (*cf.* Fig. 3.g.). Noteworthy, the antennae of *K. vau-alba* are among the longest male antennae of *Kayamuhakaia* with 0.60 length of forewing, bipectinate, with long branches of 5.0× width of shaft. The end of the lower median, the base of CuA_2 and base of CuA_1 are pure white and resulting in a pure white "V" in horizontal position. Both characters separate *K. vau-alba* from *K. hilarysommerlatteae* **sp. nov.** that occurs sympatric with the former species on Mount Mulanje.

As the diagnosis suggests are some morphological characters shared with *K. nubifera.*

Distribution. Based on the small distribution range of all species of *Kayamuhakaia* presented herein, *K. vau-alba* is most probably a rare and very local species that occurs on Mount Mulanje almost certainly above an elevation of 1.500 m and hence, in Afromontane forest types.

Due to its morphological similarities with one Afromontane/Zanzibar-Inhambane linking species (*K. nubifera*), *K. vau-alba* **sp. nov.** is classified as *Afromontane/Zanzibar-Inhambane linking* as well as endemic species to Mount Mulanje.

Since extensive destructions of various forest types occurred on Mount Mulanje at least after the year 1891 and are linked to humans and fire (Chapman & White 1970: 164, 165, 170) this species might be already extinct. The latter view of I.L. is supported by the fact that neither a male nor a potential female of *K. vau-alba* is represented in the comprehensive Metarbelidae collection of Malawi. The specimens in the private collection of I.L. comprising the years 1997, 2001 — 2017 including species from various collecting Sites on Mount Mulanje that were presented to I.L. by Raymond James Murphy (Nkhorongo) in 2008 as well as during the years 2010 — 2017.

Habitat. Unknown (*cf.* information on Mount Mulanje in Lehmann 2019b: 332—333; Lehmann *et al.* 2023: 97; *K. hilarysommerlatteae* **sp. nov.** herein).

Biological traits. The biology of *K. vau-alba* is unknown.

Finsterwaldeia I. Lehmann **gen. nov.**

Figs 1.b., 12.b., 24.a., 25.a., 30.a., 37.b. — 39.b.

Type species of genus: *Finsterwaldeia danduensis* **sp. nov.** is designated as the type species.

Origin of species in genus:

Based on two "potential parsimony-informative characters" (*cf.* 1.+ 2. below) the species of *Finsterwaldeia* are — together with species of *Kayamuhakaia* — close to the species of the *"Dimbelenge Group"* as well as *"coastal forest Group" sensu* Lehmann (2019b: 32). Hence, the ancestors of the present species of *Finsterwaldeia* most probably first evolved in the tropical lowland rain forest as well as submontane rain forest of the Afro-Arabian continent.

1. The "elongated uncus and tegumen" is at least 2.1× as long as the basal width of valva — *cf.* the similar but different apomorphy as well as parsimony-informative character number "183" that is linked to Metarbelidae that first originated in lowland rain forests of West and/or Central Africa (Lehmann 2019b: 38, 383, Fig 6c.).

2. A "thinly sclerotized, medium broad band that connects both valva ventrally" (Fig 24.a., a.2.; Fig 25.a., a.1.) — *cf.* the similar but different apomorphies as well as parsimony-informative characters number "70", "71", "80", ("104" homoplasy), "121" that are linked to Metarbelidae that first originated in lowland rain forests of West and/or Central Africa ("71", "121"), or in the Eastern Arc Mountains as well as in the "*Zanzibar-Inhambane regional mosaic*" ("70"), including also other montane areas for characters "80", "121" (Lehmann 2019b: 32, 33, 386 — 387, Fig 6c.). Noteworthy, character "70" describes a narrow, strongly sclerotized band-like structure (Lehmann 2019b: 33) that is in regard to its width closest to the band-like structure in *Finsterwaldeia danduensis* **sp. nov.**

Autapomorphies — The genus is defined by the following combination of characters in the male.

Male, epiphyses on forelegs present and well developed, areole is large in forewing, in combination with:

A sclerotized sword-like appendice originates from or close to the basal width of valva as well as near the middle of the basal width of valva and is almost as large as the appendice of the semi-transtilla. The latter appendice is often not visible and hence, "absent" in old genitalia preparations of Metarbelidae. The sword-like appendice represents in regard to its position on the valva an autapomorphy for the Metarbelidae (*cf.* Fig 24.a., a.1.).

Furthermore, a simple genitalia with a ventral edge of valva that is shorter than the basal width of valva — the latter is measured vertically from below the base of the strongly reduced semi-transtilla to ventral edge of sacculus in a not pressed condition — and with a very small, simple, not strongly sclerotized, lunule-like appendice on the valva ventral distally in combination with the sclerotized sword-like appendice mentioned above.

Diagnostic characters in male of *Finsterwaldeia* gen. nov.

- Near the central part of uncus occurs a large hole that is *ca.* 25% the size of uncus and triangular in shape.
- Uncus as long as basal width of valva (*cf.* species of *Kayamuhakaia* where the uncus is never as long as basal width of valva).
- The inner part of valva has on its surface two oblique, thinly sclerotized appendices (lunule-like) with rows of tiny setae on its upper surface. These appendices occur parallel to each other. They originate near the central basal part of valva and extend towards costa, but end well below the costa. In old genitalia preparations this structure might be "absent" or difficult to see.
- Valvae with horizontal costal edge that is oblique towards outer edge of the tiny semi-transtilla.
- Hindlegs with two pairs of tibial spurs with upper pair longer than lower pair.
- Antennae bipectinate, very long, 50% of forewing length, branches 4.5× longer than width of shaft and widely separated at base with 2.0× width of branch.

Female. Unknown.

Description. *Head*: Rough-scaled; long hair-like scales of cream-buff mixed with scales of honey yellow with a light golden glint on fronto-clypeus; a pair of pits on lower fronto-clypeus is present but rudimentary; a pair of small conical projections absent on lower fronto-clypeus; pits behind labial palpi are small narrow slits; a horizontal dorsal ridge on lower fronto-clypeus is absent; labial palpi medium long, slightly longer than half of eye-diameter, consisting of three segments with 2nd segment longest, narrowly oval. Antennae bipectinate, very long with 50% of forewing length, branches long and laterally scaled, widely separated at base; branches narrowly tube-like (viewed laterally); dorsal and lateral sides of flagellum scaled.

Thorax: Patagia and tegulae with pronounced light golden glint; hair-like scales without any broad tip; the scales on patagia forming no collar ring. Metathorax has a slightly longer scale-crest comprising long hair-like scales. Forelegs and midlegs with long dense hair-like structures. Epiphyses present, needle-like and long. Hindlegs with long hair-like structures that have a glint, with two pairs of narrow tibial spurs, both pairs of spurs unequal in length; all spurs with thorn-like tip. Forewing is broad.

Forewing upperside is largely of Isabella colour with a strong light golden glint; scale pattern is present and includes a broad dominant band of ecru-olive extending from CuA_2 to apex; below CuA_2 occur several small patches of pure white edged by patches of light brownish olive; lunules are present; costal margin is cream-buff with small patches of light brownish olive; end of discal cell with a darker patch. Any scales that are longer and hence, extend above the normal scale layer are absent.

Hindwing is ecru-olive mixed with scales of light brownish olive with a light golden glint.

Forewing venation (Fig 30.a.) with 1A+2A not forked at base; CuP absent; a continuous, not sclerotized, weak CuP fold also absent; CuA_2 originating from two-thirds of lower median; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is well separated from base of R_5; a large areole is present and has *ca.* 30% the size of upper discal cell; discocellular vein is weak and ends well before the forewing base (*cf.* Fig 30.a., a.1.+ arrow); R_1 and R_2 separate; R_1 initiating from anterior margin of median cell and R_2 initiating from anterior angle of areole; R_3+R_4 are very long stalked and originating from posterior tip of areole; R_5 originating from the same basal point of posterior tip of areole; Sc more or less parallel to R_1.

Hindwing venation (Fig 30.a.) with 3A present, 1A+2A represents a fold, CuP present but weak; CuA_2 originating from two-thirds of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, separated; M_1 and Rs originating from apical angle of anterior cell and are long stalked; with a bar from Rs to $Sc+R_1$; vein in discocellular cell on both fore- and hindwing is present but weak.

Fringe scales long with 1.0 mm length on forewing and hindwing, ecru-olive with lighter tips.

Retinaculum and frenulum are absent.

Abdomen: With dense hair-like scales of cream mixed with scales of Isabella colour and with a light golden glint; abdominal tuft short with 20% of abdomen length and cream coloured.

Male genitalia with tegumen and vinculum fused, forming a firm narrow ring, with vinculum broadest, namely *ca.* 3.5× broader than basal part of tegumen (*cf.* Fig 25.a., a.2.). Saccus well developed, broad with 1.5× broader than aedeagus, short with 50% length of ventral edge of valva. Uncus narrow, elongated, as long as basal width of valva with two acuminate tips, an emargination is lunule-like in shape; uncus and tegumen combined are (possibly also in other species of this genus and at least) 2.1× as long as basal width of valva; one large triangular hole is present on uncus; dorsal part of uncus with many tiny dots as well as short and long setae ventrally and along its two vertical edges (viewed ventrally); basal (horizontal) edge of uncus only present at base of its two vertical edges, thinly membranous, but at center of uncus the basal edge is absent, the uncus base is represented by the base of the triangular hole and hence, the uncus base is absent on *ca.* 50% of its length — the basal edge of uncus might be longer in other species of *Finsterwaldeia* that are described in the future. The gnathos is absent and not represented by a relict structure. The juxta is thinly sclerotized, large, rectangular and with an elongated triangular appendice at each lateral side (viewed ventrally); the upper half of juxta is slightly broader than the basal width of the two horizontal edges of uncus. The valva is large rectangular with an horizontal costal margin that is oblique near the base of the tiny semi-transtilla, distal margin is strongly C-shaped, 25% of valva thinly membranous and dorsally with a broadly rounded end, distally with short setae; more than two-thirds of valva include an inner valva that is slightly sclerotized; a medium broad thinly sclerotized and almost squarrish band connects both valva ventrally and hence, the valvae are not separated ventrally (best visible in fresh genitalia preparation, *cf.* Fig 25.a., a.1.). On the inner surface of valva occur two oblique rows of tiny setae that originate near the central basal part of valva and extend towards costa but are well below the base of semi-transtilla. Transtilla absent, semi-transtilla probably always small triangular with a small thinly membranous appendice (best visible in fresh preparation); the sacculus is narrow (visible only in fresh preparation) and ends in one small lunule-like appendice ventral distally, this appendice is sclerotized, hollow and results in a short extension of the sacculus distal ventrally. Phallus longer than basal width of valva, narrow and not broader than width of saccus (viewed ventrally), simple tube-like, broadest at base, not bent, with a flat and rectangular tip distally and without any appendice.

Species richness. Currently, one new species is included in this genus which is described as new to science.

Distribution. Species of *Finsterwaldeia* are only known from the sub-montane area at Dandu (Mandera County) in northeastern Kenya located *ca.* 25 km to the Southeast from the frontier to Ethiopia. Species of *Finsterwaldeia* almost certainly extend from Dandu and Dandu Hill (altitude range 738 — 1.219 m; Figs 38.c., 39.a., 39.b.) southwestwards — most probably in a scattered distribution via various "inselbergs" of northeastern Kenya — to Korondil (Fig 37.b.) and northwards and eastwards into the *"Juba Plain" sensu* Friis (1992: 11) of the *"Somali Lowlands" sensu* Friis (1992: 11) in Ethiopia and Somalia.

Hence, species of *Finsterwaldeia* have a distribution range on the African mainland that extends within the following phytochoria *sensu* White (1976, 1983):

- The *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110).
- An irregularly dissected and undulating "inselberg" called Dandu Hill (altitude 738 — 1.219 m) abuts Dandu village to the North and has slopes with many rocky outcrops that result in a high concentration of gravel and stones. This "inselberg" possibly had in 1952 or much earlier, remnants of *"Dry transitional montane forest" sensu* White (1983: 166) and/or *"Afromontane evergreen bushland and thicket" sensu* White (1983: 167) or related types in patches occurring above 900 m with its plant species composition that was once almost certainly part of the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161, 163).
- Species of *Finsterwaldeia* might occur on further "inselbergs" with vegetation that belongs to the *"Afromontane archipelago-like regional centre of endemism".*

Habitats. It is very likely that species of *Finsterwaldeia* occur and are linked to similar "inselbergs" in northeastern Kenya as well as to "inselbergs" in the

"Juba Plain" sensu Friis (1992: 11). Friis & Gilbert (1984: 330) stated that isolated "inselbergs" or "Burs"of granite, gneiss or dorite occur in southern Somalia between the coast and the escarpment of the calcareous plateau near the border with Ethiopia. As the run off from the impermeable basement complex rocks of these "burs" creates a moister environment at their foot, a wetter semi-evergreen vegetation type occurs far inland from the coast in the drier parts of southern Somalia. This vegetation was termed *"buur vegetation" sensu* Friis & Vollesen (1989: 466) and might represent an important habitat link between species of *Fisterwaldeia* and *Kayamuhakaia.*

The species of *Finsterwaldeia* was recorded at Dandu that is one of the hottest as well as driest areas of Kenya at present with a hot semi-arid climate. The following main vegetation types occur at Dandu as well as on Dandu Hill and comprise also woody Leguminosae:

- *"Somalia-Masai secondary grassland and wooded grassland" sensu* White (1983: 114, 115) dominated by, *e.g.* species of *Acacia* Mill. (Mimosoideae), *Commiphora* Jacq. (Burseraceae) and *Triumfetta flavescens* A. Rich. (Malvaceae) on overgrazed land.
- *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113) dominated by trees, *e.g. Acacia brevispica* Harms, *A. bussei* Sjøstedt, *A. nilotica* Del. and *A. paolii* Chiov. (Mimosoideae), *Commiphora samharensis* Schweinf. (included in this species is at present *C. danduensis* Gillett, 1991: 39, *cf.* https://powo.science.kew.org), *C. rostrata* Engl. var. *reflexa* Gillett (1991: 15)*, C. confusa* Vollesen, *C. baluensis* Engl. (Burseraceae) and *Delonix elata* Gamble (Caesalpinioideae) mixed with scattered trees of *Platycelyphium voense* Wild (Papilionoideae); shrubs of *Croton somalensis* Pax (Euphorbiaceae) and *Harmsia sidoides* K. Schum. (Malvaceae). The rare small tree or shrub *Dalbergia eremicola* Polhill (Papilionoideae) extends into *"Afromontane evergreen bushland and thicket"* up to at least 810 m in northern Kenya (Gillett *et al.* 1971: 103). Particularly in wooded grassland and/or along drainage lines or luggas trees of *Tamarindus indica* L. (Caesalpinioideae), *cf.* Brenan (1967: 153) occur with *Acacia horrida* Willd. mixed with shrubs of *Grewia tenax* Fiori (Malvaceae) (Beentje 1994: 158) and the small tree or shrub *Phyllogeiton discolor* Herzog (Rhamnaceae), Johnston (1972: 32).
- *"Somalia-Masai edaphic grassland" sensu* White (1983: 116) with waterlogged or swamp-like areas that were present near Dandu in 1952 and earlier, the year when the holotype of *F. danduensis* **sp. nov.** was collected. Such swamp-like or waterlogged areas are indicated by records of the herb *Caperonia serrata* C. Presl. as well as by the shrub *Cephalocroton cordofanus* Hochst. (Euphorbiaceae) collected at Dandu also in 1952 (Smith 1987: 283). Large stands of *Acacia senegal* Willd. and/or *A. seyal* Del. almost certainly occured in such waterlogged areas and might still occur near Dandu (Hilary Sommerlatte pers. comm. to I.L. in 2023). This view is supported by a record of *Senegalia circummarginata* Kyal. & Boatwr. (synonym: *Acacia circum-marginata* Chiov.) from Dandu. Brenan (1959: 94) considered the latter species as closely related to *A. senegal* Willd.

- Possibly, patches of *"Dry transitional montane forest" sensu* White (1983: 166) were present on the "inselberg" above 900 m in 1952 or earlier, *e.g.* with *Croton schimperianus* Muell. Arg. (Smith 1987: 148). The World Bank (1987, main report: 23) did not mention any forest area for the former Mandera District and stated that "… throughout northern Kenya, there are many patches of isolated forest on mountains, covering in total about 407,800 ha …" No forest patch on Dandu Hill was found during field studies on antelopes in February/March 2025 by Thomas Butynski and Yvonne de Jong (T. Butynski & Y. de Jong pers. comm. to I.L. in 2025, *cf.* Figs 38.b., 38.c., 39.a., 39.b.).
- *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115), *e.g.* with small trees of *Vepris eugeniifolia* I. Verdoorn (Rutaceae), *Euclea racemosa* L. (Ebenaceae) and *Dodonaea viscosa* Jacq. subsp. *angustifolia* J.G.West (Sapindaceae); shrubs of *Bullockia pseudosetiflora* Razafim., Lantz & B. Bremer (homotypic synonym: *Canthium pseudo-setiflorum* Bridson/ Rubiaceae), *Grewia penicillata* Chiov. (Malvaceae), *Cissus aphyllantha* Gilg (Vitaceae), *cf.* Verdcourt (1993: 38), *Xerophyta spekei* Baker (Velloziaceae) and *Cadaba farinosa* Forssk. (Capparaceae) mixed with climbers of *Cyphostemma digitatum* Desc. (Vitaceae), *cf.* Verdcourt (1993: 122, 124). This vegetation type forms an ecotone on the rocky slopes of the "inselberg". It occurs usually between patches of *"Dry transitional montane forest"* and *"Somalia-Masai Acacia-Commiphora decid-uous bushland and thicket" sensu* White (1983: 113) and hence, it has a transitional nature. At present it can be found only adjacent to the latter on and near Dandu Hill.

At Dandu and Dandu Hill "… a number of shallow and independable wells [were present and], there is often a good supply of water in a natural cistern half way up the hill …"(Naval Intelligence Division 1920: 378). Both statements suggest that before the year 1920 there was locally a good supply with groundwater and hence, the occurrence of waterlogged areas and/or *"Dry transitional montane forest"*, *"Afromontane evergreen bushland and thicket" sensu* White (1983: 166, 167) or related types occurring in patches was possible.

There might be "inselbergs" in southern Somalia where species of *Finsterwaldeia* and *Kayamuhakaia* occur sympatric in *"buur vegetation" sensu* Friis & Vollesen (1989: 466; *cf.* Table 3 herein).

The average annual rainfall is 255 mm in Mandera County at present. The rainfall pattern is erratic and unreliable. There are two rainfall seasons. The long rains usually occur between April and May and the short rains between October and December. Drought is usual and might become more severe in the future with the driest months January, June, July, August and September.

The maximum temperature is 35.8°C and minimum temperature is 24.3°C. Therefore, temperature in this region is hot (Republic of Kenya & Mandera County Government 2021).

Biological traits. The biology of species of *Finsterwaldeia* is unknown. However, it is very likely that the larvae of species of *Finsterwaldeia* feed on bark and/or in wood of species of *Acacia* Mill. (Mimosoideae) as well as *Commiphora* Jacq. (Burseraceae), *e.g. C. rostrata* Engl. and *C. samharensis* Schweinf.

Etymology. The genus is named after Finsterwalde which is the birth place of I.L. (federal state of Brandenburg, Niederlausitz, Germany). Due to the well known old German song “Wir sind die Sänger von Finsterwalde .... [= We are the singers of Finsterwalde....]” the town is also called “Sängerstadt Finsterwalde” [“Sänger” = “the singers”, “stadt” = “town”] since 2009.

The name “Vynsterwalde” is first mentioned in the year 1282 (Fischer 2005: 55). The spelling of the unique name “Finsterwalde” was used — possibly for the first time — on a map drawn by Matthias Öder in 1594 (*cf.* Oette 2013: 10). The meaning of “Finsterwalde” refers to a settlement that was first established on a forest clearing that was surrounded by a dark forest — “dark” = “finster” or “düster” — “-walde” = in names of medieval ages for settlements located in or adjacent to a forest (Fischer 2005: 206). This view is supported by a note about the town written in the year 1336 as follows: “... wybilde [= town] tzu [to] Duisterenwalde [= düsterer Wald = dark forest]” (Oette 2013: 6).

Forests still occur adjacent to the town and are dominated by *Pinus sylvestris* L. (Pinaceae) mixed with *Betula pendula* Roth (Betulaceae). The open structure of these dry forests growing on Podzols — soils with a subsurface horizon that has the appearance of ash due to strong bleaching — had a herb layer that comprised largely the subshrub *Calluna vulgaris* Hull (Ericaceae) until 1982 — a species with heights of up to 1.1 m (!) locally near Finsterwalde and which is less common or locally absent on many of its former Sites (I.L. pers. observations 2012 — 2025). The first collecting Sites for Lepidoptera of I.L. were in these habitats between 1971 (aged 7 by then) until 17th August 1982, *e.g.* on and adjacent to the author’s beloved “Segelflugplatz Heinrichsruh”, an airport used by sailplanes since 03rd August 1932 *cf.* https://www.flugplatz-finsterwalde.de/geschichte-des-flugplatzes/ with visible significant changes on the airport due to the decrease of *Calluna vulgaris* Hull but no significant changes in the adjacent landscape outside of the fenced area until 30th September 2025. Particularly during hot summers, these localities helped to fulfil the author’s childhood dreams about a hot and diverse Kenya, ignited at the age of 13 (Lehmann 2020: 58). Noteworthy, *e.g.* 52 butterfly species and 96 Geometrid moth species were recorded by I.L. during daylight on the “Segelflugplatz Heinrichsruh“ including adjacent areas with six street lights of the Frankenaer Weg located up to 250 m from the airport (Lehmann unpublished data 1971 — 1982). More or less the same number of specimens in species was found every year comprising the very rare *Hipparchia statilinus* (Hufnagel/ Nymphalidae; still present in 2024) as well as *Scopula decorata decorata* (Denis & Schiffermüller/ Geometridae; no record since 2012). In total, 25 butterfly species and only 29 species of Geometridae(!) were recorded by daylight — together with my son Shimoni — in the same area and including the few street lights during 2012 — 2025. Hence, more than 50% of all butterfly species disappeared completely, *e.g.*

Leptidea sinapis (Linnaeus/Pieridae) and the once very common *Hipparchia fagi* (Scopoli/ Nymphalidae) and *H. hermione* (Linnaeus)!

***Finsterwaldeia danduensis* sp. nov.**

Figs 12.b., 24.a., 25.a., 30.a.

Type locality and repository: Kenya, the Natural History Museum London, UK (NHMUK, formerly BMNH)

Material examined. Holotype, male: "Kenya — Dandu [Mandera County, formerly Mandera District], March 1952 Lat N.3°25' Long. E. 39°54' E.H.M. Clifford [leg.] B.M.[British Museum] 1952 — 178." On second label: genitalia slide no. 20/052020 I. L. [Ingo Lehmann].

Description. *Head*: Rough-scaled; long hair-like scales of cream-buff mixed with scales of honey yellow with a light golden glint on fronto-clypeus; eyes black without spots; a pair of pits is present but rudimentary on lower fronto-clypeus, a pair of small conical projections absent on lower fronto-clypeus; pits behind labial palpi are small, narrowly oval; a horizontal dorsal ridge on lower fronto-clypeus is absent; labial palpi medium long, slightly longer than half of eye-diameter, consisting of three segments with 2nd segment longest, narrowly oval, 1.4× longer than 1st (basal) segment, basal segment 1.2× broader than upper segment and narrowly rectangular, segment on top egg-shaped, 30% length of 2nd segment; antennae very long, 0.50 length of forewing, bipectinate, with long branches 4.5× width of shaft, branches narrowly tube-like and scaled laterally with scales of cream and sepia, branches at base widely separated with 2.0× width of branch, flagellum densely scaled sepia mixed with cream dorsally and with a light golden glint.

Thorax: Patagia and tegulae with pronounced light golden glint; hair-like scales are cream-buff or cream with tips of honey yellow; the scales on patagia forming no collar ring. Metathorax has a slightly longer scale-crest comprising long hair-like scales of cream with honey yellow tips. Forelegs and midlegs are cream-buff with long dense hair-like structures. Epiphyses present, needle-like and long with 1.1 mm. Hindlegs cream-buff with a glint on long hair-like structures, with two pairs of narrow tibial spurs, both pairs unequal in length, upper pair longer with 0.8 mm/ 0.9 mm, lower pair 0.7 mm/ 0.8 mm; all spurs with thorn-like tip. Forewing length 9.0 mm and wingspan is 20.5 mm. Forewing is broad and not elongated.

Forewing upperside is largely of Isabella colour with a strong light golden glint; scale pattern includes a broad dominant band of ecru-olive extending from CuA_2 to apex, strongly bent inwards at M_2; below CuA_2 occur three small patches of pure white, edged by larger patches of light brownish olive; lunules of light brownish olive are small and weak; costal margin is cream-buff with dominant patches of light brownish olive; end of discal cell with a patch of light brownish olive.

Hindwing is ecru-olive mixed with scales of light brownish olive with a light golden glint.

Underside of forewing as well as hindwing is buffy olive with a light golden glint and with striae of light brownish-olive along costal margin of forewing. Cilia of forewing as well as hindwing long, 0.9 — 1.0 mm, ecru-olive with pale drab-grey tip, more pronounced in hindwing cilia, with a strong light golden glint.

Abdomen: Mainly cream-buff and of Isabella colour with a strong light golden glint; abdominal tuft with long scales of cream-buff, tuft medium long with 25% length of abdomen. Genitalia with tegumen *ca.* 0.3× basal width of vinculum (Fig 25.a., a.2.); saccus broad and short, *ca.* 0.5× length of ventral width of valva; uncus narrow and elongated with 15% longer than its basal width and basal part 60% broader than upper part of uncus, bifid at tip with tips acuminate. Uncus as long as basal width of valva; uncus and tegumen are together 2.1× as long as basal width of valva. The uncus has a small and not deep lunule-like emargination that is only 10% as deep as uncus length; one large triangular hole dorsally, the hole is 25% the size of uncus. The sclerotized juxta is rectangular with two broad triangular appendices laterally, its size is medium large with 60% the size of saccus. The valva is large, *ca.* 7.5× larger than saccus, rectangular-shaped with an horizontal costal margin that is oblique near the base of the tiny semi-transtilla, the latter is only as large as 20% of juxta, 25% of valva thinly membranous and dorsally with a broadly rounded end distally with short setae; more than two-thirds of valva include an inner valva that is slightly sclerotized; a medium broad thinly sclerotized and almost squarrish band connects both valva ventrally; distal edge of valva as long as ventral edge and strongly C-shaped; ventral edge with short setae and a lunule-like appendice distally; on the inner surface of valva occur two oblique rows of tiny setae that originate near the central basal part of valva and extend towards costa but are well below the base of semi-transtilla, this structure is *ca.* 2.5× as long as length of horizontal base of semi-transtilla. The sacculus is narrow (visible only in fresh preparation) and ends in one small lunule-like appendice ventral distally, this appendice is sclerotized, hollow and results in a short extension of the sacculus distal ventrally. Phallus thinly sclerotized, long, 1.5× longer than basal width of valva or 3.5× longer than saccus, narrow and not broader than width of saccus (viewed ventrally), simple tube-like, broadest at base, not bent, with a flat and rectangular tip distally and without any appendice.

Female. Unknown.

Diagnosis. The male of *F. danduensis* **sp. nov.** can be separated from all other species of Metarbelidae by its autapomorphy in combination with other character states mentioned above. If compared to the males of *Kayamuhakaia* the elongated uncus of *F. danduensis* **sp. nov.** is as long as the basal width of valva. In contrast, the uncus is short and never as long as the basal width of valva in males of the former genus (*cf.* for example Fig 23.b. with 24.a.).

Distribution. *Finsterwaldeia danduensis* **sp. nov.** is only known from Dandu and Dandu Hill, respectively (northeastern Kenya).

Based on the two "potential parsimony-informative apomorphies" mentioned above *F. danduensis* **sp. nov.** is classified as *Somalia-Masai/Zanzibar-Inhambane linking* species as well as endemic species to Dandu Hill and its adjacent areas.

Habitat. See above.

Biological traits. The biology of *F. danduensis* is unknown.

Etymology. The species is named after the type locality Dandu (Mandera County, Kenya). The name "Dandu" might originate from the Somali name "Danu". "Danu" as well as "Danu-Sagar" are the Somali names for the small tree species *Commiphora rostrata* Engl. (Burseraceae) which is common on Dandu Hill as well as near Dandu at least as early as 1952 (*cf.* Gillett 1991: 15; Beentje 1994: 385, 686).

Lichterfeldia I. Lehmann **gen. nov.**

Figs 1.b., 12.c., 24.b., 25.b., 30.b.

<u>Type species of genus</u>: *Lichterfeldia olarinyiroensis* **sp. nov.** is designated as the type species.

<u>Origin of species in genus</u>:

Although the species of *Lichterfeldia* is at present endemic to the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110) it is very likely that species of this new genus did <u>not</u> originate in this phytochorion. This assumption of I.L. is based on one synapomorphy in the female antennae (*cf.* below) that is shared with females of *Kayamuhakaia* — including the lowland Z-I endemics *K. kismayuensis* **sp. nov.** as well as *K. neemambeyuae* **sp. nov.** — which implies that species of *Lichterfeldia* did not originate in the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) and hence, the males (at present unknown) should not have any of the parsimony-informative characters presented for the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) by Lehmann (2019b: 34 — 36); *cf.* "Discussion: Potential microrefugia of the Z-I region in southern Somalia".

Instead, the synapomorphy (see below) indicates in particular a link to montane species of *Kayamuhakaia* occurring in the Afromontane archipelago. Hence, it is more likely that the Afromontane region is the ancestral area for species of *Lichterfeldia.*

Certainly, the Pliocene faulting that produced horst strips by active rivers, *e.g.* by the Mukutan River in the Ol Ari Nyiro area 5 Ma (King 1978: 45), contributed to speciations in *Lichterfeldia* (*cf.* Discussion).

Autapomorphies — The genus is defined by the following combination of characters in the female.

Female, epiphyses on forelegs rudimentary (strongly reduced), areole is very large on forewing, in combination with:

- The antennae have an unusual narrow flagellum on its entire length with a very broad scape which means that the scape of one antenna is twice as broad as the flagellum — representing an autapomorphy for Metarbelidae — and the latter is 50% as long as the forewing length. In other species, *e.g.* of *Kayamuhakaia* the scape of antenna is never broader than 1.5× width of flagellum.

Synapomorphy — The antennae are unipectinated with relicts of branches on up to one-third of antenna — measured from base of flagellum towards tip — that are not longer than *ca.* 0.3× width of shaft near base of flagellum but up to *ca.* 1.0× width of shaft on upper one-third of flagellum and near tip. Hence, the female antennae have branches that become significantly longer towards the tips of antennae. The latter represent a synapomorphy with the females of *Kayamuhakaia.*

Diagnostic characters in female of *Lichterfeldia* gen. nov.

- Forewing medium broad which means that the forewing is not broader than hindwing.
- Forewing visibly longer than hindwing and with a strongly rounded apex (*cf.* females of *Kayamuhakaia* where the apex of the forewing is never strongly rounded but pointed).
- The areole in forewing is large with at least 45% the size of upper discal cell.
- Labial palpi three-segmented with basal segment and central segment of equal length.
- Hindlegs with two pairs of tibial spurs with upper pair narrower as well as longer than lower pair.
- A ring-like band posteriorly on or adjacent to segment 8 is absent.

Male. Unknown.

Description. *Head*: Rough-scaled; long hair-like scales of cream-buff mixed with scales of olive-ocher with a light golden glint on fronto-clypeus; a pair of pits on lower fronto-clypeus is present; a pair of small conical projections absent on lower fronto-clypeus; pits behind labial palpi are small oval; a horizontal dorsal ridge on lower fronto-clypeus is absent; labial palpi medium long, slightly longer than half of eye-diameter, consisting of three segments with rectangular 1st (basal) segment and oval 2nd segment of equal length, segment on top egg-shaped. Antennae unipectinated, very long with 50% of forewing length, with relicts of branches on up to one-third of antenna and up to *ca.* 1.0× width of shaft on upper one-third of flagellum, branches laterally scaled, widely separated at base; branches tube-like (viewed laterally); dorsal and lateral sides of flagellum scaled.

Thorax: Patagia and tegulae with pronounced light golden glint; hair-like scales as well as short medium broad scales occur; the scales on patagia are worn, possibly forming no collar ring. Metathorax has a slightly longer scale-crest comprising hair-like scales. Forelegs and midlegs with long dense hair-like structures. Epiphyses present but rudimentary, needle-like. Hindlegs with a glint on long hair-like structures, with two pairs of tibial spurs, both pairs of spurs unequal in length; all spurs with thorn-like tip. Forewing elongated, apex strongly rounded.

Forewing upperside largely olive-ocher with a strong light golden glint; scale pattern is weak or absent; lunules are weak or absent; costal margin is cream-buff. Any scales that are longer and hence, extend above the normal scale layer are absent.

Hindwing olive-ocher with ecru-olive scales and a light golden glint.

Forewing venation with 1A+2A long forked at base (*cf.* Fig 30.b., b.1.); CuP absent; a continuous, not sclerotized, weak CuP fold also absent; CuA_2 originating from two-thirds of lower median; CuA_1, M_3 and M_2 separate and originating from apical angle of posterior cell; M_1 originating from distal margin of median cell and is well separated from base of R_5; a very large areole is present and is 45% the size of upper discal cell; R_1 and R_2 separate; R_1 initiating from anterior margin of median cell and R_2 initiating from anterior angle of areole; R_3+R_4 are very long stalked (*cf.* Fig 30.b.) and originate from posterior tip of areole; R_5 originates from below posterior tip of areole and its base is well separated from base of R_3+R_4; Sc more or less parallel to R_1.

Hindwing venation with 3A present, 1A+2A represents a fold, CuP present but weak; CuA_2 originating from two-thirds of posterior cell; CuA_1, M_3 and M_2 originating from apical angle of posterior cell, widely separated; M_1 and Rs originating from apical angle of anterior cell and are stalked; without a bar from Rs to $Sc+R_1$; vein in discocellular cell on forewing is weak and absent near apical angle of discocellular cell; on hindwing the vein in discocellular cell is present but weak.

Fringe scales long on forewing and hindwing.

Retinaculum and frenulum are absent.

Abdomen: With dense hair-like scales of cream mixed with scales of olive-ocher and with a light golden glint; abdominal tuft short and cream coloured. Female postabdominal structure and genitalia (Figs 24.b., 25.b.) with papillae anales broad in lateral view, dorsal part obliquely 8-shaped or elliptic in posterior view, covered with short and long setae, lobes of papillae anales are very small, probably always up to 60% shorter as dorsal width of segment 8 (viewed laterally). Between the papillae anales and segment 8 occurs a large thinly membranous structure. Segment 8 is narrow rectangular and not bent inwards dorsal anteriorly and narrower ventrally, thinly sclerotized; any sclerotized or membranous setae are absent on segment 8; a ring-like band posteriorly is absent; the posterior apophyses are longer than anterior apophyses, with a sclerotized base similar to a "T" in horizontal position that is very long ventrally and extends to the ventral edge of the papillae anales on each side (in lateral view) with both ventral ends of this T-like structure connected by a thinly membranous narrow band ventrally (viewed posteriorly and visible in fresh preparation); the anterior apophyses are narrow and slightly bent upwards with the base of one anterior apophysis larger than one lobe of papillae anales. The narrower distal part of the anterior apophysis is 50% longer than the sclerotized dorsal width of segment 8.

The ductus bursae is narrow and long, its length is as long as the length of the posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no sclerotized plate-like or bottleneck-shaped structure; corpus bursae is thinly membranous, without any structures, if not broken or not pressed below glas, much larger as segment 8 in lateral view.

Species richness. Currently, one new species is included in this genus which is described as new to science.

Distribution. Species of *Lichterfeldia* are at present endemic to the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110).

Based on one species they are known from a montane area called "Kuti" (altitude 1.885 m) located on the Ol Ari Nyiro Ranch (36°17' and 36°29'E, 0°29' and 0°42' N; Laikipia County) *ca.* 23 km to the East of Lake Baringo and *ca.* 40 km northeast of Lake Bogoria. Hence, the type locality is situated to the East of the central Kenya Rift in northwest-central Kenya and on the western Laikipia Plateau. Species of *Lichterfeldia* might occur in submontane and montane habitats of the Somalia-Masai phytochorion along the western escarpments of the Laikipia Plateau including areas of the Afromontane archipelago where the latter abuts the former.

Hence, species of *Lichterfeldia* have a distribution range on the African mainland that extends within the following phytochoria *sensu* White (1976, 1983):

- The "*Afromontane archipelago-like regional centre of endemism".*
- The *"Somalia-Masai regional centre of endemism".*

Habitats. The main vegetation types (*cf.* White 1983: 45 — 55) of the Ol Ari Nyiro Ranch (*cf.* Muasya *et al.* 1994: 149 — 154) comprise for an area of 360 km^2 (altitude range *ca.* 1.260 — 2.200 m) the following vegetation:

- Patches of *"Dry transitional montane forest" sensu* White (1983: 166) of the "*Afromontane archipelago-like regional centre of endemism*" occur in the southwestern part of the ranch and are dominated by *Juniperus procera* Hochst. (Cupressaceae), *Olea europaea* L. (Oleaceae), *Croton megalocarpus* Hutch., *C. macrostachyus* Hochst. (Euphorbiaceae) and *Trichocladus ellipticus* Eckl. & Zeyh. (Hamamelidaceae). Along the edges of these forest patches occur often woodlands that are dominated by *Acacia abyssinica* Benth. (Mimosoideae).

- *“Afromontane evergreen forest, scrub forest, and related types” sensu* White (1983: 122) of the *“Somalia-Masai regional centre of endemism”* occur on the bottom of the Mukutan Gorge (elevation *ca.* 1.260 m), *e.g.* dominated by *Phoenix reclinata* Jacq. (Arecaceae), *Bridelia micrantha* Baill. (Phyllanthaceae), *Trichocladus ellipticus* Eckl. & Zeyh. (Hamamelidaceae), *Acacia xanthophloea* Benth. (Mimosoideae), *Garcinia livingstonei* T. Anderson (Clusiaceae), *Ficus glumosa* Delile (Moraceae) and *Albizia grandibracteata* Taub. (Mimosoideae).
- *“Upland woodland” sensu* White (1983: 121) of the *“Somalia-Masai regional centre of endemism”* occurs on top of the western ridges as well as in the northern and eastern parts of the ranch. These woodlands are dominated by *Combretum molle* R.Br. (Combretaceae), *Acacia brevispica* Harms and on alluvial deposits occurs *A. gerrardi* Benth.; wet soils or places near permanent water are often dominated by *A. xanthophloea* Benth. (Mimosoideae).
- *“East African evergreen and semi-evergreen bushland and thicket” sensu* White (1983: 115) of the *“Somalia-Masai regional centre of endemism”, e.g.* with *Tarchonanthus camphoratus* L. (Asteraceae) that forms pure stands in the southern part of the ranch; *Euclea divinorum* Hiern, *E. racemosa* L. subsp. *schimperi* F. White (Ebenaceae) are dominant shrubs in the northern and eastern parts; *Carissa spinarum* L. (Apocynaceae) and *Croton dichogamus* Pax (Euphorbiaceae) occur as dominant shrubs on rocky Sites in the eastern parts of the ranch.
  This vegetation type forms an ecotone between the patches of *“Dry transitional montane forest”* and *“Upland woodland”* and hence, it has a transitional nature.

The vegetation types as described above are locally dominated by woody Leguminosae. They are located in a semi-arid climate. The average annual rainfall over a period of 41 years is 773 mm at the center of the ranch with decreasing rainfall from southwest (900 mm) to northeast (700 mm). The highest rainfall occurs between April and May as well as July and August (Muasya *et al.* 1994).

Biological traits. The biology of species of *Lichterfeldia* is unknown.

Etymology. The genus is named after Lichterfeld located *ca.* 5 km southeast of Finsterwalde (Niederlausitz, Germany). The village was first mentioned as “Lichtinfeld” in the year 1474 and as “Lichterfeld” in 1505. The meaning of “Lichterfeld” suggests a village or settlement in open country that is located at a “field” (= “Feld”) in sunlight (= “Licht)”, *cf.* Fischer (2005: 104). The field was possibly used for agriculture. The forests around Lichterfeld comprised two of the first collecting Sites for butterflies and moths of I.L. until August 1982 and have the same dominant tree species and open structure as described in context with the etymology of Finsterwalde.

***Lichterfeldia olarinyiroensis* sp. nov.**

Figs 12.c., 24.b., 25.b., 30.b.

Type locality and repository: Kenya, National Museums of Kenya, Nairobi (NMK)

Material examined. Holotype, female: "Kenya, Rift Valley — Ol Ari Nyiro Ranch, Kuti [Laikipia County], 0°34'41.7"N 36°24'18.3"E [correct data for Kuti is 0°38'23.00"N 36°25'40.00"E], 1910 m [correct altitude is 1.885 m]. Black/MV lights. 24 to 25-IX-2002. K. Maes & P. Ochieng [leg.]." On second label: genitalia slide no. C14/072028 I.L. [Ingo Lehmann].

Description. *Head*: Rough-scaled; long hair-like scales of cream-buff mixed with scales of olive-ocher with a light golden glint on fronto-clypeus; a pair of pits on lower fronto-clypeus is present but rudimentary; a pair of small conical projections absent on lower fronto-clypeus; pits behind labial palpi are small oval; a horizontal dorsal ridge on lower fronto-clypeus is absent; labial palpi medium long, slightly longer than half of eye-diameter, consisting of three segments with rectangular 1st (basal) segment and oval 2nd segment, both segments of equal length, segment on top elongated egg-shaped and 30% length of central segment. Antennae unipectinated, very long with 50% of forewing length, with relicts of branches on up to one-third of antenna and up to *ca.* 1.0× width of shaft on upper one-third of flagellum, branches laterally scaled cream, widely separated at base; branches tube-like (viewed laterally); dorsal and lateral sides of flagellum scaled cream.

Thorax: Patagia and tegulae with pronounced light golden glint and hair-like scales as well as short medium broad scales of olive-ocher and cream; the olive-ocher scales on patagia are largely worn (missing), possibly forming no collar ring. Metathorax has a slightly longer scale-crest comprising cream hair-like scales. Forelegs and midlegs have long dense hair-like structures of olive-ocher. Epiphyses present but rudimentary, needle-like, 0.3 mm long. Hindlegs with a glint on long hair-like structures of cream as well as olive-ocher, with two pairs of tibial spurs, upper pair narrow, 0.9 mm/ 1.0 mm long, lower pair slightly broader, 0.7 mm/ 0.9 mm long; all spurs with thorn-like tip. Forewing length 11.0 mm and wingspan is 23.5 mm. Forewing is medium broad and elongated with a rounded apex. Forewing upperside is worn, largely olive-ocher with a strong light golden glint; scale pattern is worn or absent; lunules are worn or absent; costal margin is cream-buff. Any scales that are longer and hence, extend above the normal scale layer are absent.

Hindwing worn, olive-ocher with ecru-olive scales and a light golden glint. Underside of forewing as well as hindwing is olive-ocher with a light golden glint. Cilia of forewing and hindwing are long, 0.8 — 1.0 mm, cream with a light golden glint.

Abdomen: Mainly olive-ocher and cream-buff with a light golden glint; abdominal tuft with scales of cream-buff, tuft short with 20% length of abdomen. Female postabdominal structure and genitalia (Figs 24.b., 25.b.) with papillae anales broad and as large as 70% of segment 8 in lateral view, dorsal part obliquely

8-shaped or elliptic in posterior view, covered with short and long setae, lobes of papillae anales are very small, up to 60% shorter as dorsal width of segment 8 (viewed laterally) and as large as 15% of the papillae anales. Between the papillae anales and segment 8 occurs a large thinly membranous structure that is as large as 90% of segment 8 in lateral view. Segment 8 is narrow rectangular, not bent inwards dorsal anteriorly, narrow ventrally and thinly sclerotized ventrally (Fig 24.b., b.1.); any sclerotized or membranous setae are absent on segment 8; a ring-like band posteriorly is absent; the posterior apophyses are long, 30% longer as anterior apophyses, with a sclerotized base similar to a "T" in horizontal position that is very long ventrally and extends to the ventral edge of the papillae anales on each side (in lateral view) with both ventral ends of this T-like structure connected by a thinly membranous narrow band ventrally (viewed posteriorly and visible in fresh preparations); the anterior apophyses are narrow and slightly bent upwards with the base of one anterior apophysis larger than one lobe of papillae anales with 1.5× the size of one lobe. The distal narrower part of the anterior apophysis is 50% longer than the sclerotized dorsal width of segment 8. The ductus bursae is narrow, long with 1.2 mm in length, its length is as long as the length of the posterior apophysis, thinly membranous, without any structures; below the base of the ductus bursae occurs no sclerotized plate-like or bottleneck-shaped structure; corpus bursae is thinly membranous, without any structures, broadly oval and is, if not broken or not pressed below glas, 2.5× as large as segment 8 in lateral view (Fig 25.b., b.3.).

Male. Unknown.

Diagnosis. The female of *Lichterfeldia olarinyiroensis* **sp. nov.** can be separated from all other species of Metarbelidae by its autapomorphy in combination with other character states mentioned above. If compared to the females of *Kayamuhakaia* a ring-like band occurs posteriorly on or adjacent to segment 8 (*cf.* Fig 14.a., a.1.). In contrast, this band-like structure is absent in the female of *Lichterfeldia.* Additionally, the forewing is only medium broad, elongated and has a strongly rounded apex in *L. olarinyiroensis* **sp. nov.** In females of *Kayamuhakaia* the forewing is always broad and has a pointed apex.

Distribution. *Lichterfeldia olarinyiroensis* **sp. nov.** is only known from Ol Ari Nyiro (Kenya) that belongs to one of Kenya's *KBAs* (UNDP 2021: 24).

Note: There was no species of this new genus recorded in more than 30 light-trappings that were undertaken in various vegetation types on the eastern Laikipia Plateau during 2016 — 2018, *e.g.* on the Mpala Research Center by I.L. as well as on the Lolldaiga Hills Ranch and Wildlife Conservancy by I.L. together with Mike Roberts, Julius Mathiu, Tom Butynski and Robert Wells. This might suggest that *L.olarinyiroensis* **sp. nov.** has a very local distribution range on the western Laikipia Plateau and on the Ol Ari Nyiro Ranch, respectively. Based on its present habitat data and diagnosis, *L. olarinyiroensis* **sp. nov.** is classified as endemic species of the *"Somalia-Masai regional centre of endemism"* as well as endemic species of the *KBA* "Ol Ari Nyiro" (UNDP 2021: 24).

Habitat. The place “Kuti” (the name derives from “kutiti” that means “small” in the Masai language, *cf.* Hollis 1905) refers to Kuki Gallmann’s house (Mike Roberts pers. comm. to I.L. in 2024). The vegetation type that surrounds “Kuti” comprises *“East African evergreen and semi-evergreen bushland and thicket” sensu* White (1983: 115) dominated by shrubs of *Euclea divinorum* Hiern, *E. racemosa* L. subsp. *schimperi* F. White (Ebenaceae) and *Carissa spinarum* L. (Apocynaceae). Adjacent to this vegetation type occurs in the West *“Upland woodland” sensu* White (1983: 121). These woodlands are dominated by *Acacia brevispica* Harms and on alluvial deposits with *A. gerrardi* Benth. (Mimosoideae) mixed with shrubs of *Croton dichogamus* Pax (Euphorbiaceae), in particular on rocky Sites (*cf.* Muasya *et al.* 1994).

Biological traits. The biology of *L. olarinyiroensis* is unknown.

Etymology. The species is named after Ol Ari Nyiro (Ranch, Laikipia County, Kenya). The name “Ol Ari Nyiro” derives from the Masai language and means “the one river” (“Ol” = “the”; “Ari” or “Are” = number “1”; “ngiro” or “nyiro” = “river”, *cf.* Hollis 1905). “The one river” might be the Mukutan River which flows, *e.g.* through the Mukutan Gorge from east to west.

Another translation for “Ol Ari Nyiro” is “the place of springs” (Mike Roberts pers. comm. to I.L. in 2024) which is incorrect in regard to the Masai language but might refer to another tribe and its language.

DISCUSSION

Species of this monophylum do not represent basal taxa of Metarbelidae as defined by Lehmann (2019b: 24, 25, 30), *e.g.* a fully developed CuP vein in forewing is absent and the whole genitalia is not thinly membranous.

Co-radiation of Metarbelidae and Caesalpinioideae in the lowland rain forest of the Afro-Arabian continent: the example *Kayamuhakaia*

The archetype of the African tropical lowland rain forest evolved 65 Ma (White 2001: Fig 1.1). A possible co-radiation of a diverse Metarbelidae fauna and a diverse woody Leguminosae flora in the tropical lowland rain forest of the Afro-Arabian continent *ca.* 65.5 — 55.8 Ma or 59.9 — 40 Ma (for woody Leguminosae, *e.g.* Jacobs 2004: 1580) was shown and discussed by Lehmann (2019b: *e.g.* 59, 76, 259, 263, 342 — 345). Lowland and submontane species of *Kayamuhakaia* represent a good example that supports this view of a co-radiation as they are closely linked to forests and woodlands that are dominated by Caesalpinioideae (*cf.* Table 1, 2 + 4) and most probably originated first in the lowland rain forest as stated above in context with two "potential parsimony-informative characters". Hence, those lowland and submontane species of *Kayamuhakaia* that are linked to the Caesalpinioideae cannot be older than the latter.

Caesalpinioideae are near to the basal Leguminosae and represent one of the largest and oldest groups of tropical tree species among the Angiosperms as their earliest fossil records 70 — 65 Ma indicate (*e.g.* Leal 2004: 1). The Caesalpinioideae comprise at least 1900 species in 152 genera worldwide with the highest diversity and endemism in the African lowland rain forests at present, *e.g.* in *"Lower Guinea" sensu* White (1978: 258) occur 191 species including 124 species that are endemic to this region with highest numbers in the hilliest region, namely in Gabon. In *"Congolia" sensu* White (1978: 258) where species of *Kayamuhakaia* are present, occur 74 species of Caesalpinioideae with 26 endemics (Leal 2004: XIII). As the results from long-term fieldwork by I.L. on the dominance of Caesalpinioideae and Metarbelidae in southeast coastal Kenya (*e.g.* Lehmann & Kioko 2005: 135, 147, 157; Lehmann 2008: 69, 70; Lehmann unpublished data 2005 — 2007) as well as from detailed morphological studies on more than 1000 species in more than 130 genera of Metarbelidae (Lehmann in prep.) indicate, occur high diversities of the latter in tropical Africa and are closely associated with legume-dominated forests and woodlands (Lehmann 2019b: 342, 343) — including in particular the dominance of Caesalpinioideae. If Caesalpinioideae are dominant, *e.g.* in wetter forests of *"Lower Guinea" sensu* White (1978: 258) as well as in wetter types of miombo and coastal forests (*cf.* Table 1 + 2), the highest diversities of genera and species of Metarbelidae have been found. This suggests that their larvae feed on the bark and/or in the wood of Caesalpinioideae.

A non-existent dispersal pattern on the species level between land-units, *e.g.* such as forests isolated by short distances of a few kilometres, was found in 27 studied Caesalpinioideae species with a ballistic seed dispersal in Lopé and Mitendi (central Gabon) by Leal (2004: 51, 56). Such a very low dispersal capacity is supported by the result that no evidence for occasional long-distance seed dispersal events was found, *e.g.* on a distance of *ca.* 100 km from the Chaillu Massif to Mitendi and Lopé.

A non-existent dispersal pattern on the species level of Metarbelidae between isolated forests and woodlands — within a distance of 6 — 20 km — has been first found and was discussed by Lehmann (2008: 69, 70; Lehmann 2019b: 342, 343; Lehmann *et al.* 2023: 84). The short as well as long distance dispersal by wind was excluded by Lehmann (2019b: 328). Meanwhile, it has been found that in 99% of more than 1000 studied species a non-existent dispersal pattern on the species level appears to be a fact supported by long-term fieldwork in central and coastal Kenya (*e.g.* Lehmann 2008: 70; Lehmann *et al.* 2018; Lehmann 2019b: 325). The results of the fieldwork by Leal (2004) in regard to a non-existent dispersal pattern of dominant coastal forest Caesalpinioideae species is supported with the results presented in Table 1 for all Sites comprising distances of 6 — 20 km to Kaya Muhaka.

Additionally, ten species that are included in the total number of 12 presented in Table 1 — including one species of *Kayamuhakaia* — were always found at the same Site in the studied forest, *e.g.* in Kaya Muhaka. A species is usually only represented by males. A record of both sexes of the same species at the same time and at the same Site is very rare. This experience was confirmed in results of fieldwork of I.L. undertaken in central Kenya and suggests that the majority of lowland, submontane and montane species are very philopatric and that females appear to be less active flyers if compared to their males. Almost certainly, this very high degree of philopatry in Metarbelidae is supported, *e.g.* in the lowland rain forest by a non-existent dispersal pattern in many Caesalpinioideae resulting in the latter as well as in the former in high levels of endemism at genus and species level.

The experience of I.L. is further supported by data based on long-term fieldwork undertaken throughout Malawi and including a large number of specimens of Metarbelidae presented by Raymond James Murphy (R.J.M., Nkhorongo) from his “168 well known areas” in regard to Lepidoptera including Metarbelidae if present (R.J.M. pers. comm. to I.L. in 2011). With very view exceptions a non-existent dispersal pattern on the species level is a fact and confirms the very high degree of philopatry in Metarbelidae of Malawi.

The combination of a non-existent dispersal pattern in lowland rain forest Caesalpinioideae as well as in all species of *Kayamuhakaia*, support the possibility of a co-radiation of lowland species of both in the tropical lowland rain forest and adjacent submontane areas on the Afro-Arabian continent.

Table 1

Total diversity, Single-site Zanzibar-Inhambane (Z-I) endemic species of Metarbelidae and number of species of Caesalpinioideae in “seven well known areas” of coastal Kenya, including two microrefugia marked with an asterisk (*****) in bold.

The number of lowland species of *Kayamuhakaia* in forests dominated by trees of rain forest Caesalpinioideae is compared with areas with total absence of dominance of Caesalpinioideae.

Data is based on extensive fieldwork by I.L., E.K. & CFCU in the forests and environment of Muhaka, Gogoni, Diani, Ukunda, Kinondo and Shimoni in 1994 — 2007 (*e.g.* Lehmann & Kioko 1994, 2005; Lehmann unpublished data of 2005 — 2007) and including morphological study results of I.L. on Metarbelidae until June 2024 (Lehmann 2019b; Lehmann in prep.).

The distance of all localities to Kaya Muhaka is 6 — 20 km. The distance to the Indian Ocean is *ca.* 100 m (nearest forest edge marked with two asterisks (**)) — 5.5 km.

A low species : genus ratio is shown in Metarbelidae and occurs also in rain forest Caesalpinioideae comprising six genera with six dominant species in Gogoni Forest and five genera with five dominant species in Kaya Muhaka. No genus of Caesalpinioideae represents an Z-I endemic genus. For Z-I endemic Metarbelidae genera *cf.* Table 2.

Four “Key Biodiversity Areas” of Kenya are shown in bold.

Forest or locality	**Number of Genera in Metarbelidae**	**Number of Species with *Single-site Z-I endemics* in Metarbelidae**	**Species of *Kayamuhakaia***	**Number of Species of Caesalpinioideae in Sample Area**	**Number of dominant Species of rain forest Caesalpinioideae in Sample Area**
Gogoni Forest (*)	07	10 / ***02***	01	11	06 **(*)**
Kaya Muhaka (*)	06	09 / ***01***	01	08	05 **(*)**
Kaya Diani	01	01 / *0*	0	01	0
Diani (village)	0	0	0	03	0
Ukunda (village)	0	0	0	02	0
Kaya Kinondo (**)	01	01 / *0*	0	0	0
Shimoni Forest (**)	01	02 / *0*	0	0	0
TOTAL	**09**	**12 /** ***03***	**01**	**14**	**06**

Mangrove forests located near to coastal forests

The case of nearby mangrove forests as part of an azonal and ecological transition zone (Sheppard 2000: 24) to coastal forests, meaning that the former are not included in the latter (Clarke 2000: 22), *e.g.* Gogoni Forest and the Gasi mangrove forest are separated by only 2 km — indicates the following pattern: The result of fieldwork undertaken in the Gasi mangrove forest in context with a single species of Metarbelidae is not presented in Table 1 since neither this mangrove Metarbelidae species nor its undescribed genus does occur in the Gogoni Forest Sample Area of I.L. & E.K. and has also never been found by I.L. in the remaining "six well known areas". Instead, at least one species (possibly are several species of the same genus involved) has been found in various mangrove forests along the Kenya coast and this result was first presented by Jenoh *et al.* (2016) and Jenoh (2022).

Additional data from coastal forests occurring near to mangrove forests in Kenya comprise also no record of any coastal forest species that belongs to this undescribed genus. This interesting species-group — linked to mangrove forests that are never dominated by Caesalpinioideae — will be presented in a comprehensive revision by Lehmann, Jenoh, Kioko & Koedam (in review 2025).

Divergence by vicariance

The common pattern for Metarbelidae is divergence by vicariance first presented by Lehmann (2019b: 52 — 314) comprising a Sample size of 60 genera.

Hence, it is very likely that this pattern is also present in the monophylum described and constructed mentally herein by apomorphies and synapomorphies. Divergence events for this monophylum are almost certainly linked to multiple expansions and regressions of the lowland tropical rain forest on the Afro-Arabian continent as well as to geological activities and volcanism — including montane regions — that generated sufficient isolations of forests and woodlands for "the speciation". After an irreversible divergence event ("the speciation") both descendant populations each are by definition of the "phylogenetic species concept" members of a new species (Wägele 2005: 55, 56, 59 — 61).

Divergence events in *"Congolia"* and East Africa

The first major break-up of the Eocene pan-African rain forest is dated to the Oligocene 32.9 Ma and corresponds to a period of drastic global cooling from the development of permanent continental ice-sheets in Antarctica. At this time the central African rain forest as well as legume-dominated woodlands were already similar to the present rain forest and miombo, *e.g.* regarding the tree species composition and woodland structure (White 2001: Fig 1.1; Jacobs 2004: 1577) including many genera of Caesalpinioideae that evolved 65 — 23 Ma (Maley 2001: 74). Almost certainly, species of *Kayamuhakaia* were also present in this rain forest.

Nevertheless, the following two facts support the assumption of I.L. that their distribution range towards *"Lower Guinea"* and *"Upper Guinea" sensu* White (1978: 258) was most probably limited much earlier, and if correct, there were no divergence events in these two phytochorical regions regarding this monophylum:

First, the Cretaceous Congo River (Burke & Gunnell 2008: 8) with its large floodplain, swamp forests (present forest area is 124 000 km^2) as well as numerous tributaries represent until present an important biogeographic boundary (Blom & Schipper 2004: 240, 241). This boundary was present since the Cretaceous when a large palaeo-Congo River system existed that continued flowing northwestwards into the Central African Shear Zone (Roberts *et al.* 2014: 292). Alternatively, all river flow across central Africa funneled into, not out of, the Congo Basin (Roberts *et al.* 2014: 292) supported by the assumption that once a large "Palaeo-lake Congo" covered the whole cuvette centrale. This hypothesis is refuted by other scientists, *e.g.* Schwarzer *et al.* (2011) who stated that major parts of the drainage system in the central African rain forest discharged into the Atlantic Ocean through the Ogooué Valley (Gabon) and the Cuanza system (Angola) during 65 — 36 Ma; the lower Congo rapids (*ca.* 350 km in length) originated mainly *ca.* 5 Ma (Schwarzer *et al.* 2011). Almost certainly these large river systems represented effective barriers limiting the distribution of lowland species of *Kayamuhakaia* (*cf.* Table 2 + 3) towards *"Upper Guinea"* and *"Lower Guinea" sensu* White (1978: 258).

Second, the *"Sangha River Interval" sensu* White (1978: 261) and as figured by Rietkerk *et al.* (1996: 619) is *ca.* 450 km across to the West of Bokatola, *ca.* 750 km across at its northern and southern end with *ca.* 1.450 km in length between both ends from the North to the South. Possibly, it was largely a grassland corridor during drier climatic phases (White 2001: 12). This assumption is supported by the facts that neither Maley (1991: Fig 6) nor Leal (2004: Fig 1.5.) presented any macrorefugia for this interval where Caesalpinioideae are largely absent or only few species occur with a very limited and scattered distribution, *e.g. Scorodophloeus zenkeri* Harms (*cf.* Rietkerk *et al.* 1996: Fig 2c.). No endemic Metarbelidae genus was found for this interval (Lehmann in prep.). No endemic tree species of *"Lower Guinea"* and *"Congolia"* occur in this interval but widespread species (White 1978: 261). In addition to the large river systems mentioned above the interval represents an effective barrier that might help to explain the absence of species of *Kayamuhakaia* from *"Lower Guinea"* and *"Upper Guinea" sensu* White (1978: 258).

Omitting the fragmentations of the rain forests in the latter two phytochorical regions in this discussion — as no species of this monophylum has been found there — the global cooling induced a drier climate, *e.g.* at equatorial levels. The result was a fragmentation between the central African lowland rain forest and the rain forest in East Africa. In the isolated lowland rain forest block of East Africa evolved endemic rain forest lineages with a mean age of 32.9 Ma (42.9 — 23.6 Ma), *e.g.* within the African clade of Annonaceae the "*Sanrafaelia/Ophrypetalum* clade" *sensu* Couvreur *et al.* (2008: Fig 2). This result confirms earlier assumptions, *e.g.* by Wasser & Lovett (1993: 3) that tropical lowland rain forest was present in Eastern Africa *ca.*30 Ma. The fragmentation of the lowland rain forest induced certainly speciations among lowland species of *Kayamuhakaia.*

The second major split occurred after the lowland rain forest has extended again during the "Miocene climatic optimum" (17 — 15 Ma) characterized by high global temperatures and moister conditions. Possibly during the "Miocene climatic optimum", large continuous lowland rain forest and miombo woodlands dominated by Caesalpinioideae occurred from the coast of East Africa towards the Congo Basin as well as towards Mkuwadzi Hill and Mount Mulanje including coastal Mozambique. As the grass abundance across Africa increased by 16 Ma (Jacobs 2004: 1579), *e.g.* in the Niger Delta in*"Lower Guinea" sensu* White (1978: 258) to 10% in core documents (Jacobs 2004: 1578) and hence, significantly, it is likely that the *"Sangha River Interval" sensu* White (1978: 261) was fully covered by a wooded grassland by then. Large savanna-like areas in East Africa evolved and are comparable to the modern Serengeti, *e.g.* known from western Kenya by 14 Ma (Jacobs 2004: 1578). Above all in the Lowlands, savanna-like vegetation evolved during a much drier climate with high temperatures and regular fires. The latter were certainly blocking the distribution of forest species of Metarbelidae into wooded savannas resulting in their low diversity with Metarbelidae. For example, low diversities of Metarbelidae are known from the Serengeti (Lehmann in prep.) as well as from the Athi River-Kapiti Plains (Lehmann *et al.* 2023: Fig. 21.d. + 100). As some of the montane areas in East Africa were present by then, *e.g.* Mount Elgon, certainly montane species of *Kayamuhakaia* descended in altitude together with montane plant communities (*cf.* White 2001: 14) into the remaining forests on lower elevations, *e.g.* into forests along river banks — known already from near Lake Victoria and western Kenya by 17.8 Ma (Jacobs 2004: 1578). Along the coast of present Kenya and Tanzania as well as in the Eastern Arc Mountains endemic coastal Kenyan/Tanzanian forest lineages evolved, *e.g.* "node 'b' with *Asteranthe asterias*" Engl. & Diels (Annonaceae/ *cf.* Lehmann & Kioko 2005: Table 5 + 147, 149 with records from wetter as well as drier coastal Kaya forests) with an age of 23.4 — 10.5 Ma and a mean age for the Z-I endemic genus *Asteranthe* Engl. & Diels of 16.8 Ma (Couvreur *et al.* 2008: Fig 2). Included is at present only a second species in this genus, namely *A. lutea* Vollesen known from coastal Tanzania and in particular from habitats of riverine forests, suggesting that it might belong to a Dry Maritime-Riverine species complex.

In summary, the following four conclusions can be drawn for the monophylum presented herein at this point:

- First, the speciation during the Oligocene and Lower Miocene (37 — 10.5 Ma) almost certainly generated in regard to the lowland as well as montane ancestral species the distribution pattern that is still visible in the present species for East Africa (*cf.* Tables 1 — 3, 5 — 7; Fig 1.a. + 1.b.).
- Second, the distribution of the group of ancestors of *K. bokatolaensis* **sp. nov.** in*"Congolia" sensu* White (1978: 258) might be as old as 65 Ma making this lowland species to one of the oldest descendants in the Sample herein.
- Third, the total of three Zanzibar-Inhambane (Z-I) endemic genera (Lehmann in prep.; data is based on study results until June 2024) as well as the total of six genera of Metarbelidae with a strong affinity to the Z-I region (Z-I-A-G, Lehmann in prep. and including *Kayamuhakaia*) and all Z-I endemic species

presented here for the Z-I Lowlands cannot be older than 32.9 Ma (*cf.* Table 1, 2 + 3).

- Fourth, due to its relatively large distribution range in scattered isolated Kenyan coastal forests, the type species *K. haberlandorum* is among the potential oldest descendants of lowland Z-I endemic ancestors of *Kayamuhakaia* in Kenya; and *K. hilarysommerlatteae* is among the potential oldest descendants of lowland and submontane Z-I endemic ancestors of *Kayamuhakaia* in Malawi.

Table 2

Number of Z-I endemic genera (in bold), number of genera with a strong affinity to the Z-I region (Z-I-A-G), Z-I endemic species and two *"linking species"* (Z-I and Z-R; G-C and A-M) of Metarbelidae are presented for "14 well known areas" with records in or adjacent to vegetation types dominated by Caesalpinioideae with a Guineo-Congolian affinity.

Kenyan and Tanzanian coastal forests comprise: Arabuko-Sokoke, Rabai Kayas, Shimba Hills, Kaya Muhaka, Gogoni Forest, Tiwi (forest patch 700 m southwest from Tiwi village?), Buda Forest; Mogo Forest (destroyed) and Kimboza Forest.

Z-I exclaves in Malawi are small exclaves of a former or still present *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) with at least one Z-I endemic genus comprising Mkuwadzi Hill. The *"Swahilian/Maputaland regional transition zone" sensu* Clarke (1998: 61, 62) comprises the Ruo River Gorge on Mount Mulanje.

"Congolia" includes Bokatola.

The *"Malawi Interval" sensu* Chapman & White (1970: 76) is <u>not</u> shown by lowland species, *e.g.* species of Z-I endemic genera and lowland species of Z-I-A-G including Z-I endemics of *Kayamuhakaia*.

The postulated lowland forest refugia are presented in context with the total number of Z-I endemic genera in Metarbelidae and species of *Kayamuhakaia*.

Microrefugia comprising one Z-I-A-G with a sister-genus on Madagascar are marked with an asterisk (*****) in bold (based on Lehmann & Dalsgaard 2023: 138, 142).

"Linking species" are marked with two asterisks (******) in bold.

Single-site endemics are underlined.

Vegetation types: **(01)***"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126); **(02)***"Cynometra forest" sensu* Githitho (2021: Fig 1); **(03)***"Paramacrolobium coeruleum* community*" sensu* Schmidt (1991: 73); **(04)** wetter *"Zambezian transition woodland" sensu* White (1983: 91) <u>or</u> **(04a)** wetter *"Zanzibar-Inhambane transition woodland" sensu* White (1983: 188) dominated by old *Brachystegia* trees and other Caesalpinioideae considered herein as relicts **(04b)** of a former *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186); **(05)** *"Zanzibar-Inhambane lowland rain forest"* with **(05a)** Sites in a submontane area; **(06)** *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) with wet evergreen levee forests on alluvial islands in rivers.

Data is based on studies by I.L. until June 2024 (Lehmann in prep.).

"Key Biodiversity Areas" of Kenya are shown in bold.

Table 2

Forest or Locality	**Main Vegetation Types**	**Number of Z-I endemic Genera/ Z-I-A-G + Z-I endemic Species**	**Species of *Kayamuhakaia* with Z-I Single-site endemics**	**Postu-lated (Micro-) Refuge**	**Reference (example)**
Arabuko-Sokoke Forest	(01), (02), (04a)	**02** / 02 / 09	***haberlandorum*, *ngwenoae*, *kasikamwiuae***	**Yes**	Grubb (2001: 93, 95) + defined herein
Rabai Kayas Kaya Mbwadu or Mkwadu?	(01)	**0?** / 01 / 01	*haberlandorum?*	**Yes**	Grubb (2001: 93, 95) + defined herein
Shimba Hills(*)	(03), (01)	**01** / 03 / 04	***haberlandorum***	**Yes**	Grubb (2001: 93, 95) + defined Herein
Kaya Muhaka	(01)	**02** / 03 / 07	***haberlandorum***	**Yes**	Grubb (2001: 93, 95) + defined herein
Gogoni Forest	(01), (04a)	**02** / 03 / 10	***haberlandorum***	**Yes**	Grubb (2001: 93, 95) + defined herein
Tiwi (collecting Site?)	(01)	0 / 02 / 02	***haberlandorum***	Yes?	defined herein
Buda Forest(*)	(01), (04a)	**0?** / 03 / 03	*haberlandorum?*	**Yes**	Grubb (2001: 93, 95) + defined herein
Dar Salam Mogo Forest	(01), (04a)	0 / 01 / 01	***triangularis***	destroyed	*cf.* habitat description
Kimboza Forest	(05)	**0?** / 02 / 02	***kimbozensis***	**Yes**	Grubb (2001: 93, 95) + defined herein
Mkuwadzi Hill	(04), (04b)	**01** / 02 / 04	***mkuwadziensis*** ** Z-I and Z-R	**Yes**	defined herein
Ruo River Gorge	(05), (05a)	**01** / 03 / 05	***hilarysommerlatteae***	**Yes**	defined herein
Bokatola	(06)	0 / 01 / 0	***bokatolaensis*** ** G-C and A-M	**Yes**	Maley (2001: 72)
TOTAL	**10**	**03/ 06 /26** or 28	**08** or 10?	**11**	

Further isolations of lowland forests occurred after 12.6 Ma, *e.g.* in the Tugen Hills of the Baringo Basin (western Kenya) where by 9.5 Ma grasses increased substancially in plant communities. In East Africa, a mosaic from forests to open woodlands and savannas was largely present between 12.6 Ma and 6.8 Ma (Jacobs 2011: 1579, 1580) including the coastal areas. "The well-calibrated lengthy stratigraphic sequence in the Tugen Hills … suggest a lowland rainforest habitat for the majority of sites…" during 7.2 Ma — 6.5 Ma (Leakey & Harris 2003: 639). This coincides with the third major split of the lowland rain forest in East Africa during the Upper Miocene 8.4 — 5.4 Ma (also Maley 2001: 68). During this split new Kenyan/Tanzanian coastal forest endemic lineages could evolve, *e.g.* "node 'c' with *Uvariodendron kirkii*" Verdc./ Annonaceae (*cf.* Lehmann & Kioko 2005: 147, 148, 149 with records from wetter as well as drier coastal Kaya forests) and with a mean age of 8.4 Ma (Couvreur *et al.* 2008: Fig 2).

The extensions of savanna vegetation mentioned above are important since they were associated with further reductions of the lowland rain forest in East Africa. A significant further change occurred 2.5 Ma and coincides with the first large Arctic glacial advance with a peak in the distribution of grasses (*e.g.* Maley 2001: 68; White 2001: Fig 1.1). Most divergence events in East Africa occurred in Annonaceae and other woody representatives of the East African rain forest flora as well as in clawed frogs earlier than 2.5 Ma (*e.g.* Couvreur *et al.* 2008: Discussion). Hence, it is likely that the origin of the seven East African *Kayamuhakaia* species from Somalian, Kenyan and Tanzanian coastal lowland Z-I forest/scrub forest types (*cf.* Table 2 + 3) are also of pre-Pleistocene origin. This implies the hypothesis of an almost complete lack of divergence events in *Kayamuhakaia* in the Lowlands and in consequence also in *Finsterwaldeia* during further arid phases of the last 2.5 million years. This could be an explanation for the occurrence of *K. haberlandorum* in several coastal forest refuges on the North Coast as well as South Coast and for the morphological similarities shared between *K.kasikamwiuae* **sp. nov.** and *K. mkuwadziensis* **sp. nov.**, occurring both in disjunct refuges.

The possibility that few additional lowland species in refugia evolved during and between the arid phases can not be excluded, *e.g. K. ngwenoae* **sp. nov.** in Arabuko-Sokoke Forest, during the past 800,000 to 12,500 yr B.P. — a period when a greater prevalence of climatic cycles existed that were associated with phases of high aridity. One fact that supports both hypotheses — the almost complete lack of divergence after 2.5 Ma as well as few speciation events in lowland refuges locally between 800,000 and 12,500 yr B.P. — is the remarkable low diversity but high rate of endemism of lowland species in comparison to the much higher diversity of montane species of *Kayamuhakaia* in East Africa clearly dominated by female records in montane regions and suggesting that females are more active flyers in the latter regions — a rare pattern among more than 130 genera.

Certainly, the more numerous montane species of *Kayamuhakaia* represent not only more recent speciations but also more speciations in contrast to the lowland species. The four youngest species with divergence events that cannot be older than their habitats comprise: First, two species on Mount Kilimanjaro (2.5 Ma); second, one species on Mount Meru (2.0 Ma); third, one species occurring in the forests adjacent to Lake Nkuruba ?and in Kibale Forest, representing two submontane and lower montane forest Sites that cannot be older than 18,000 years in regard to the *"Rwenzori-Montane Environment" sensu* Hamilton *et al.* (2001: 60 + Table 4.3.; *cf.* also habitat descriptions herein). The latter authors stated that there is "… no major refugium for lowland or moist lower montane forest in Uganda …" The four youngest species of *Kayamuhakaia* from the three habitats mentioned above represent interestingly also *"linking species"* to the Z-I region (*cf.* Table 5) suggesting that divergence events during the last 2.5 million years occurred in species of *Kayamuhakaia.*

Five characteristic patterns for Metarbelidae—Caesalpinioideae in microrefugia of the Z-I region and for one Z-I exclave in the Zambezian region

The remarkable high biodiversity in flora and fauna of the postulated microrefugia Arabuko-Sokoke Forest, Rabai Kayas, Shimba Hills, Kaya Muhaka, Buda Forest and Gogoni Forest among the Kenyan coastal forests and the Tanzanian Kimboza Forest (*cf.* Table 1 + 2 + habitat descriptions), that are richer in species as well as richer in endemic taxa, suggests that repeated isolations caused by arid phases as well as the repeated survival of always the same forest Sites in the same location during arid phases resulted in speciations of a great number of taxa with endemic taxa belonging to a high number of genera. Maley (2001: 73, 74) concluded from many publications that dealt with these issues under the effect of arid phases "… that speciation in environments isolated ecologically (niches) and speciation in geographically isolated environments (vicariance) … seem to complement each other." The repeated survival of microrefugia in coastal East Africa as well as in the Eastern Arc Mountains is due to a stable climate and rainfall during the last 2.3 million years under the influence of the Indian Ocean (*cf.* Lovett 1993: 27) with data showing indeed a benign environmental change and stable altitudinal forest distribution and species composition, *e.g.* since 38,000 yr B.P. (Marchant *et al.* 2007: 6, 12 + Fig 5).

The total of three Z-I endemic genera (Lehmann in prep.) indicate speciations of new species-groups in the Z-I region — *cf.* Table 2 — representing 2.3% of the total number of Metarbelidae genera studied by I.L. until June 2024. It becomes clear that microrefugia of the Z-I region have always one Z-I endemic Metarbelidae genus supported by several dominant Caesalpinioideae rain forest or wetter woodland species as well as comprising at least one Single-site Z-I endemic species (*cf.* Table 1 + 2; Lehmann in prep.). The Single-site Z-I endemics almost certainly include species that evolved in the refuges (*cf.* Table 1 + 2) but Z-I endemics occurring in various refuges are almost certainly of pre-Pleistocene age, *e.g. K. haberlandorum.* Single-site endemics might include also younger species, *e.g. K. ngwenoae* **sp. nov.**

Conclusions:

- The first and second characteristic pattern for microrefugia located in the Z-I region in regard to Metarbelidae are:

Microrefugia are generic and microrefugia are specific.

This result, that postulated refuge areas are not only specific but also generic, coincides with findings by Robbrecht (1996: 577) on the geography of African Rubiaceae. The latter include on the species level 17% of the endemic tree species; in the Caesalpinioideae 8.2% and in the Annonaceae 8.2% (*cf.* the text above) for the Zanzibar-Inhambane/Swahilian region *sensu lato* (Clarke *et al.* 2000: 136) and hence, their species are good indicators for microrefugia in the Coastal Forest belt of Eastern Africa.

At genus level there is only one endemic genus among Caesalpinioideae but eight endemic genera in Annonaceae and six endemic genera in Rubiaceae occurring in the Coastal Forest belt of Eastern Africa (Clarke *et al.* 2000: Table 4.1.1) suggesting fewer speciations among Caesalpinioideae in the Z-I region. This supports the fact that all coastal forests of Eastern Africa are relict forests of wetter or drier types with dominant Guineo-Congolian genera of rain forest Caesalpinioideae that date back to the period of the Eocene pan-African rain forest and hence, there occurrence in the Coastal Forest belt is older than 32.9 Ma (*cf.* Table 1).

Based on fieldwork results by Leal (2004) and Lehmann & Kioko (2005) with the latter presented in Table 1 herein and Lehmann (in prep.), a non-existent dispersal pattern among rain forest Caesalpinioideae and Metarbelidae with a strong affinity to rain forests has been found in Gabon and in coastal Kenya. Hence, genera including species with a Guineo-Congolian rain forest origin, *e.g.* *Scorodophloeus* Harms and *Kayamuhakaia* persisted through the arid phases in the same Eastern African lowland locations, but microrefugia are not indicated only by genera such as *Kayamuhakaia* as one representative of Z-I-A-G (*cf.* Table 4).

Conclusion:

- The third characteristic pattern for Z-I microrefugia in regard to Metarbelidae is:
  Microrefugia are generic with an additional affinity to lowland and submontane rain forests of *"Congolia"*.

These three characteristic patterns have been found for the following two forest/old woodland relicts in Malawi ("old" = Caesalpinioideae trees older than 200 years) dominated by Caesalpinioideae:

First, on Mkuwadzi Hill near Nkhata Bay (Lake Malawi), comprising:

- one Z-I endemic genus of Metarbelidae,
- Z-I endemic species (both Lehmann in prep.),
- one genus of Z-I-A-G with an affinity to *"Congolia"* + to the Z-I region (*Kayamuhakaia*),
- *K. mkuwadziensis* **sp. nov.** is present that shares morphological similarities with *K. kasikamwiuae* **sp. nov.** from Arabuko-Sokoke Forest microrefugium (Kenya, North Coast).

Second, in the Ruo River Gorge on Mount Mulanje, comprising:

- one Z-I endemic genus,
- Z-I endemic species (both Lehmann in prep.),
- one genus of Z-I-A-G with an affinity to *"Congolia"* + to the Z-I region (*Kayamuhakaia*),
- *K. hilarysommerlatteae* **sp. nov.** is present that shares morphological similarities with *K. petermuriithii* **sp. nov.** from the Taita Hills (Eastern Arc Mountains, Kenya) and *K. haberlandorum* from forest microrefugia in coastal Kenya.

Hence, both localities are defined herein as microrefugia that persisted in repeated arid phases as one Z-I exclave in the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88) with Mkuwadzi Hill and in the "*Swahilian/ Maputaland regional transition zone" sensu* Clarke (1998. 61, 62) with the Ruo River Gorge. These two microrefugia indicate a possible "northern link" for Z-I forest species, *e.g.* for species of the undescribed Z-I endemic genus and species of *Kayamuhakaia,* to the coast of the Indian Ocean via southern Tanzania (including Kimboza Forest) and a possible "southern link" for Z-I forest species and species of *Kayamuhakaia* via Mount Mulanje (including additional hills located to the southeast of Lake Malawi, Lehmann in prep.) to the coast of Mozambique during 32.9 — 2.5 Ma. The latter conclusion implies that the "Approximate limit of the Coastal Forest belt ..." as figured by Clarke (2000: Fig 1.2.7) will be extended in regard to Metarbelidae closer to the southeastern shore of Lake Malawi and including for example the Namizimu Forest Reserve. The *"Western limit" sensu* Clarke (2000: 22, 23) of the coastal forests of Eastern Africa will be 605 km (Lehmann in prep.) instead of 450 km. In conclusion there is a fourth and fifth pattern:

- The fourth characteristic pattern for Z-I microrefugia is:
  Microrefugia are generic and specific with an additional affinity to distant lowland and submontane refuges located as Z-I exclaves in the Zambezian region and in the Z-I transition zones.
- The fifth characteristic pattern for Z-I microrefugia is:
  Microrefugia comprise not only forest refugia but represent also old woodlands dominated by Caesalpinioideae, *e.g."Eastern African Coastal Brachystegia Forest" sensu* Clarke (2000: 5.3) representing a *"Zanzibar-Inhambane transition woodland" sensu* White (1983: 188) or exclaves of the latter in the Zambezian region.

Potential microrefugia of the Z-I region in southern Somalia

Metarbelidae collected along dhesheegs or shallow lakes fed by groundwater flow and flooded by rivers in clay floodplains — *e.g.* flooded by the Jubba River or its tributaries — in the *"Bur Region"* as well as in the *"South Somalia Coastal Plain" sensu* Friis (1992: 11) do not include species of the three identified Z-I endemic genera. The only known two Z-I endemic species of the Z-I-A-G are presented in Table 3 together with data on Metarbelidae collected in the areas mentioned above. The first, fourth and fifth pattern presented for the identification of Z-I microrefugia are absent from southern Somalia at present.

Table 3

Lowland species of Metarbelidae in southeastern Somalia: Z-I endemic genera are absent; Z-I endemics, number of Z-I-A-G including species of *Kayamuhakaia* are shown. Metarbelidae in "two well known areas" along dhesheegs in the *"Bur Region"* and the *"South Somalia Coastal Plain" sensu* Friis (1992: 11) confirm White's two phytochoria for the Dhesheeg Waamo Wildlife Reserve: First, the *"Somalia-Masai regional centre of endemism"* (*cf.* Lehmann 2019b: 83-87); second, for Kismayu behind the dunes and Lag Badana-Bushbush National Park: *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 112, 185).

The edge of dhesheegs **(7)** is dominated along the Middle Jubba River **(7a)** with woody Leguminosae, *e.g. Afzelia quanzensis* Welw. (Caesalpinioideae); *Newtonia erlangeri* Brenan, species of *Acacia* Mill. (Mimosoideae), *Mimusops obtusifolia* Lam. (Sapotaceae), *Camptolepis ramiflora* Radlk. (Sapindaceae) *sensu* Madgwick (1989: 98, 99). The following delimitation is based on data presented by Friis & Vollesen (1989: 466, 467): **(8)** *"Zanzibar-Inhambane evergreen and semi-evergreen bushland and thicket" sensu White* (1983: 189) between Bad Daada and Kismayu including **(8a)** the western bank of the Jubba River just north of Kismayu, **(8b)** *"buur* vegetation*"* comprising, *e.g. Erythrina melanacantha* Harms (Papilionoideae), **(8c)** Zanzibar-Inhambane vegetation behind old coastal dunes derived from ancient coral rock with less pronounced woodland at Kismayu; **(9)** *"Zanzibar-Inhambane scrub forest" sensu* White (1983: 188) between Bad Daada and Raas Kaambooni with potential local dominance of *Craibia brevicaudata* Dunn (Papilionoideae) and Caesalpinioideae, *e.g. Dialum orientale* Baker f., *Afzelia quanzensis* Welw., **(9a)** potential riverine forest at Buulo Xaaji possibly similar to **(9b)** tall Z-I forest along the temporary stream "Lach Buscbusc" comprising, *e.g.* species of *Albizia* Durazz., *Parkia filicoidea* Welw. (Mimosoideae).

Locality	**Main Vegetation Types**	**Number of Z-I-A-G + Z-I endemic Species**	**Z-I endemic Species of *Kayamuhakaia***	**Postulated relict of Microrefuge**	**Reference (example)**
Kismayu (behind the coastal dunes?)	(8), (8a), (8b), (8c)	01 / 01	*kismayuensis "linking species"* Z-I and L-V	No.	
? Buulo Xaaji	(9), (9a), ?(9b)	01 / 01	*neemambeyuae*	No. Original floodplain forest/woodland /Z-I vegetation is possibly no longer present.	Madgwick (1989: 94, 95)
Lag Badana-Bushbush National Park	(9), (9b)	01 / 01	*neemambeyuae*	Yes, if "*buur* vegetation" or other Z.I vegetation dominated by Caesalpinioideae is present.	Hamilton & Taylor (1991: 70); Friis (1992: Photo 27.)
dhesheegs north of Jilib, various river banks, Dhesheeg Waamo Wildlife Reserve	(7), (7a)	0 / 0 *ca.* 100 km north of Kismayu	0	No.	Six endemic species in five genera of the Somalia-Masai region (I.L. unpubl.).

Furthermore, all remaining studied species recorded in southern Somalia belong to genera that are endemic to the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110), *e.g.* Gen. Nov. F in Lehmann (2019b: 83 — 87).

As there is no palaeobotanical evidence from Somalia (Friis 1992: 21) the following situation exists in regard to present vegetation types:

First, large areas of southern Somalia between elevations of 50 — 1.200 m are covered by *"Somalia-Masai Acacia Commiphora deciduous bushland and thicket" sensu* White (1983: 113). The occurrence of species in five genera of Metarbelidae that are endemic to the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) confirms White's major vegetation type along dhesheegs close to the Jubba River of southern Somalia (*cf.* Table 3).

One synapomorphy in the antennae of females is presented herein between species of *Kayamuhakaia* and species of *Lichterfeldia* with the latter endemic to the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) at present, *e.g. Lichterfeldia olarinyiroensis* **sp. nov.** (*cf.* Tab 7), indicating also a link to the Afromontane region and hence, to montane species of *Kayamuhakaia.* The synapomorphy that is shared with females of *Kayamuhakaia* — comprising the lowland Z-I endemics *K. kismayuensis* **sp. nov.** as well as *K. neemambeyuae* **sp. nov.** — implies that species of *Lichterfeldia* did not originate in the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) and hence, the males (at present unknown) should not have any of the parsimony-informative characters presented for the *"Somalia-Masai regional centre of endemism" sensu* White (1983. 110) by Lehmann (2019b: 34 — 36). The same conclusion is drawn herein for the two unknown males of *K. kismayuensis* **sp. nov.** as well as *K. neemambeyuae* **sp. nov.** This implies that both species did originate in the Z-I region but not in the adjacent Somalia-Masai phytochorion.

Second, forest vegetation is restricted in the *"Bur Region"* as well as in the *"South Somalia Coastal Plain" sensu* Friis (1992: 11) to the foot of 'burs' (also called 'buurs') and along rivers (Friis 1992: 21). Various authors confirm that forests along rivers have been largely destroyed by humans with very few remaining Z-I forest patches, *e.g.* Madgwick (1989: 94, 95/ patches still present along the Jubba River at Bu'ale?, *cf.* Clarke 2000: 5.4; tall Z-I forest along the "Lach Buscbusc" still present?, *cf.* Friis 1992: 43 + Photo 27.). Destructions of forest-like "*buur* vegetation" and coastal forests were also confirmed by various authors. Very small patches of the latter vegetation remain in southern Somalia, *e.g.* Friis (1992: 21, 26). It is very likely, that *K. neemambeyuae* **sp. nov.** occurs in one or in both of the latter vegetation types and indicates the occurrence of Z-I endemic species many kilometers further inland from the coast of the Indian Ocean in southern Somalia.

Third, of importance are the forest-like patches that alternate with bushland and single or grouped trees that comprise floristically a transitional character (Friis 1992: 21, 27 + Fig 3). This vegetation occurs behind — on the landward side — of the coastal dunes of southern Somalia that are between 1 — 3 km wide and occur along the Indian Ocean. The floristically transitional character of these forest-like patches is — based on fieldwork by Friis & Vollesen (1989: 466, 467) — expressed in their close association to forests of the Zanzibar-Inhambane region, in particular to *"Zanzibar-Inhambane scrub forest" sensu* White (1983: 188) and to *"Zanzibar-Inhambane evergreen and semi-evergreen bushland and thicket" sensu White* (1983: 189). From the latter fieldwork results the fact becomes clear that *"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 187) is largely no longer present in southern Somalia but possibly in the Mundane Range to the South of the Somalia-Kenya frontier (*cf.* Clarke 2000: 22) and in patches along the temporary stream Lach Buscbusc (*cf.* Friis 1992: Photo 27.).

The occurrence of two Z-I endemic lowland species — *K. kismayuensis* **sp. nov.** as well as *K. neemambeyuae* **sp. nov.** — support a close floristic association of their habitats to the Z-I region as well as its transitional character since both species are morphologically linked to the Z-I endemic *K. haberlandorum* as well as to *K. maasi* **sp. nov.**, an endemic species of the *"Lake Victoria regional mosaic" sensu* White (1983: 179). The latter phytochorion is located at least 720 km westwards from the type localities in southeastern Somalia.

It is very likely that not only additional Z-I endemics occur in these forest-like patches described above as well as in "*buur* vegetation" but also Single-site Z-I endemic Metarbelidae species that can indicate a high conservation value for such forest and bushland patches.

***"Linking species"* groups**

Seven groups of *"linking species"* are presented for this monophylum comprising 20 species of *Kayamuhakaia* and one species of *Finsterwaldeia*.

If these 21 species are compared with the remaining 19 species it becomes clear that the occurrence of linking morphological characters in species of this monophylum varies with altitude. Hence, species of submontane and montane localities comprise more *"linking species"* (*cf.* Table 4, 5 + 7), while groups of upper montane species (definition for each mountain range is necessary) and subalpine species (altitude above 3.000 m) as well as the group of lowland species have no or few *"linking species"* (Table 2, 3 + 6).

Lowland *"linking species"* presented in Table 2 occur all in Lowlands close to or in hilly (submontane) areas. An exception includes one Z-I endemic lowland species presented in Table 3 from Kismayu with a morphological link towards species occurring in Kakamega Forest and in forest adjacent to Lake Nkuruba, located northeast and northwest of Lake Victoria, respectively.

Conclusion:

- *"Linking species"* are presented in groups that are discussed separately.

First group: *"Linking species"* of the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) and the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 180/L-V) presented in Table 3 and 5 (*cf.* "L-V and Z-I" or "Z-I and L-V").

This group is represented by three species, namely from Kismayu (southern Somalia), Kakamega Forest (western Kenya) and from near Lake Nkuruba (southwestern Uganda) comprising one lowland *"linking species"* presented in Table 3.

One of the interesting species is *K. maasi* **sp. nov.** from a young forest Site with forest patches adjacent to Lake Nkuruba that receive more than 1500 mm of annual rainfall (*cf.* habitat text for this species). This is a high amount of rainfall if compared to 1600 — 2000 mm that receive the majority of rain forests in the *"Guineo-Congolian regional centre of endemism" sensu* White (1983: 71, 72). Hence, *K. maasi* **sp. nov.** is <u>not</u> associated with tree species of dry lower-montane forest in Uganda, *e.g."Dry transitional montane forest" sensu* White (1983: 166) occurring at *ca.*1.650 m with an average annual rainfall of *ca.*800 mm.

There are only two main naturally forested regions in Uganda including one region to the North and adjacent of Lake Victoria that was connected — before forest destructions by humans occurred — by a broad forest band to the second region in the West and Southwest of Uganda extending westwards into *"Congolia"* (Hamilton *et al.* 2001: 58 + Fig 4.1.). As tree species indicate belongs all lowland forest in Uganda to the Guineo-Congolian phytochorion and tree species of dry lower-montane forest are widely distributed in Uganda indicating the widely occurrence of dry climates in the past (Hamilton *et al.* 2001: 58, 59, 60). Highest humidity in the Lake Victoria region was prior to 6,500 yr B.P. when forests of the Guineo-Congolian type occurred and were later replaced by semi-deciduous types (Ssemmanda & Vincens 2002: 519). Hence, if the assumption is that *K. maasi* **sp. nov.** evolved in Guineo-Congolian rain forest types during 18,000 — 6,500 yr B.P. and including the *"Rwenzori-Montane Environment" sensu* Hamilton *et al.* (2001: 60 + Table 4.3) in this assumption, a most recent contact of this species with other species of *Kayamuhakaia* that occur further eastwards, *e.g.* in Kakamega Forest (*ca.* 45 km southeast of Mount Elgon) was possible via rain forest areas located to the North of Lake Victoria. Such a contact dates back to a time prior to 6,500 yr B.P. This assumption of I.L. is supported by the "[Mount] *Elgon-Lowland Environment"* as well as "[Mount] *Elgon-Montane Environment" sensu* Hamilton *et al.* (2001: 63 + Table 4.3) where wetter types of lowland and montane forest were present 11,000 yr B.P. — 6,000 yr B.P.

A contact of species of *Kayamuhakaia* from Lake Nkuruba/Kibale Forest, Kakamega Forest and the Z-I region in southern Somalia certainly includes unknown ancestors that were present in montane forests of central Kenya as well as in lowland forests of northern Kenya by the end of the Pleistocene and early Holocene. For example, forest did largely occur in northern Kenya to the East of Lake Turkana 9,800 yr B.P. (Friis 1992: 24) which indicates a wetter period in the lowland areas of northern and northeastern Kenya, probably also in southern Somalia.

It is very likely that not only forest but a mosaic of floodplain savannas dissected by gallery woodlands and riverine forests also existed by then and persisted at least along rivers during drier phases. This assumption implies that neither Lake Nkuruba/Kibale Forest nor Kakamega Forest was isolated over a long period of time but at least connected via riverine forests to species on mountain ranges of central Kenya but also connected via riverine forests to species of the Lowlands in northern Kenya and southern Somalia representing habitats of ancestors of *Kayamuhakaia* by then. The example of Lothagam — located to the southwest of Lake Turkana in northern Kenya — supports such an assumption: If throughout the Miocene and Pliocene gallery woodlands existed although an increased aridity occurred between 6.7 Ma and 5 Ma (Leakey & Harris 2003: 626) these gallery woodlands and possibly riverine forests certainly were also present by the end of the Pleistocene in northern Kenya and possibly extending to southern Somalia. Clarke (2000: 5.4) included such *"Somalia-Masai Riparian Forest"* into the *"Eastern African Coastal Riverine/Groundwater/Swamp Forest (transitional vegetation formation sub-type)"*.

Based on morphological similarities presented in the diagnosis of *K. aberdarensis* **sp. nov.**, the Aberdare Range — with a major built-up phase 6.5 Ma possibly ending *ca.*5 Ma (Shackleton 1978: 24) — appears herein as an area where also species of *Kayamuhakaia* still occur with morphological similarities to species of southern Somalia. Such a result is absent at present from species on Mount Kenya nearby. If this result is confirmed in more species of *Kayamuhakaia* in the future, the ancestors of those "Aberdare-southern Somalia group" date back to a time that pre-dates the first built-up phase of Mount Kenya 5.8 Ma (Schoorl *et al.* 2014: 45) and hence, to the Upper Miocene. As Mount Kenya had an altitude of at least 7.000 m by then and was ice-capped it must have had its effects on the regional vegetation at least until its last major collapse 2.8 Ma. A much taller and more active volcano Mount Kenya might be one reason for the absence of Metarbelidae that are morphologically linked to species of southern Somalia. Additionally, this also represents one reason for the absence of any *"linking species"* on Mount Kenya at present (*cf.* Table 6).

It is unlikely that lowland species of *Kayamuhakaia* — a genus with Guineo-Congolian + Z-I affinities — occur in present lowland areas of northern Kenya. Instead, species of *Finsterwaldeia* — a genus with Z-I affinities — is still present at least in northeastern Kenya (*cf.* Table 7) suggesting a common ancestor and a divergence event somewhere in northern Kenya or further to the North.

If again, Kakamega Forest in western Kenya is considered, an isolation of this forest prior to 9,800 yr B.P. is unlikely. Only a short period of isolation, if at all, explains the occurrence of eight genera of Metarbelidae comprising at present only one near-endemic Guineo-Congolian genus (*cf.* Lehmann 2019b: 74) but seven genera occurring widely in eight additional phytochoria *sensu* White (1983: Fig 4). Such a pattern, comprising a large number of genera of Metarbelidae that occur in a large number of phytochoria — *e.g.* a total of nine phytochoria are represented by those genera in Kakamega Forest (Lehmann unpublished data) — is absent from all macro- and microrefugia presented herein.

Conclusions:

- *"Linking species"* of *Kayamuhakaia* of the Z-I region of southern Somalia (Table 3) and L-V regions of western Kenya (Kakamega Forest) and northwest of Lake Victoria in Uganda (forest adjacent to Lake Nkuruba — presented as the habitat for one of the youngest species of *Kayamuhakaia* herein, *cf.* Table 5) indicate a late Pleistocene or early Holocene contact at least via riverine forests and gallery woodlands close to or prior to 9,800 yr B.P.
- There is no supporting data among Metarbelidae that any microrefugium is involved in the areas mentioned above including Kakamega Forest.

Second group: *"Linking species"* of the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 180/L-V) and the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88/Z-R) presented in Table 4 (*cf.* "Z-R and L-V").

Although this "group" is only represented by one species at present, namely *K. mbalensis* **sp. nov**., it is predicted herein that more species of *Kayamuhakaia* will be found in the future that belong to the "Z-R and L-V" group.

Burtt (1942: 127 — 140, 141, 142) described a continuous transect of the *"Tabora-Kahama type of miombo"* occurring — during the years of his fieldwork in 1925 to 1938 — from the southern coast of Lake Victoria southwards to Shinyanga and Kahama and further southwards to Tabora (northwestern Tanzania). Dominant Caesalpinioideae of this miombo type comprise, *e.g. Burkea africana* Hook., *Afzelia quanzensis* Welw. and locally common are *Brachystegia spiciformis* Benth., *e.g.* around Kahama, and *B. tamarindoides* Welw., *e.g.* around Tabora. Other characteristic tree species include, *e.g. Hexalobus monopetalus* Engl. & Diels (Annonaceae), *Oldfieldia dactylophylla* J. Léonard (Picrodendraceae), *Albizia harveyi* E. Fourn. (Mimosoideae) and *Lonchocarpus capassa* Rolfe (Papilionoideae).

Caesalpinioideae that "abound" in the Mbala (Abercorn) area and extend eastwards to Mbeya and northwards to Tabora and hence, into the *"Tabora-Kahama type of miombo"*, includes the small tree *Cryptosepalum exfoliatum* De Wild. subsp. *exfoliatum* P.A. Duvign. & Brenan (synonym: *Cryptosepalum fruticosum* Hutch.). The Caesalpinioideae *Brachystegia allenii* Hutch. & Burtt Davy, *Julbernardia paniculata* Troupin and *Isoberlinia angolensis* Hoyle & Brenan var. *lasiocalyx* Hoyle & Brenan (synonym: *Isoberlinia densiflora* Milne-Redh.) also "abound" in Mbala but extending in miombo southwards into Malawi (Burtt 1942: 141).

The assumption of real historical processes is that a "reproductive community" of ancestors of *K. mbalensis* **sp. nov.** occurred somewhere in these continuous miombo woodlands that extended once from Mbala northwards to the southern coast of Lake Victoria and possibly further northwestwards along the western coast of Lake Victoria and adjacent to Guineo-Congolian lowland rain forest types, *e.g.* during 18,000 — 6,500 yr B.P. (*cf.* Hamilton *et al.* 2001: Fig 4.1.). Divergence events occurred at an unknown point in time. New phylogenetic species that are reproductively isolated evolved, *e.g. K. mbalensis* **sp. nov.** — sharing morphological similarities with *K. maasi* **sp. nov.** The former is certainly the older species as the first woodlands dominated by woody legumes and structurally similar to the present miombo occurred in the areas of Singida — located to the Southeast of Shinyanga — as well as at Mahenge (north-central Tanzania) as early as 46 Ma (*cf.* Jacobs 2011: 1577).

<u>Conclusion</u>:

- If *K. mbalensis* **sp. nov.** or species of *Kayamuhakaia* occur sympatric around Mbala and share also morphological similarities to species of *Kayamuhakaia* occurring in the Z-I region as well as in miombo further to the Southeast from Mbala, *e.g.* in Malawi, is unknown. There is not a single female record of *Kayamuhakaia* to the South of Mbala. The assumption is, that species of the "Z-R and Z-I" group very likely occur in miombo around Mbala as it used to be the main vegetation with the "…great *Brachystegia* woodlands…" extending from Morogoro as well as Mbala southwards (Burtt 1942: 141) and throughout Malawi before the large destructions of miombo occurred by humans for subsistence cultivation, *e.g.* in Malawi (White *et al.* 2001: 56).

Third group: *"Linking species"* of the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88/Z-R) and the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) presented in Table 2 and 4 (*cf.* "Z-I and Z-R" / "Z-R and Z-I").

This group is represented by four species. They are of particular importance and indicate the following pattern:

- First, species of *Kayamuhakaia* were present in *"Zambezian miombo woodland" sensu* White (1983: 92) that once occurred largely throughout Malawi including the ancestors of isolated species at present, *e.g.* still shown by morphological similar characters shared between *K. yvonnedejongae* **sp. nov.** from Zomba (southern Malawi) and *K. huchtemanni* **sp. nov.** from Mzuzu (northern Malawi).
- Second, species of *Kayamuhakaia* certainly still occur in *"Zambezian miombo woodland"* that is present throughout the greater part of the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88) especially on the Southern African Plateau — that originated 150 Ma (*cf.* Lehmann *et al.* 2023: 71, 72, 98, 99) — as well as on its flanking escarpments where miombo is the prevalent vegetation.
- Third, species of *Kayamuhakaia* might be locally common in *"Zambezian miombo woodland"* — *cf.* males of *K. huchtemanni* **sp. nov.** during 2008 to 2013 — since it is nearly always dominated by Caesalpinioideae of the genera *Brachystegia* Benth., *Julbernardia* Pellegr. and *Isoberlinia* Craib with their tree species that are not only dominant but "… extremely gregarious and only rarely occur in other vegetation types …" (White 1983: 92).

Kayamuhakaia aarviki **sp. nov.** from Morogoro shares not only morphological similar characters with *K. haberlandorum* of the Z-I region in Kenya but also with *K. petermuriithii* **sp. nov.** of the Taita Hills. The assumption of I.L. is that its type locality Morogoro was once not only locally covered by the *"Tabora-Kahama type of miombo" sensu* Burtt (1942: 75, 141, 142, Phot. 13 + 16) that extended as continuous vegetation from Morogoro to the southern coast of Lake Victoria (Burtt 1942: 141) — dominated by Caesalpinioideae, *e.g.* *Brachystegia boehmii* Taub., *Burkea africana* Hook., *Bobgunnia madagascariensis* J.H.Kirkbr. & Wiersema (synonym: *Swartzia madagascariensis* Desv.) — but extended also as miombo northeastwards to the Taita Hills as well as towards coastal Kenya. If this assumption is correct then not only 'forest microrefugia' but also 'miombo microrefugia' were present and important. In regard to forests, White (1981: 52) mentioned a route from the northern end of Lake Malawi towards the Taita Hills comprising a "southern migratory track" for lowland forest species but omitted vegetation such as miombo. For example, 'miombo microrefugia' located in lowland and submontane areas were necessary for the survival of the ancestor species of *K. aarviki* **sp. nov.** during arid phases. The occurrence of such 'miombo microrefugia' is supported by Dale (1939: Map 1 + 2) for coastal Kenya were large relicts of *Brachystegia* Benth. woodland still occurred in savannas adjacent and landwards to forest microrefugia mentioned herein at least until the late 1930s, *e.g.* landwards of Arabuko-Sokoke Forest, the Rabai Kayas and Shimba Hills.

Conclusions:

- The fifth characteristic pattern for Z-I microrefugia as described above and in context with Metarbelidae-Caesalpinioideae is supported with 'miombo microrefugia'. The latter almost certainly were located not only in lowland and submontane areas close to or adjacent to forest microrefugia of the Z-I region but also adjacent to the Eastern Arc Mountains further inland, *e.g.* to the West of the Uluguru Mountains, as well as in miombo close to the western as well as southeastern shores of Lake Malawi, *e.g.* 'miombo microrefugia' adjacent to and on Mkuwadzi Hill. Hence, their location is between the "Upland Areas" and the Z-I region as figured by Clarke (2000: Fig 1.2.5) and comprising ancestor species of *K. mkuwadziensis* **sp. nov.**, *K. aarviki* **sp. nov.**, *K. yvonnedejongae* **sp. nov.** and *K. huchtemanni* **sp. nov.**
- Based on morphological male characters the latter four species indicate together with *K. kasikamwiuae* **sp. nov.**, *K. haberlandorum*, *K. petermuriithii* **sp. nov.** and *K. kimbozensis* **sp. nov.** a "northern link" comprising largely miombo that once existed from western Malawi to the coast of the Indian Ocean via southern Tanzania (including Kimboza Forest) towards southeastern Kenya as well as to Arabuko-Sokoke Forest further northwards.
- This implies that ancestor species of *Kayamuhakaia* of the third group certainly occurred, *e.g.* in *"Eastern African Coastal Brachystegia Forest" sensu* Clarke (2000: 5.3) representing a *"Zanzibar-Inhambane transition woodland" sensu* White (1983: 188). A supporting fact for this assumption is the occurrence of one paratype of *K. ngwenoae* **sp. nov.** in "*Brachystegia* forest" (*cf.* Githitho 2021: 15, 16) in the Arabuko-Sokoke Forest microrefugium (*cf.* Fig 32.a. herein).

Table 4

Z-I endemic genera of Metarbelidae are absent. A number of genera of Z-I-A-G occur in "six well known areas" of four localities including relicts of natural vegetation in two townships of the *"Zambezian regional centre of endemism" sensu* White (1983: 86, 88 / Z-R) with submontane and montane species of *Kayamuhakaia* defined as Z-R endemics as well as *"linking species"* to the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) or to the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 180/L-V). Data is based on morphological characters. For species of *Kayamuhakaia cf.* diagnosis.

Dominance of Caesalpinioideae was largely present and still occurs only in patches of their type localities. Data is based on Burtt's fieldwork in 1925 to 1938, *e.g.* at Mbala (formerly Abercorn) and Morogoro with data gathered long time before the destruction of many extensive miombo and other large woodlands occurred.

There are ten genera of Metarbelidae known from Morogoro based on data until June 2024 (*cf.* Lehmann 2009: Table 1 with "cf. *Metarbela latifasciata* Gaede" as *K. aarviki* **sp. nov.** herein). Included in this number are four Z-I-A-G genera (*cf.* Table 4).

Small exclaves of a former or still present *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) located in the Zambezian region are presented in Table 2. Such exclaves comprise at least one Z-I endemic genus of Metarbelidae.

Vegetation types of the Zambezian region: **(10)** Wetter miombo, *"The eastern or Kilosa type of Brachystegia woodland" sensu* Burtt (1942: 86, 141, Phot. 13) dominated by Caesalpinioideae, *e.g. Brachystegia boehmii* Taub., *B. bussei* Harms, *B. spiciformis* Benth.; Mimosoideae, *e.g. Albizia versicolor* Welw., *Senegalia goetzei* subsp. *microphylla* Kyal. & Boatwr. (synonym: *Acacia ulugurensis* Taub.); **(11)** *"Tabora-Kahama type of miombo" sensu* Burtt (1942: 75, 141, 142, Phot. 16) that once covered a large continuous area and, *e.g.* reached from Morogoro to the southern coast of Lake Victoria dominated by Caesalpinioideae, *e.g. B. boehmii* Taub., *Burkea africana* Hook., *Bobgunnia madagascariensis* J.H.Kirkbr. & Wiersema (synonym: *Swartzia madagascariensis* Desv.); Papilionoideae, *e.g. Pterocarpus angolensis* DC., *Pericopsis angolensis* Meeuwen (synonym: *Afrormosia angolensis* Harms) and *Monotes engleri* Gilg (Dipterocarpaceae); **(12)** *"Brachystegia allenii* [Hutch. & Burtt Davy] *and Isoberlinia globiflora-Brachystegia woodlands" sensu* Burtt (1942: 79), (*I. globiflora* Hutch. is a synonym of *Julbernardia globiflora* Troupin); **(13)** Wetter *"Brachystegia woodlands" sensu* Burtt (1942: 141) dominated by, *e.g. Brachystegia taxifolia* Harms, *B. spiciformis* Benth., *B. floribunda* Benth., *Julbernardia globiflora* Troupin; **(14)** *"Zambezian swamp forest and riparian forest" sensu* White (1983: 91) with tree species in riparian forest relicts that have a Guineo-Congolian affinity and with one large liana species indicating a Z-I affinity and Caesalpinioideae are not dominant or locally absent.

Locality	**Main Vegetation Types**	**Z-I endemic Genus / Z-I-A-G + Z-R endemic Species**	**Z-R endemic Species of *Kayamuhakaia***	***"linking Species"***	**Phytochoria**
Morogoro (township)	(10), (11)	0 / 04 / 04	*aarviki*	Yes.	Z-R and Z-I
Mbala (Abercorn)	(12)	0 / 02 / 04	*mbalensis*	Yes.	Z-R and L-V
Mzuzu, Nkhorongo	(13)	0 / 03 / 04	*huchtemanni*	Yes.	Z-R and Z-I
Zomba (township)	(14)	0 / 02 / 02	*yvonnedejongae*	Yes.	Z-R and Z-I

In the following three groups of *"Linking species"* (*cf.* Table 5) as well as in the group of no linking but endemic species (*cf.* Table 6) and in context with the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161, 163/A-M) the following two general patterns are confirmed:

- First, 58% or 22 species of *Kayamuhakaia* as well as the species of the genus *Lichterfeldia* are endemic or somehow linked to the Afromontane archipelago. This confirms the results of Lehmann (2019b: 41, 42, 333 — 341) who stated, *e.g.* "… for Metarbelidae evolution … a main driving force was and perhaps still is 'elevation'."
- Second, the statement of White (1981: 35) is confirmed with the following results:
  - There are no disjunctions among species of both genera mentioned above in regard to the Afromontane archipelago as only local endemic species have been identified.
  - No intruders from the Lowlands have been identified as also all lowland species are local endemics.

Fourth group: *"Linking species"* of the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161, 163/A-M) and the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) presented in Table 5 (*cf.* "A-M and Z-I").

This group is represented by seven species. Certainly the ancestors of all seven species were in contact with ancestors of unknown lowland species of the Z-I region.

One of the most striking results is that two species of this group occur in the Lolldaiga Hills and in the Nairobi area (central Kenya). Less surprising are species of this group that occur in localities such as the Taita Hills (Eastern Arc Mountains) in Kenya; on Mount Kilimanjaro and Mount Meru (*"Northern forests" sensu* Lovett 1998: Fig 1) in Tanzania as well as on Mount Mulanje in Malawi.

An interesting species pair in this context is *K. nubifera* (endemic to the Nairobi area at present) and *K.vau-alba* (if not yet extinct it represents a Mount Mulanje endemic) with significant similar morphological characters in the male antennae. The latter species represents the only species of *Kayamuhakaia* that is known from Malawi occurring in a habitat that belongs almost certainly — like the habitat of *K. nubifera* — to the Afromontane archipelago and is located above 1.500 m on Mount Mulanje.

Hence, the *"Malawi Interval" sensu* Chapman & White (1970: 76) is shown and confirmed for the first time in context with Metarbelidae by a large absence of montane species as well as by a large absence of A-M *"linking species"* of *Kayamuhakaia* throughout Malawi. As the *"Malawi Interval"* has not yet been confirmed for montane species that belong to several other genera of Metarbelidae collected during the last 120 years as well as in some of the "168 well known areas" of Malawi, the large-scale forest and miombo destructions in Malawi appear as no major reason for the absence of montane species of *Kayamuhakaia*.

Conclusions:

- At present the *"Malawi Interval"* is shown only in montane species of two genera, *e.g. Kayamuhakaia*, but is not shown in montane species of other genera, *e.g. Ortharbela* Aurivillius, 1910 (Lehmann 2019b: 245, 247 + additional data until June 2024).
- The morphological link of *K.vau-alba* and *K.nubifera* is complex since it has to be considered in context with the evolution of the A-M region as well as the evolution of the Z-I region. Hence, similar and significant morphological characters in both species might indicate an ancient connection of their ancestor species on a South to North distance between both localities of *ca.* 1500 km and including areas of the Z-I region. Such a contact cannot be older in regard to *K. nubifera* than 6.5 Ma — 5.0 Ma when voluminous trachytes, trachytic tuffs and phonolites erupted and built the Nairobi area (Shackleton 1978: 24).
- It is unlikely that this pair of montane species can be explained only by any latitudinal limit for species of *Kayamuhakaia*, in particular in regard to Malawi.

The contact of ancestors of the seven species with ancestors of unknown lowland species of the Z-I region occurred certainly numerous times during the last 32.9 Ma. More recently, some species of this group might have been in contact until 2,800 yr B.P. when the last pronounced decline of forest occurred in various parts of East Africa and peaking around 2,000 yr B.P. (Maley 2001: 75, 76).

In consequence of repeated retreats of forest blocks since 32.9 Ma the groups of ancestors of montane species as well as the groups of ancestors of lowland species of *Kayamuhakaia* became reproductively isolated, and possibly strongly reduced in their number, in the same isolated forest/woodland area. The result were local speciations that occurred in their descendants which diverged irreversibly from other groups, *e.g.* due to a long period of habitat isolation (*cf.* Wägele 2005: 55, 56).

Various authors stated that montane communities in Africa expanded many times into the Lowlands at expense of rain forest in cool dry phases and then retracted towards higher elevations again when the climate became warmer and wetter, especially during the last 800,000 years (*e.g.* White 2001: 14; Maley 2001: 69, 71). In lower mountain areas, in hilly regions and in the "Dissected Lowland", the narrow valleys, often with streams, were found to be an important habitat as well as microrefugium for Caesalpinioideae representing different species compositions that suggest local extinction events and no range expansions (Leal 2004: 46, 50, 51).

Lehmann (2019b: 336) presented two examples — that support the statements of White and Maley: First, comprising the montane butterfly *Charaxes acuminatus* subsp. *shimbanus* van Someren (1963). Larsen (1991: 283) stated "This is essentially a montane butterfly … rarely found much below 1800 m or so. The

Shimba Hills population lives at unusually low levels … and is only found in the highest level forests there [elevation range 150 — 448 m with natural forests only above 228 m and mainly located on the Shimba Hills plateau *cf.* Schmitt 1991: 3, 4, 5, 20].” This species was first found in Kenyan coastal lowland forests below 45 m and for the first time below an altitude of 10 m by I.L. (*cf.* Lehmann & Kioko 2000: 24; Kroon 2001: Editorial + Back cover; Lehmann & Kioko 2005: 136). Second, two undescribed species of the genus *Ortharbela* Aurivillius, 1910 (Lehmann 2019b: 245, 247) that I.L. studied from the only two known lowland localities in Buda Forest (Kenya, *cf.* Lehmann & Dalsgaard 2023: 142) and nearby Marenji Forest (Kenya, *cf.* Lehmann 2009: 198) comprising an elevation range of 27 — 93 m for the former and 30 — 160 m for the latter. The former montane butterfly species descended into the Lowlands towards forest almost adjacent to the Indian Ocean beach during a wet period when forests were connected, *e.g.* with the Shimba Hills, representing a montane relict species below an elevation of 45 m today. In contrast, the two *Ortharbela* species indicate a local speciation since both were not yet found outside of Buda and Marenji forests with their possible closest relative representing one undescribed species in a submontane region of the East Usambara Mountains (Tanzania *cf.* Lehmann 2019b: 245, 247) located *ca.* 110 km to the Southwest.

Additional records of *Ortharbela* species that suggest local speciations were found by I.L. until June 2024 including one undescribed species from a submontane region in the Uluguru Mountains (Tanzania, *cf.* Lehmann 2019b: Fig 150) and five undescribed montane species of *Ortharbela* from five miombo and forest habitats occurring throughout Malawi including areas of the Afromontane archipelago. Hence, the *“Malawi Interval” sensu* Chapman & White (1970: 76) is not shown in montane forest species of *Ortharbela*.

In regard to *Kayamuhakaia* an additional species can be added to this pattern, namely *K.petermuriithii* **sp. nov.** that occurs in Yale Forest (Taita Hills, Eastern Arc Mountains) at an elevation of 1.804 m but can still be found as a relict montane species in the Lowlands around Kivuli Camp (Tsavo Conservancy) at an elevation of 484 m. Based on the definitions for Eastern Arc forest types by Lovett (1993: 37 — 40) “*Montane forest*” is found in an “Altitude: 1200 — 1800 m. …” and “*Submontane forest*” in an “Altitude: 800 — 1400 m. …” this example of *K. petermuriithii* **sp. nov.** shows that indeed montane species — and not only submontane species — descended into the Lowlands where this species became adapted to non-forest vegetation at present. It is very likely that this scenario occurred more recently, *e.g.* before 2,800 yr B.P. when the last pronounced decline of forest occurred in various parts of East Africa (*e.g.* Maley 2001: 75, 76).

In large lowland areas, an increase of grassland at expense of lowland rain forest was mentioned, *e.g.* for Gabon where cool dry seasons were particularly strong since rainfall ceased completely and some Caesalpinioideae survived only in microrefugia comprising riverine forest (Leal 2004: 7, 8, 10, 25, 46, 51).

In coastal forest and in miombo on their landward side of the Z-I region, microrefugia in hilly areas, along rivers and along smaller streams were certainly an important habitat where Caesalpinioideae survived several times in arid phases with few species expanding their range upstream as in Gabon (*cf.* Leal 2004: 46).

Such a pattern might be similar in species-groups of Metarbelidae that are closely associated to Caesalpinioideae, *e.g.* species of *Kayamuhakaia* (*cf.* Table 1 + 2 + 4).

Gallery forests comprising Caesalpinioideae with dehiscent pods and located close to permanent streams were presented as microrefugia also by White (2001: 20). They had survived various times the dry phases and hence, representing a network with macrorefugia for the Lowlands but also a network between montane regions. This might also explain why montane species of *Kayamuhakaia* occurring in East Africa, *e.g.* on the Lolldaiga Hills, in the Nairobi area, on the Taita Hills, on Mount Kilimanjaro and Mount Meru share morphological similar characters with East African coastal lowland species, *e.g. K. kismayuensis* **sp. nov.**, *K. ngwenoae* **sp. nov.**, *K. haberlandorum* (*cf.* Table 5 + species diagnosis).

<u>Conclusions</u>:

- Species of *Kayamuhakaia* that belong to the “A-M and Z-I” group represent neoendemics since they post-date the separation of the western and eastern lowland rain forest 32.9 Ma.
- Although gallery forests and riverine woodlands comprise microrefugia — if still dominated by Caesalpinioideae and located particularly in narrow valleys — there is no visible dispersal pattern among any of the present species of the “A-M and Z-I” group. Instead, montane species occurring in the Lowlands are interpreted herein as “montane relicts” but not as indicators for any expansion scenario in regard to a particular species under present climate conditions, *e.g. K. petermuriithii* **sp. nov.**
- All species represent local neoendemics and can include montane relicts in Lowlands.

Fifth group: *“Linking species”* of the *“Guineo-Congolian regional centre of endemism” sensu* White (1983: 71, 73/G-C) and the *“Afromontane archipelago-like regional centre of endemism” sensu* White (1983: 161, 163/A-M) presented in Table 2 and Table 5 (*cf.* “G-C and A-M” / “A-M and G-C”).

This group is represented by two species, namely *K. bokatolaensis* **sp. nov**. (considered as a lowland rain forest species) and *K. aberdarensis* **sp. nov.** (considered as a montane forest species). It is predicted that more species of *Kayamuhakaia* will be found in the future that belong to the “G-C and A-M” group. Although represented by only two species (females) the results are significant in regard to species of *Kayamuhakaia* due to the following facts:

First, White (1981: 52 + Fig 1.A, 1.B) mentioned a “southern migratory track” for lowland forest species from the Guineo-Congolian region into the coastal parts of East Africa via the northern end of Lake Malawi, some Eastern Arc Mountains of Tanzania and via the Taita Hills. Based on morphological characters and considering that the males of both species are unknown at present, there is no support for this “southern migratory track” among *Kayamuhakaia*. Instead, the present data on Metarbelidae for lowland forest species from the *“Guineo-Congolian regional centre of endemism” sensu* White (1983: 71, 73) supports a track via southern Uganda into western Kenya, *e.g.* for species of *Shimonia* Lehmann &

Rajaei, 2013, *cf.* Lehmann (2019b: 208 + Fig 124). The latter track is supported by species of *Kayamuhakaia*, occurring in *"Congolia"*, southern Uganda, western Kenya and southern Somalia as well as on the Aberdare Range of central Kenya considering only females (*cf.* "First group" with notes on the "Aberdare-southern Somalia group").

Table 5

Afromontane and Victoria Basin endemic species as well as *"linking species"* of *Kayamuhakaia* comprising the following phytochoria: **(1)***"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161/A-M); **(2)** small exclaves of *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 186/Z-I); **(2a)***"Swahilian/Maputaland regional transition zone" sensu* Clarke (1998: 61, 62); **(3)***"Lake Victoria regional mosaic" sensu* White (1983: 179/L-V); **(4)***"Guineo-Congolian regional centre of endemism" sensu* White (1983: 71/G-C). Data is based on collecting Sites as well as morphological characters for each species (*cf.* diagnosis).

Four montane species are considered herein as the youngest species with speciation events during the last 2.5 million years (*cf.* Discussion). These species are shown in bold.

Dominance of Caesalpinioideae is absent on Sites located in "11 well known areas".

"Key Biodiversity Areas" of Kenya are shown in bold.

The *"Malawi Interval" sensu* Chapman & White (1970: 76) is shown by a large absence and local rarity of only one A-M *"linking species"* of *Kayamuhakaia* based on a comprehensive collection of Metarbelidae from well distributed "168 well known areas" throughout Malawi (*cf.* also Table 6).

Vegetation types: **(15)** *"Undifferentiated Afromontane Forest" sensu* White (1983: 165) dominated by, *e.g. Xymalos monospora* Baill. (Monimiaceae), *Astropanax volkensii* Lowry, G.M. Plunkett, Gostel & Frodin (Araliaceae), *Prunus africana* Kalkman (Rosaceae); **(16)** *"Dry transitional montane forest" sensu* White (1983: 166) dominated by, *e.g. Brachylaena huillensis* O. Hoffm. (Asteraceae), *Calodendrum capense* Thunb. (Rutaceae) or **(16**)** *Albizia schimperiana* Oliv. (Mimosoideae); **(17)** "*Cassipourea malosana - Setaria plicatilis* agg. community" *sensu* Schmitt (1991: 83); **(18)** *"Afromontane rain forest" sensu* White (1983: 164); **(19)***"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket"* and **(20)** *"Somalia-Masai secondary grassland and wooded grassland" sensu* White (1983: 113, 114); **(21)** *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115) that replaced **(16)** and was dominated by **(16*)** *Juniperus procera* Hochst. (Cupressaceae); **(22)** *"Evergreen clump-grassland"* with patches of *"Diospyros-Olea forest" sensu* Kenya Government & Ministry of Overseas Development, UK (1969); **(23)** *"middle-age secondary forest"* of the "*Strombosia scheffleri* – plant community"*sensu* Althof (2005: 78, 90); **(24)** *"Drier peripheral semi-evergreen Guineo-Congolian rain forest"*; **(25)** *"Transitional rain forest" sensu* White (1983: 181).

Table 5

Locality	Main Vegetation Types	A-M or L-V endemic Species of *Kayamuhakaia*	linking Species	Phytochoria
Yale Forest (**Taita Hills**) + Kivuli Camp	(1), (15), (19), (20)	*petermuriithii* (A-M: Taita Hills near-endemic)	Yes.	A-M and Z-I
Nairobi	(1), (16)	*nubifera* (A-M: Nairobi endemic)	Yes.	A-M and Z-I
Lolldaiga Hills (Ranch)	(1), (16*), (21)	*wellsi* (A-M: Lolldaiga Hills endemic)	Yes.	A-M and Z-I
Aberdare Range, Lower Salient	(1), (17)	*aberdarensis* (A-M: Aberdare Range endemic)	Yes.	A-M and **G-C**
Lolgorien	(1), (22)	*finchhattoni* (A-M: endemic to Lolgorien and nearby?)	Yes.	A-M and L-V
Kakamega Forest	(3), (23)	*juliusmathiui* (L-V: Kakamega Forest endemic)	Yes.	L-V and Z-I
Lake Nkuruba with adjacent forest	(3), (18), (24), (25)	***maasi*** (L-V: Nkuruba – Kibale endemic)	Yes.	L-V and Z-I
Gitega	(3), (18)	*gitegaensis* (L-V: Central Plateau endemic)	Yes.	L-V and A-M
Gitega	(3), (18)	*fontainei* (L-V: Central Plateau endemic)	Yes.	L-V and A-M
Kibonoto, Mount Kilimanjaro	(1), (16), (16**)	***tombutynskii*** (A-M: Mount Kilimanjaro endemic)	Yes.	A-M and Z-I
east of Kimambo Gardens, Mount Kilimanjaro	(1), (16), (16**)	***kilimanjaroensis*** (A-M: Mount Kilimanjaro endemic)	Yes.	A-M and Z-I
Arusha National Park, Mount Meru	(1), (15)	***rupimangatae*** (A-M: Mount Meru endemic)	Yes.	A-M and Z-I
Mount Mulanje (unknown Site but almost certainly above 1.500 m)	(1) or (2), (2a)	*vau-alba* (A-M: Mount Mulanje endemic and the only Afromontane endemic for Malawi, “Malawi Interval” is shown)	Yes.	A-M and Z-I

Second, Lovett (1993: 40) mentioned that the flora in all the different forest types of the 13 Eastern Arc Mountain blocks have strong western affinities, *e.g.* with 60% of the 274 tree species analysed also occurring in the main part of the Guineo-Congolian region. Based on 442 species in 60 genera of Metarbelidae, Lehmann (2019: 335, 336) already stated that no species was found in the Eastern Arc Mountains that belongs to a genus of the *"Guineo-Congolian regional centre of endemism" sensu* White (1983: 71, 73). The still missing link to the *"Guineo-Congolian regional centre of endemism"* is confirmed based on data for more than 1000 species in more than 130 genera of Metarbelidae considering in particular the Taita Hills, the East Usambara Mountains, the Uluguru Mountains and the Udzungwa Mountains. One possible reason for this fact is almost certainly that many extinction events occurred considering the very high degree of philopatry in Metarbelidae and in particular in species that belong to genera of the Guineo-Congolian region. Such extinction events are supported for many of the Eastern Arc Mountains by the fact that large areas are covered by younger sedimentary and volcanic rocks that overlie the Precambrian crystalline rocks. The volcanic rocks are "… all very recent and date from 5 myr B.P." (Newmark 2002: 7).

Sixth group: *"Linking species"* of the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161, 163/A-M) and the *"Lake Victoria regional mosaic" sensu* White (1983: 179, 180/L-V) presented in Table 5 (*cf.* "A-M and L-V" / "L-V and A-M").

This group is represented by three species, namely *K. finchhattoni* **sp. nov**., *K. gitegaensis* **sp. nov**. and *K. fontainei* **sp. nov**. that occur 210 km to the Southwest (Gitega) as well as 90 km to the East (Lolgorien) of Lake Victoria in a present forest-savanna mosaic comprising grass savannas with forest remnants. Additionally, Gitega is one of the most densely populated areas in Burundi.

Both habitats are located at altitudes between 1.590 and 1.780 m and hence, on the lower level of montane forest. The latter include *"Afromontane rain forest" sensu* White (1983: 164) at Gitega as well as drier patches of *"Diospyros-Olea forest" sensu* Kenya Government & Ministry of Overseas Development, UK (1969) at Lolgorien. Since *K. gitegaensis* **sp. nov**. and *K. fontainei* **sp. nov**. are linked to the former vegetation type both species occurred in areas around Lake Victoria already prior to 6,500 yr B.P. the last time when highest humidity was experienced in this region while drier montane forest "… underwent significant extension …" between 3,000 and 1,700 yr B.P. in particular along the eastern periphery of Lake Victoria (Ssemmanda & Vincens 2002: 519 + Fig 2) including areas around Lolgorien. Hence, *K. finchhattoni* **sp. nov**. represents a relict species at Lolgorien that still indicates this past extension of drier montane forest.

While morphological characters are more complex in *K. fontainei* **sp. nov**. (*cf.* diagnosis), the two species *K. gitegaensis* **sp. nov**. and *K. finchhattoni* **sp. nov**. share similar characters in their morphology. Hence, the ancestors of the latter two species almost certainly were widely distributed in the same area of lower montane forest comprising the Central Plateau of Burundi towards Lolgorien before Lake Victoria was formed. Almost certainly, speciation events occurred in the ancestor population of both species during the mid-Pleistocene when drainage in western

Uganda was reversed due to renewed tilt from the shoulders of the Albertine Rift with major environmental large-scale effects, *e.g.* the reversed rivers formed Lake Kyoga as well as Lake Victoria (Shackleton 1978: 26).

Conclusions:

- Based on the latter fact, the closest approach for this group at present is to conclude that it does represent species that evolved during or after the mid-Pleistocene.
- The ancestral areas of the ancestors are likely somewhere on the Central Plateau of Burundi as well as on lower montane regions around the present Lake Victoria.

The Afromontane endemic species of *Kayamuhakaia*

Eleven species are defined as Afromontane endemics, comprising nine species from Kenya and two species from Rwanda (*cf.* Table 6). These East African montane endemics are certainly younger than the East African coastal lowland species of *Kayamuhakaia* (*cf.* Table 1, 2 and 3) due to the following facts:

First, prior to the initiation of the EARS a relatively high topography — representing at least submontane levels as a result of regional upwarpings of the basement with separate phases of vertical movement (*cf.* Oxburgh 1978: 9 + Fig 1:1; Shackleton 1978: 20, 22; King 1978: 31) — is known from northeastern Uganda, the Nyungwe Forest area, the majority of Burundi, northwest and central Kenya, large parts of southwestern Tanzania, eastern Zambia and the majority of Malawi by 31 Ma (*cf.* Macgregor 2015: Fig 5).

The initiation of rifting in the “Western Branch” of the EARS began contemporaneously with the “Eastern Branch” 26 — 25 Ma (Roberts *et al.* 2012: 289, 293 + Figs 1, 4c). These active volcanic systems that developed an internal draining basin with border faults, uplifted rift shoulders and lava floods beyond their Rift limits, certainly favoured the speciation among montane species, *e.g.* in the Kivu Rift entering a main phase of active Rift development 5 Ma certainly affecting the adjacent Nyungwe Forest area located to the East of the Rift (*cf.* Macgregor 2015: Fig 10). A prolonged, widespread rifting and uplift of the East African Plateau throughout the Neogene (Roberts *et al.* 2012: 293) certainly favoured numerous speciation events, *e.g.* in western and central Kenya. Endemic montane species that occur in these areas that comprise largely a Neogene surface cannot be older than their specific montane ranges where they occur.

For example, volcanism first commenced *ca.* 23 Ma in the Kenya Rift extending to just south of the Equator (*cf.* Shackleton 1978: 21; Roberts *et al.* 2012: 289; Macgregor 2015: Fig 4), *e.g.* Mount Elgon begun to erupt *ca.* 20 Ma (Burke & Gunnell 2008: 27); the Elgeyo Hills were affected by active volcanism in the Elgeyo Escarpment initiating at 15 Ma with further eruptions 13.5 — 12 Ma (*cf.* Shackleton 1978: 21; Macgregor 2015: Fig 8); flood phonolites covered large areas of central Kenya, *e.g.* on the Maralal and Laikipia plateaus just to the North of the Equator as well as on the Aberdare Range 13.5 — 11 Ma (*cf.* Shackleton 1978: 23; King 1978:

45 + Fig 3:1; Macgregor 2015: Fig 8); Pliocene faulting produced horst strips by active rivers, *e.g.* by the Mukutan River in the Ol Ari Nyiro area 5 Ma (King 1978: 45); Mount Kenya initiated with a first build-up phase *ca.* 5.8 Ma (Schoorl *et al.* 2014: 45).

Certainly, the remarkable high diversity and high rate of endemism of montane species in comparison to the much lower diversity of lowland species of *Kayamuhakaia* in East Africa is a result of active volcanism. Furthermore, montane species of *Kayamuhakaia* are younger the closer they occur to the *"Northern Tanzanian Divergence Zone"* (Dawson 1992), *e.g.* on Mount Kilimanjaro that developed first *ca.* 2.5 Ma and Mount Meru that developed during the last 2 Ma (*cf.* Macgregor 2015: Fig 11). Species from the latter two areas are defined as *"linking species"* (*cf.* Table 5 and "Fourth group").

An outstanding feature represented by all species in Table 6 is the fact that no male is known from endemic Afromontane species of *Kayamuhakaia* occurring in montane, upper montane and subalpine habitats in Kenya and Rwanda where Caesalpinioideae are absent.

Conclusions:

- The latter result contrasts with the great majority of Metarbelidae species of the Afrotropical Region — including basal taxa (*cf.* Lehmann 2019b: 44 — 51) — where females are unknown but males are known. This pattern occurs also, *e.g.* in several species of *Lukeniana* Lehmann, Zahiri & Husemann, 2023 representing a regular element of the Afromontane archipelago (Lehmann *et al.* 2023: 13).
- The females in species of *Kayamuhakaia* appear to be more active in their montane, upper montane and subalpine habitats than their males in regard to East Africa.
- This behavior is certainly of more recent origin in Metarbelidae and might be linked to the initiation of rifting as well as to active volcanic systems in the "Western Branch" of the EARS as well as in the "Eastern Branch" and hence, cannot be older than 26 — 25 Ma.
- Malawi is excluded here (*cf.* notes on the *"Malawi Interval"* herein).

Table 6

Afromontane endemic species of *Kayamuhakaia* recorded in Kenya and Rwanda in the following phytochoria: **(1)** *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161/A-M); **(5)** *"Somalia-Masai regional centre of endemism" sensu* White (1983: 112/S-M). Data is based on collecting Sites as well as morphological characters for each species (*cf.* diagnosis).

Dominance of Caesalpinioideae is absent on all Sites located in "nine well known areas".

"Key Biodiversity Areas" of Kenya are shown in bold.

The *"Malawi Interval" sensu* Chapman & White (1970: 76) is shown in the absence of any Afromontane endemic species of *Kayamuhakaia* in Malawi.

Vegetation types: **(26)** *"Lower Montane Wet Forest" sensu* Zhou *et al.* (2018: Fig 1, Table 1); **(27)** *"Ocotetalia usambarensis" sensu* Bussmann & Beck (1995: 488) dominated by, *e.g. Kuloa usambarensis* Trofimov & Rohwer (Lauraceae); **(28)** "*Hagenietalia abyssinicae*" *sensu* Bussmann & Beck (1995: 524); **(29)***"Hagenio abyssinicae – Juniperion procerae" sensu* Bussmann & Beck (1995: 526) with *Daucus incognitus* Spalik, Reduron & Banasiak (Apiaceae); **(30)** *"Single-dominant Afromontane Forest" sensu* White (1983: 165) dominated by *Juniperus procera* Hochst. (Cupressaceae); **(31)** *"Moist Montane Forest" sensu* Lambrechts *et al.* (2003: 9) dominated by *Cassipourea malosana* Alston (Rhizophoraceae); **(21)** *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115) that replaced **(30)** in **(1)** and where **(5)** abuts locally Afromontane vegetation at altitudes above 1.700 m; **(15)** *"Undifferentiated Afromontane Forest" sensu* White (1983: 165) on drier slopes and with secondary vegetation of **(21)**, or dominated by **(32)** *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae); **(22)** *"Evergreen clump-grassland"* with patches of *"Diospyros-Olea forest" sensu* Kenya Government & Ministry of Overseas Development, UK (1969); **(33)** wetter subalpine vegetation in the *"Ericaceous Belt" sensu* Hedberg (1951: 182) including relicts of the *"Hagenia-Hypericum Zone" sensu* Hedberg (1951: 174) with small patches of forest dominated by *Hagenia abyssinica* J.F.Gmelin (Rosaceae) in a vegetation mosaic; **(34)** "*montane forest at middle altitudes (2.100 — 2.600 m)*" *sensu* Fischer & Killmann (2008: 15) dominated by *Beilschmiedia rwandensis* R. Wilczek and *Kuloa michelsoni* Trofimov (Lauraceae).

Table 6

Locality	**Main Vegetation Types**	**A-M endemic Species of *Kayamuhakaia***	**linking Species**	**Noteworthy in regard to Metarbelidae**
Castle Forest Lodge area, **Mount Kenya**	(1), (26), (27)	*mountkenyaensis* (A-M: Mount Kenya endemic)	No.	
Rutundu lake area, **Mount Kenya**	(1), (28)	*nancycammae* (A-M: Mount Kenya endemic)	No.	Collecting Site just above 3.000 m elevation.
ca. 4 km east of Rutundu road, **Mount Kenya**	(1), (29)	*hermannstaudei* (A-M: Mount Kenya endemic)	No.	Collecting Site just above 2.900 m elevation.
Ngong Forest, Nanyuki, Naro Moru River Lodge, Lolldaiga Hills	(1), (30), (5), (21)	*nanyukiensis* (A-M endemic)	No.	S-M abuts Afromontane forest types in an elevation range of 1.750-1.900 m, *e.g.* locally near Naro Moru.
Kikuyu Escarpment Forest	(1), (31)	*karenae* (A-M: endemic to Kikuyu Escarpment Forest and ?Nyamweru Forest)	No.	
Lower Loroghi Forest, Karisia Hills	(1), (15), (21)	*barrychappelli* (A-M: Karisia Hills endemic)	No.	
Lolgorien	(1), (22)	*lolgoriensis* (A-M: endemic to Lolgorien and nearby?)	No.	
Kaptagat, Elgeyo Hills	(1), (15), (32)	*stephanierobertsae* (A-M: Elgeyo Hills endemic)	No.	
Kimothon River bank forest, **Mount Elgon** National Park	(1), (33)	*yiruchengae* (A-M: Mount Elgon endemic)	No.	Collecting Site at 3.200 m altitude!
Nyungwe Forest, Nyungwe National Park	(1), ?(34)	*killmannae* (A-M: Nyungwe Forest endemic + ?Cyamudongo Forest)	No.	
Nyungwe Forest, Nyungwe National Park	(1), (34)	*philipokwaroi* (A-M: Nyungwe Forest endemic + ?Cyamudongo Forest)	No.	

Seventh group: *"Linking species"* of the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) and the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 112/S-M) presented in Table 7 (*cf.* "Z-I and S-M").

This "group" is only represented by one species at present, namely *Finsterwaldeia danduensis* **sp. nov.**

Table 7

Lichterfeldia and *Finsterwaldeia* comprise at present species that are endemic to the Somalia-Masai region (S-M) of Kenya including herein one Z-I and S-M *"linking species"* of *Finsterwaldeia.* The first letters "Z-I" imply that the Z-I region is the possible ancestral area.

Species of both genera were recorded in or adjacent to the following phytochoria: **(1)** *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161/A-M); **(5)** *"Somalia-Masai regional centre of endemism" sensu* White (1983: 112/S-M). Data is based on collecting Sites as well as morphological characters for each species (*cf.* diagnosis).

Dominance of Caesalpinioideae is absent on both Sites.

"Key Biodiversity Areas" of Kenya are shown in bold.

Vegetation types: **(35)** *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113) dominated by trees, *e.g. Acacia brevispica* Harms, *A. bussei* Harms, *A. nilotica* Del., *A. paolii* Chiov. (Mimosoideae), *Commiphora samharensis* Schweinf., *C. rostrata* Engl. var. *reflexa* Gillett (1991: 15), *C. confusa* Vollesen, *C. baluensis* Engl. (Burseraceae) and *Delonix elata* Gamble (Caesalpinioideae); **(36)** *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115), *e.g.* with small trees of *Vepris eugeniifolia* I. Verdoorn (Rutaceae), *Euclea racemosa* L. (Ebenaceae) and *Dodonaea viscosa* Jacq. subsp. *angustifolia* J.G.West (Sapindaceae); shrubs of *Bullockia pseudosetiflora* Razafim., Lantz & B. Bremer (Rubiaceae) mixed with climbers of *Cyphostemma digitatum* Desc. (Vitaceae); *cf.* Verdcourt 1993: 122, 124); **(37)** *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115), *e.g.* dominated by *Tarchonanthus camphoratus* L. (Asteraceae), *Euclea divinorum* Hiern, *E. racemosa* L. subsp. *schimperi* F. White (Ebenaceae).

Locality	**Main Vegetation Types**	**endemic Species of *Finsterwaldeia* and *Lichterfeldia***	**linking Species**	**Phytochoria**
Dandu Hill ("inselberg") + Dandu (village)	(2), (35), (36)	*F. danduensis* (S-M: Dandu Hill endemic + ?adjacent area endemic)	Yes.	Z-I and S-M
Ol Ari Nyiro (Ranch)	(1), (2), (37)	*L. olarinyiroensis* (S-M endemic to *KBA* Ol Ari Nyiro + ?Western Laikipia Plateau)	No.	S-M abuts often Afromontane vegetation types, *e.g.* in the Mukutan Gorge

The assumption of I.L. is that neither any other species of this new genus nor *F.danduensis* **sp. nov.** has any links to the *"Somalia-Masai regional centre of endemism"* based on morphology (parsimony-informative characters of the S-M region should be absent, *cf.* Lehmann 2019b: 34). It is only due to the definition for *"linking species"* (*cf.* Material and Methods) that the S-M region is included here based on the locality of Dandu Hill while the Z-I region has to be mentioned first since it is considered as the most likely ancestral area.

Three morphological facts in context with the possible ancestral area should be considered that support the assumption of this "Z-I and S-M" group:

First, it was already stated that character "70" describes a narrow, strongly sclerotized band-like structure (Lehmann 2019b: 33, 386) that is in regard to its width closest to the band-like structure in *Finsterwaldeia danduensis* **sp. nov.**

Second, the apomorphy "70" (*cf.* Fig 25.a., a.1.+ Fig 24.a., a.2.) supports as a "parsimony-informative character" the split that separates the *"coastal forest Group" sensu* Lehmann (2019b: 32) into three genera (Lehmann 2019b: 32 + Fig 6c.). This clade occurred in the *"Afromontane archipelago-like regional centre of endemism" sensu* White (1983: 161/A-M), in the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/Z-I) as well as in the *"Tongaland-Pondoland regional mosaic" sensu* White (1983: 197, 198).

Third, the "elongated uncus and tegumen" is at least 2.1× as long as the basal width of valva. The most similar and closest approach for this character is the "parsimony-informative character" number "183" that is linked to Metarbelidae species that first originated in lowland rain forest of West Africa and/or Central Africa (Lehmann 2019b: 38, 383, Fig 6c.).

<u>Conclusions</u>:

- The closest morphological approach comprises two "potential parsimony-informative characters" that indicate that ancestors of species of *Finsterwaldeia* once occurred in the Guineo-Congolian lowland rain forest with links to species in the Afromontane archipelago as well as to species of the Z-I region.
- If these assumptions are correct they show a complex pattern that cannot be older than 32.9 Ma.

One reason for this complex pattern lies in the geographical position of Dandu Hill:

First, *ca.* 150 km further to the northwest of Dandu Hill begins a *"transition between dry single-dominant Afromonante forest and East African evergreen and semi-evergreen bushland and thicket" sensu* Friis (1992: Fig 3.). This zone is adjacent to various types of Afromontane forest further to the West and Northwest.

Second, Friis (1992: 22, 23) mentioned a number of genera comprising tree species with a strong Guineo-Congolian affinity — including Caesalpinioideae — that once occurred in the whole of northeast tropical Africa as well as on the western side of the Ethiopian Highlands *ca.* 8 Ma. It was thought for a long time that nothing of these Guineo-Congolian forest types remained in northeast Africa. Only in the late 1980s few scattered forests in the southwestern Escarpment of the northwestern Ethiopian Highlands were discovered by botanists, *e.g.* in Wellega, Illubabor and Kefa and have been identified as *"Lowland Dry peripheral semi-deciduous Guineo-Congolian forest"* and *"Transitional rain forest" sensu* Friis (1992: 28, 29) located on elevations of 450 — 1500 m. These discoveries are supported by Metarbelidae comprising species of two genera that are both linked to the Guineo-Congolian lowland rain forests as well as to the drier forest type as mentioned above, *e.g.* the occurrence of various undescribed species of the genus *Lebedodes* Holland (*cf.* Lehmann 2019b: 74 — 77 + Fig 30).

Third, a vegetation that has been identified as *"Transition between Zanzibar-Inhambane undifferentiated forest, ZI scrub forest and ZI evergreen and semi-evergreen bushland and thicket" sensu* Friis (1992: 42, 43) occurs on the *"South Somalia Coastal Plain"* as well as much further inland in southern Somalia on the *"Juba Plain"* and in the *"Bur Region" sensu* Friis (1992: Fig. 2. + Photo 26, 27, 28) at the foot of large rocky outcrops or "burs" which are also characteristic for adjacent parts in Kenya. This means that such relict Z-I vegetation types possibly still occur further to the East from Dandu Hill at the foot of "inselbergs".

The dry climate of the Dandu Hill area at present was almost certainly initiated a little after 3,000 yr B.P. when an arid phase largely affected the majority of tropical Africa culminating 2,500 — 2,000 yr B.P. (Maley 2001: 76). Additionally, intense erosion occurred during this arid phase. Hence, it is very likely that "inselbergs" in northeastern Kenya were mainly shaped by this intense erosion, resulting in such an irregularly dissected and undulating "inselberg" as Dandu Hill (altitude 738 — 1.219 m).

<u>Conclusions</u>:

- The ancestors of species of *Finsterwaldeia danduensis* **sp. nov.** must have mainly occurred in areas further to the Northwest and to the Northeast of Dandu Hill in a vegetation mosaic of lowland rain forest, Afromontane forest as well as in Z-I forest types of the Lowlands.
- Species of *Finsterwaldeia* are almost certainly still associated with Z-I as well as montane vegetation on "inselbergs" and "burs" where they represent relicts of a vegetation mosaic that occurred before 3,000 yr B.P.
- This implies — together with the morphological facts — that *Finsterwaldeia danduensis* **sp. nov.** can be considered as a relict species indicating a past more humid climate.

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Figures 1.a. — 39.b.

Figures 1.a. — 1.b. Collecting Sites of studied specimens of 40 species of the new genera *Kayamuhakaia* (1.a.), *Finsterwaldeia* and *Lichterfeldia* (1.b.)

1.a. *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184, 185/ Z-I) and *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61, 62): 1 Buulo Xaaji, 2 near Buulo Xaaji, 3 Lag Badana-Bushbush National Park, 4 Kismayu behind the coastal dunes, 1 — 4 belong also to the *"South Somalia Coastal Plain" sensu* Friis (1992: 11); 5 Malindi, 6 west of Gede, 7 Arabuko-Sokoke Forest, 8 Watamu, 9 Rabai, 10 Kaya Muhaka, 11 Gogoni Forest, 12 Shimba Hills, 13 Diani, 14 Tiwi, 15 Buda Forest, 16 Gasi, 17 near Matsangoni, 43 Dar Salam (original spelling).

Exclave of the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 184): 44 Kimboza Forest.

"Afromontane archipelago-like regional centre of endemism" sensu White (1983: 161, 163) and *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 112) and "*Lake Victoria regional mosaic" sensu* White (1983: 179, 180): 18 Yale Forest, 19 Kivuli Camp, 20 Nairobi (Loresho Ridge), 21 Ngong, 22 Nanyuki, 23 Lolldaiga Hills Ranch, 24 Naro Moru River Lodge, 25 Mount Kenya (Castle Forest), 26 Mount Kenya near Lake Rutundu, 27 Mount Kenya *ca.* 4 km west of Rutundu road, 28 Aberdare Range (Lower Salient), 29 Aberdare Range (Lower Salient), 30 Gatamaiyu Forest Nature Reserve, 31 Karisia Hills (Loroghi Forest), 32 Lolgorien, 33 Kaptagat, 34 Kakamega Forest, 35 Mount Elgon (Kimothon River), 36 Lake Nkuruba, 37 Nyungwe Forest, 38 Gitega, 40 Mount Kilimanjaro (Kibonoto), 41 Mount Kilimanjaro (near Kimambo Gardens), 42 Mount Meru.

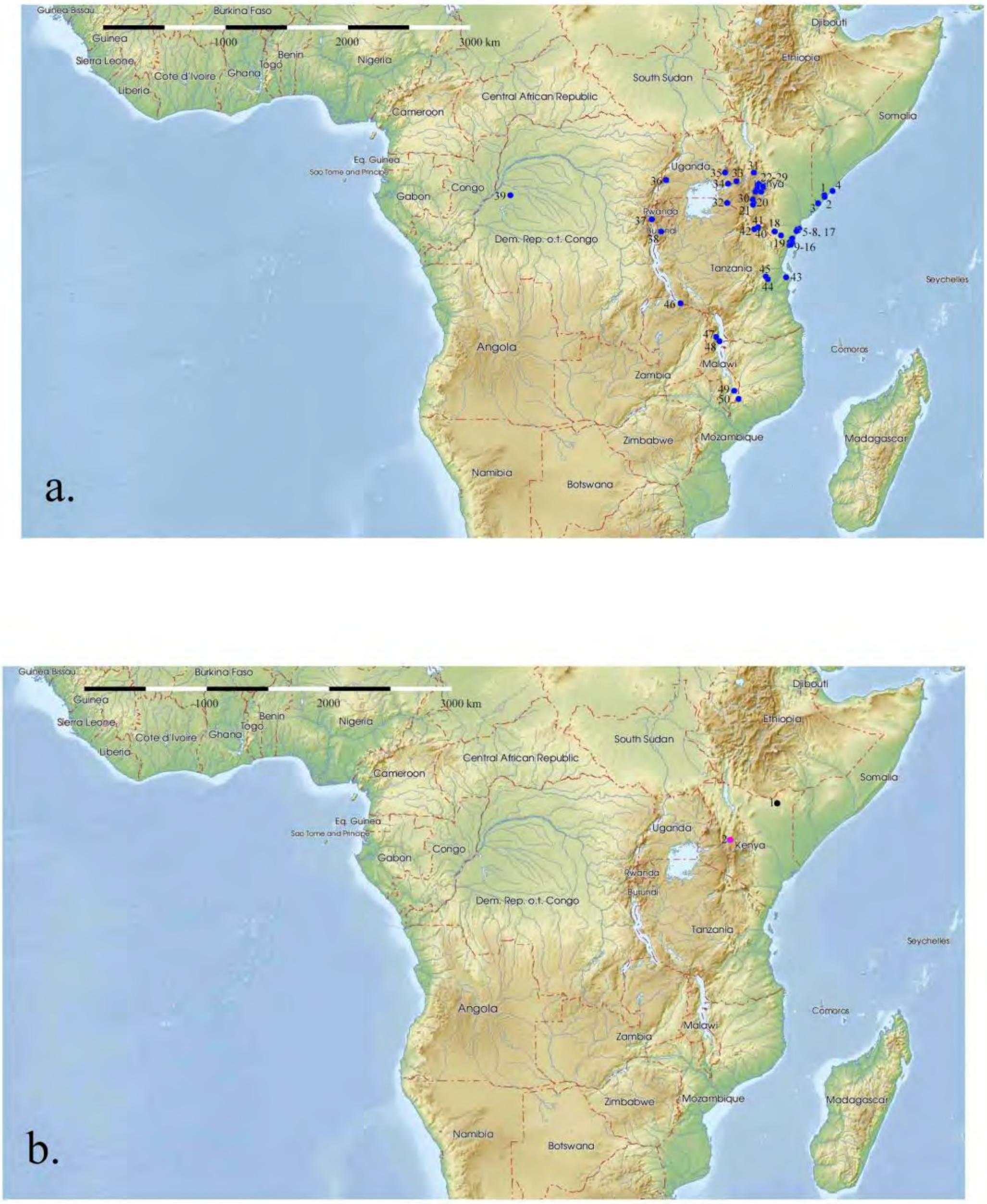
"Guineo-Congolian regional centre of endemism" sensu White (1983: 71, 73): 39 Bokatola.

"Zambezian regional centre of endemism" sensu White (1983: 86, 88): 45 Morogoro, 46 Mbala, 47 Mzuzu, 48 Mkuwadzi Hill (considered herein as former Z-I exclave), 49 Zomba.

"Swahilian/Maputaland regional transition zone" sensu Clarke (1998: 61, 62): 50 Ruo River Gorge (Mount Mulanje).

1.b. *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 112): 1 Dandu Hill and Dandu village, 2 Ol Ari Nyiro.

1.



a.
0
1000
2000
3000 km
Guinea Bissau
Burkina Faso
Guinea
Sierra Leone
Cote d'Ivoire
Ghana
Togo
Benin
Nigeria
Liberia
Cameroon
Central African Republic
South Sudan
Ethiopia
Djibouti
Somalia
Eq. Guinea
Sao Tome and Principe
Gabon
Congo
Dem. Rep. o.t. Congo
Uganda
Kenya
Rwanda
Burundi
Tanzania
Seychelles
Comoros
Angola
Zambia
Malawi
Zimbabwe
Mozambique
Madagascar
Namibia
Botswana
1
2
3
4
5-8, 17
9-16
18
19
20
21
22-29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
b.
1

Figures 2. — 12. Specimens of species of the new genera *Kayamuhakaia, Finsterwaldeia* and *Lichterfeldia*

Figures 2.

2.a. *Kayamuhakaia haberlandorum*, male, Kenya, South Coast, Kwale County, Kaya Muhaka, northwestern forest edge — the collecting Site of the holotype as well as of the figured male was adjacent to trees of *Julbernardia magnistipulata* Troupin (Caesalpinioideae) and *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae) in *"Zanzibar-Inhambane secondary grassland and wooded grassland" sensu* White (1983: 189); *cf.* Lehmann (1997: 49).

K. haberlandorum is considered at present as descendant species that represents one of the three closest species to the unknown basal ancestor of *Kayamuhakaia, cf.* "Present species closest to the unknown basal species of genus" in the chapter "Results".

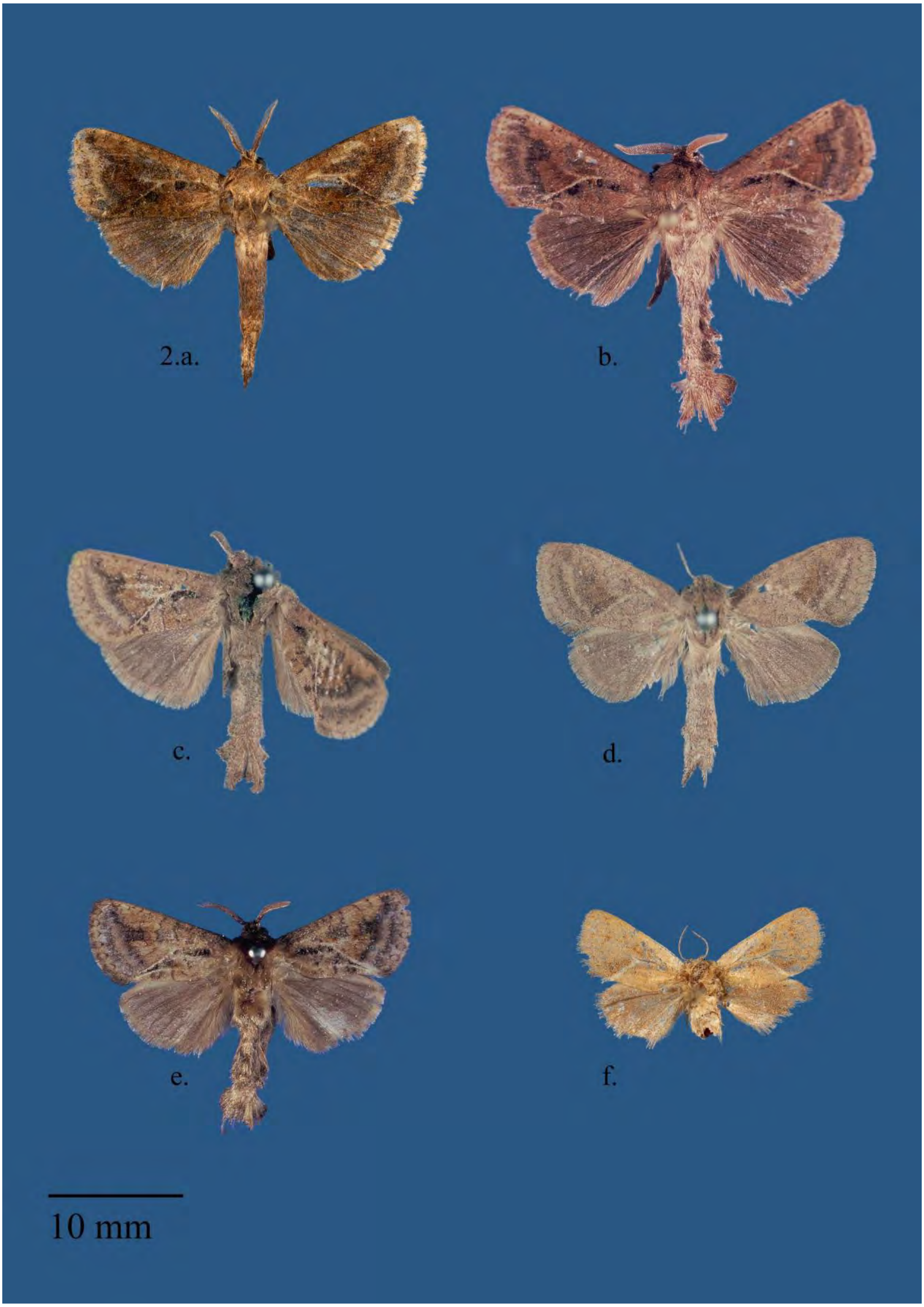
2.b. *K. haberlandorum*, male, Kenya, South Coast, Kwale County, Shimba Hills, collecting Site unknown.

2.c. *K. haberlandorum*, male (faded), Kenya, North Coast, Kilifi County, Rabai, collecting Site almost certainly the same as for the female below.

2.d. *K. haberlandorum*, female (faded), Kenya, North Coast, Kilifi County, Rabai, collecting Site almost certainly in one of the Rabai Kayas named "Mbwadu" (*cf.* Willis 1996: 94) or "Mkwadu" as written by hand possibly by van Someren (*cf.* "Note" of I.L. below the label data of *K. haberlandorum* in the text).

2.e. *K. haberlandorum*, male (slightly faded), Kenya, South Coast, Kwale County, Gasi Forest, collecting Site probably in a wetter type of *"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 187).

2.f. *K. neemambeyuae*, holotype, female (slightly faded, abdomen bent upwards and not visible in picture), Somali Republic, Jubaland federal state, "Lake [misprint of Lag?] Baddana", collecting Site unknown — most probably collected in the Lag Badana-Bushbush National Park, *e.g.* along the banks of the Lach Buscbusc (*cf.* Friis 1992: Photo 27.) or along the banks of the Baddana River, *e.g.* near or south of Buulo Xaaji where the river widens significantly and possibly looked like a "lake" for the collector. This species is the first published record of any Metarbelidae for the physiographic unit *"S* [South] *Somalia Coastal Plain" sensu* Friis (1992: Fig 2.).


2.a.
b.
c.
d.
e.
f.
10 mm

Figures 3.

3.a. *Kayamuhakaia kismayuensis*, holotype, female, Somali Republic, Jubaland federal state, Kismayu town area, collecting Site unknown but almost certainly behind the coastal dunes. The species represents the second published record (*cf.* Fig 2.f. herein) of any Metarbelidae for the physiographic unit *"S* [South] *Somalia Coastal Plain" sensu* Friis (1992: Fig 2.).

3.b. *K. ngwenoae*, holotype, male, Kenya, North Coast, Kilifi County, Arabuko-Sokoke Forest, collecting Site in *"Cynometra-Manilkara forest" sensu* Britton & Zimmerman (1979: 3).

3.c. *K. kasikamwiuae*, holotype, male (damaged, faded, end of abdomen not present in picture), Kenya, North Coast, Kilifi County, Arabuko-Sokoke Forest, collecting Site in *"mixed wetter semi-deciduous forest" sensu* Githitho (2021: Fig 1) or *"lowland rain forest" sensu* Britton & Zimmerman (1979: 3).

3.d. *K. petermuriithii*, holotype, male (wings slightly worn), Kenya, *"northern Eastern Arc Mountains" sensu* Lovett (1998: 62), Taita Hills, Yale Forest, Taita-Taveta County, collecting Site in the forest interior of an *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

3.e. *K. nubifera* (Bethune-Baker, 1909), "type", female (wings slightly worn, end of abdomen not present in picture), Kenya, Nairobi, Nairobi City County, collecting Site unknown.

3.f. *K. latifasciata* (Gaede, 1929), "type", female (end of abdomen not present in picture), Kenya, Nairobi, Nairobi City County, collecting Site unknown — this species is considered herein as synonym of *K. nubifera*.

3.g. *K. nubifera* (Bethune-Baker, 1909), male, Kenya, Nairobi, Nairobi City County, collecting Site unknown.


3.a.
b.
c.
d.
e.
f.
g.
10 mm

Figures 4.

4.a. *Kayamuhakaia nanyukiensis*, holotype, female, Kenya, Laikipia County, Nanyuki town area, collecting Site unknown.

4.b. *K. nanyukiensis*, paratype, female, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house (*cf.* Fig 34.a.), collecting Site in *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115).

4.c. *K. wellsi*, holotype, male, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house (*cf.* Fig 34.a.), collecting Site in *"East African evergreen and semi-evergreen bushland and thicket"*.

4.d. *K. wellsi*, paratype, female, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house (*cf.* Fig 34.a.), collecting Site in *"East African evergreen and semi-evergreen bushland and thicket"*.

4.e. *K. mountkenyaensis*, holotype, female (abdomen not present in picture), Kenya, Mount Kenya, Mount Kenya Forest Reserve, Castle Forest Lodge area, Kirinyaga County, collecting Site in *"Ocotetalia usambarensis" sensu* Bussmann & Beck (1995: 488).

4.f. *K. nancycammae*, holotype, female (wings slightly worn), Kenya, Mount Kenya, Mount Kenya Forest Reserve, "Kazita River" [=Kathita River and near Lake Rutundu representing one of the highest elevations for Metarbelidae, *cf.* Table 6], Meru County, collecting Site most probably in *"Hagenietalia abyssinicae" sensu* Bussmann & Beck (1995: 524).


4.a.
b.
c.
d.
e.
f.
10 mm

Figures 5.

5.a. *Kayamuhakaia hermannstaudei*, holotype, female (right forewing slightly worn), Kenya, Mount Kenya, Mount Kenya Forest Reserve, *ca.* 4 km east of Rutundu road, Meru County, collecting Site in *"Hagenio abyssinicae – Juniperion procerae" sensu* Bussmann & Beck (1995: 526).

5.b. *K. aberdarensis*, holotype, female, Kenya, Aberdare Range, Aberdare National Park, Lower Salient, Nyeri County, collecting Site in closed forest of the "*Cassipourea malosana - Setaria plicatilis* agg. community" *sensu* Schmitt (1991: 83).

5.c. *K. karenae*, holotype, female (wings worn, abdomen not present in picture), Kenya, Aberdare Range, Kikuyu Escarpment Forest, Gatamaiyu Forest Nature Reserve, Kiambu County, collecting Site most probably in *"Moist Montane forest" sensu* Lambrechts *et al.* (2003: 9).


5.a.
b.
c.
10 mm

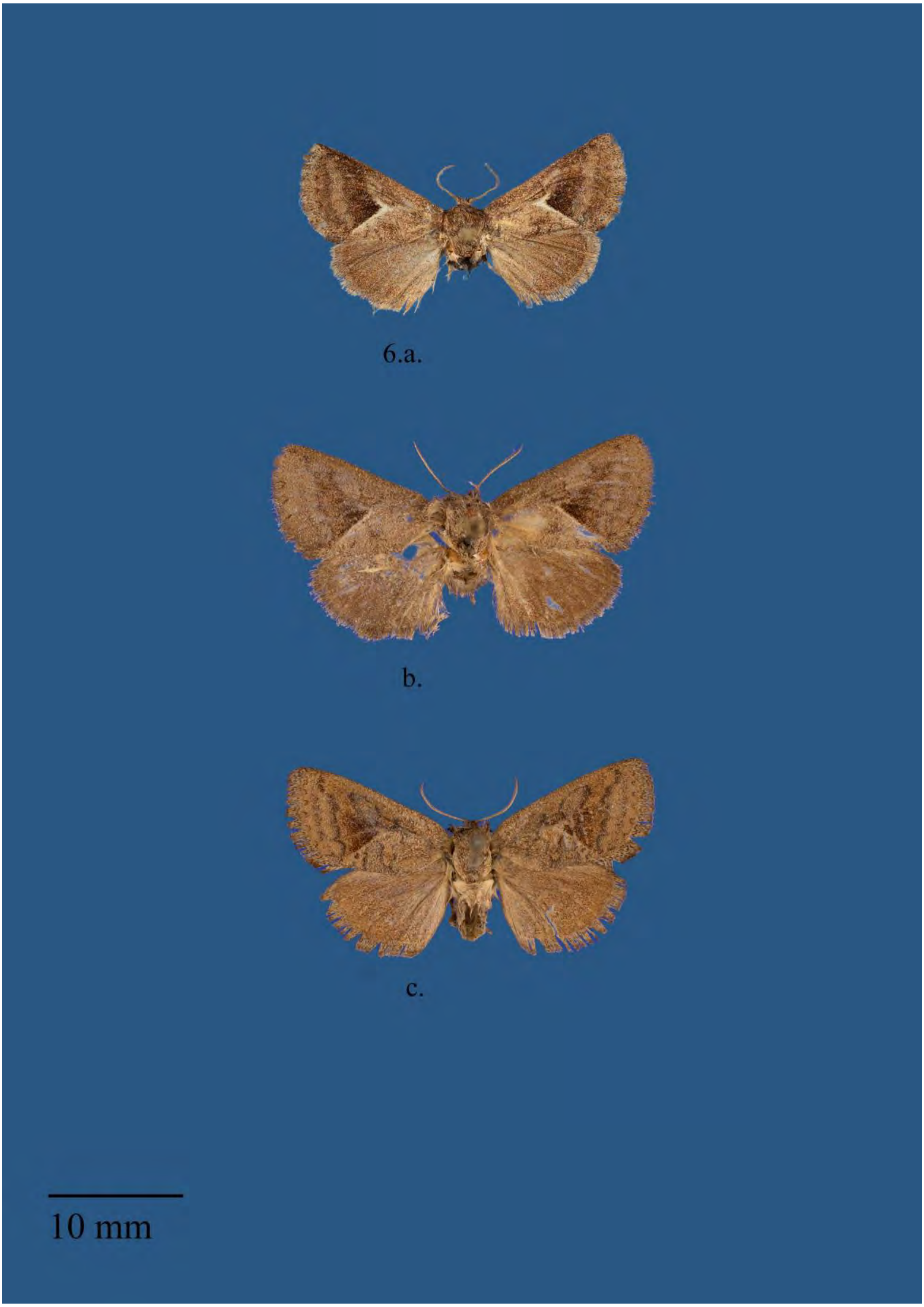
Figures 6.

6.a. *Kayamuhakaia barrychappelli*, holotype, female (abdomen not present in picture), Kenya, Maralal Plateau, Karisia Hills, northwestern lower Loroghi Forest, Samburu County, collecting Site in secondary bushland that replaced largely a drier type of *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

6.b. *K. finchhattoni*, holotype, female (wings damaged, abdomen not present in picture), Kenya, Lolgorien, Narok County, collecting Site in *"Evergreen clump-grassland"* with patches of semi-deciduous *"Diospyros-Olea forest"* or in a *"Broad-leaved savanna type with Combretum mixtures of probable forest origin" sensu* Kenya Government & Ministry of Overseas Development UK (1969) including riverine forest and woodland patches that occur along numerous drainage lines.

6.c. *K. lolgoriensis*, holotype, female (abdomen not present in picture), Kenya, Lolgorien, Narok County, collecting Site in *"Evergreen clump-grassland"* with patches of semi-deciduous *"Diospyros-Olea forest"* or in a *"Broad-leaved savanna type with Combretum mixtures of probable forest origin" sensu* Kenya Government & Ministry of Overseas Development UK (1969) including riverine forest and woodland patches that occur along numerous drainage lines.

Based only on wing pattern this species cannot be separated from *K. finchhattoni*, *cf.* for example Figs 18.b. with 18.c.


6.a.
b.
c.
10 mm

Figures 7.

7.a. *Kayamuhakaia stephanierobertsae*, holotype, female, Kenya, Elgeyo Hills, Kaptagat, Uasin Gishu County and at the border with Elgeyo Marakwet County, collecting Site unknown, most probably in or close to the Kaptagat Forest Reserve in *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

7.b. *K. juliusmathiui*, holotype, female, Kenya, Kakamega Forest, Isecheno Nature Reserve, Kakamega County, collecting Site in *"middle-age secondary forest"* of the "*Strombosia scheffleri* – plant community" *sensu* Althof (2005: 90).

7.c. *K. yiruchengae*, holotype, female (wings worn but <u>not</u> faded), Kenya, Mount Elgon, Mount Elgon National Park, Kimothon River, Trans Nzoia County, collecting Site in subalpine forest patches of the *"Ericaceous Belt" sensu* Hedberg (1951: 182) including relict patches of the *"Hagenia-Hypericum Zone" sensu* Hedberg (1951: 174) representing one of the highest elevations for Metarbelidae, *cf.* Table 6.


7.a.
b.
c.
10 mm

Figures 8.

8.a. *Kayamuhakaia maasi*, holotype, female (abdomen not present in picture), Uganda, Western Region, Kabarole District, Lake Nkuruba Nature Reserve, collecting Site in a transitional forest type comprising Guineo-Congolian linking tree species and Afromontane linking tree species adjacent to the southern shore of Lake Nkuruba.

8.b. *K. gitegaensis*, holotype, female (wings slightly worn), Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest" sensu* White (1983: 181).

Well visible are the very long antennae. They are with 0.50 length of forewing among the longest in females of *Kayamuhakaia.*

8.c. *K. fontainei*, holotype, male, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest"*.

8.d. *K. fontainei*, paratype, female, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest"*.

8.e. *K. killmannae*, holotype, female, Rwanda, Nyungwe National Park, Nyungwe Forest, the exact locality of the collecting Site in the forest is unknown (*cf.* additional notes by I.L. regarding the label data in the text for the description of this species).


8.a.
b.
c.
d.
e.
10 mm

Figures 9.

9.a. *Kayamuhakaia philipokwaroi*, holotype, female, Rwanda, Southern Region, Nyamagabe District, Pindura, Nyungwe National Park, Nyungwe Forest, collecting Site in *"montane forest at middle altitudes (2.100 — 2.600 m)" sensu* Fischer & Killmann (2008: 15).

9.b. *K. bokatolaensis*, holotype, female, Democratic Republic of the Congo, Équateur Province, Bokatola, collecting Site in *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) located in a *"small scale* [fluvial lowland forest] *refuge area" sensu* Leal (2001: 1073, 1077) that persisted several times during ice ages.

K. bokatolaensis is considered at present as descendant species that represents one of the three closest to the unknown basal ancestor species of *Kayamuhakaia*, *cf.* "Present species closest to the unknown basal species of genus" in the chapter "Results".

9.c. *K. tombutynskii*, holotype, female, Tanzania, Kilimanjaro Region, Mount Kilimanjaro, Kibonoto, Siha District, collecting Site most probably in the cultural zone that is dominated by Chagga home gardens with relicts of *"Dry transitional montane forest" sensu* White (1983: 166, 167).


9.a.
b.
c.
10 mm

Figures 10.

10.a. *Kayamuhakaia kilimanjaroensis*, holotype, female (abdomen not present in picture), Tanzania, Kilimanjaro Region, Mount Kilimanjaro, forest east of Kimambo Gardens, Siha District, collecting Site in the cultural zone that is dominated by Chagga home gardens with relicts of *"Dry transitional montane forest" sensu* White (1983: 166, 167).

10.b. *K. rupimangatae*, holotype, female (wings slightly worn, abdomen not present in picture), Tanzania, Arusha Region, Mount Meru, Miriakamba Hut, Arusha National Park, Meru District, collecting Site in *"Undifferentiated Afromontane Forest" sensu* White (1983: 165).

10.c. *K. triangularis*, "Type", male, collected at the original Dar Salam, *cf.* Shaykh Al-Amin (1995: 20), today Tanzania, Dar es-Salaam Region. The collecting Site was most probably in the "Sachsenwald"— it was a wetter or moist coastal forest type comprising a matrix of swampy as well as more open tree layers. The "Sachsenwald" does no longer exist although it was later protected as the Mogo Forest Reserve of which also nothing remains (*cf.* Hawthorne 1984: 96, 143 — 146). Hence, it is very likely that *K. triangularis* is already extinct or highly threatened.

Well visible in the picture is the hindwing upperside that is not faded but ivory yellow mixed with light buff.


10.a.
b.
c.
10 mm

Figures 11.

11.a. *Kayamuhakaia kimbozensis*, holotype, male, Tanzania, Morogoro Region, Kimboza Catchment Forest Reserve, Morogoro District, collecting Site in *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186).

Visible in the picture are more narrow, elongated forewings (*cf.* Fig 11.b.).

11.b. *K. aarviki*, holotype, male, Tanzania, Morogoro Region, Morogoro town area, Morogoro District, collecting Site in a cultivated garden with relicts of a drier type of *"Zambezian miombo woodland" sensu* White (1983: 92).

Well visible in the picture are several almost rectangular shaped black patches edged with Isabella colour and cream on the forewing upperside (*cf.* Fig 11.a.).

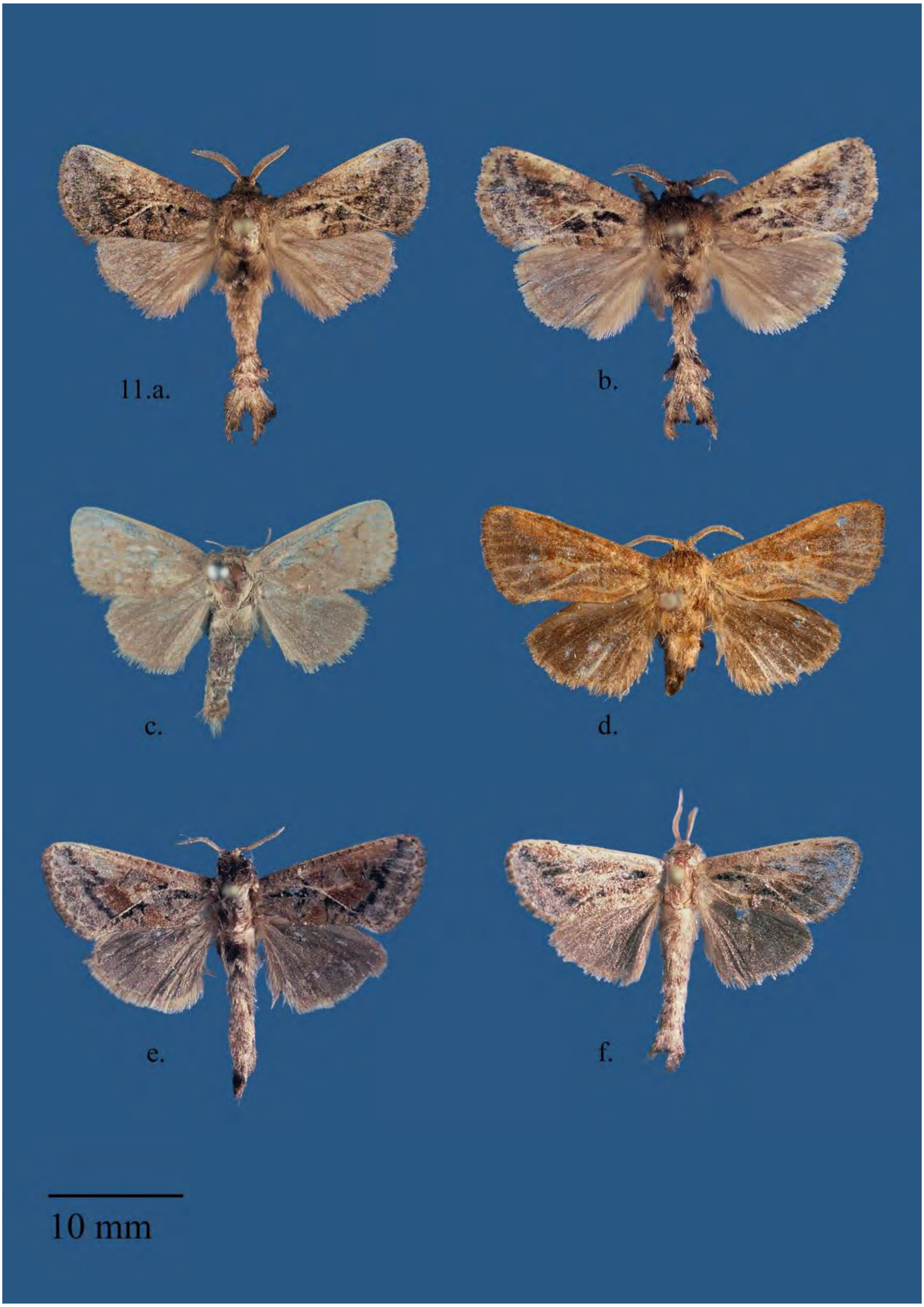
11.c. *K. mbalensis*, holotype, female (wings faded), Zambia, Northern Province, Mbala, Mbala District, collecting Site unknown — most probably in *"northern wet miombo woodland" sensu* Chidumayo (1997: 8) or in undifferentiated *Brachystegia-Isoberlinia* woodlands *sensu* Burtt (1942: 79); both woodland types are dominated by Caesalpinioideae.

11.d. *K. mkuwadziensis*, holotype, male (abdomen not present in the picture), Malawi, Northern Region, Mkuwadzi Hill, Nkhata Bay District, collecting Site in one of the few surviving patches of *"Zambezian transition woodland" sensu* White (1983: 91) dominated by trees of Caesalpinioideae older than 200 years. This Site was formerly most probably adjacent to or covered by *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) — a forest type that was completely destroyed in the Nkhata Bay area by humans (*cf.* Chapman & White 1970: 178; White *et al.* 2001: 60, 61).

The forewings are largely of deep olive-buff and Isabella colour and do not have lunules or any subterminal and terminal band; wing pattern is absent, *cf.* Fig 12.a.

11.e. *K. huchtemanni*, holotype, male, Malawi, Northern Region, Mzuzu, Nkhorongo, Mzimba District, collecting Sites for this species are located in *"Zambezian transition woodland"* and *"Zambezian miombo woodland" sensu* White (1983: 91, 92).

11.f. *K. yvonnedejongae*, holotype, male (forewings worn), Malawi, Southern Region, Shire Highlands, Mount Zomba, on the banks of the Lower Mlunguzi River, Zomba township, Forestry Research Institute of Malawi, Zomba District, collecting Site in a relict patch of *"Zambezian swamp forest and riparian forest" sensu* White (1983: 91).


11.a.
b.
c.
d.
e.
f.
10 mm

Figures 12.

12.a. *Kayamuhakaia hilarysommerlatteae*, holotype, male (abdomen not present in picture, wings slightly worn), Malawi, Southern Region, Mount Mulanje, Ruo River Valley, Mulanje Mountain Reserve, Mulanje District, collecting Site along the banks of the Ruo River in a relict of *"Zanzibar-Inhambane lowland rain forest"* and *"Transitional rain forest" sensu* White (1983: 186, 187).

K. hilarysommerlatteae is considered at present as descendant species that represents one of the three closest species to the unknown basal ancestor species of *Kayamuhakaia* in Malawi, *cf.* "Present species closest to the unknown basal species of genus" in the chapter "Results".

Visible in the picture is an almost absent wing pattern. This absence might represent a plesiomorphic state in species of *Kayamuhakaia*. Additional specimens are necessary to support this assumption (*cf.* Fig 11.d. for *K. mkuwadziensis*).

12.b. *Finsterwaldeia danduensis*, holotype, male, Kenya, Dandu or Dandu Hill, Mandera County, collecting Site most probably in wetter tiny Sites that occur on Dandu Hill in *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115); less likely in *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113).

Visible in the picture are the very long antennae with 0.50 length of forewing.

12.c. *Lichterfeldia olarinyiroensis*, holotype, female (forewings and hindwings worn), Kenya, Ol Ari Nyiro Ranch, Kuti, Laikipia County, collecting Site in *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115).

Visible are the very long antennae with 50% of forewing length and an unusual narrow flagellum on its entire length.

12.a.

b.

c.

10 mm

Figures 13. — 24. Genitalia in pressed condition below glass of species of the new genera *Kayamuhakaia*, *Finsterwaldeia* and *Lichterfeldia*

Figures 13.

13.a. *Kayamuhakaia haberlandorum*, male, Kenya, South Coast, Kwale County, Kaya Muhaka, northwestern forest edge.

13.b. *K. haberlandorum*, male, Kenya, North Coast, Kilifi County, Rabai, collecting Site almost certainly the same as for the female below (Fig 13.c.).

The uncus and tegumen are elongated (Fig 13.b., b.1. and b.2.). An "elongated uncus and tegumen" means in this context that both are 1.8 — 2.1× as long as the basal width of valva. The uncus only is short and never as long as the basal width of valva in contrast to species of *Finsterwaldeia* (*cf.* Fig 24.a.).

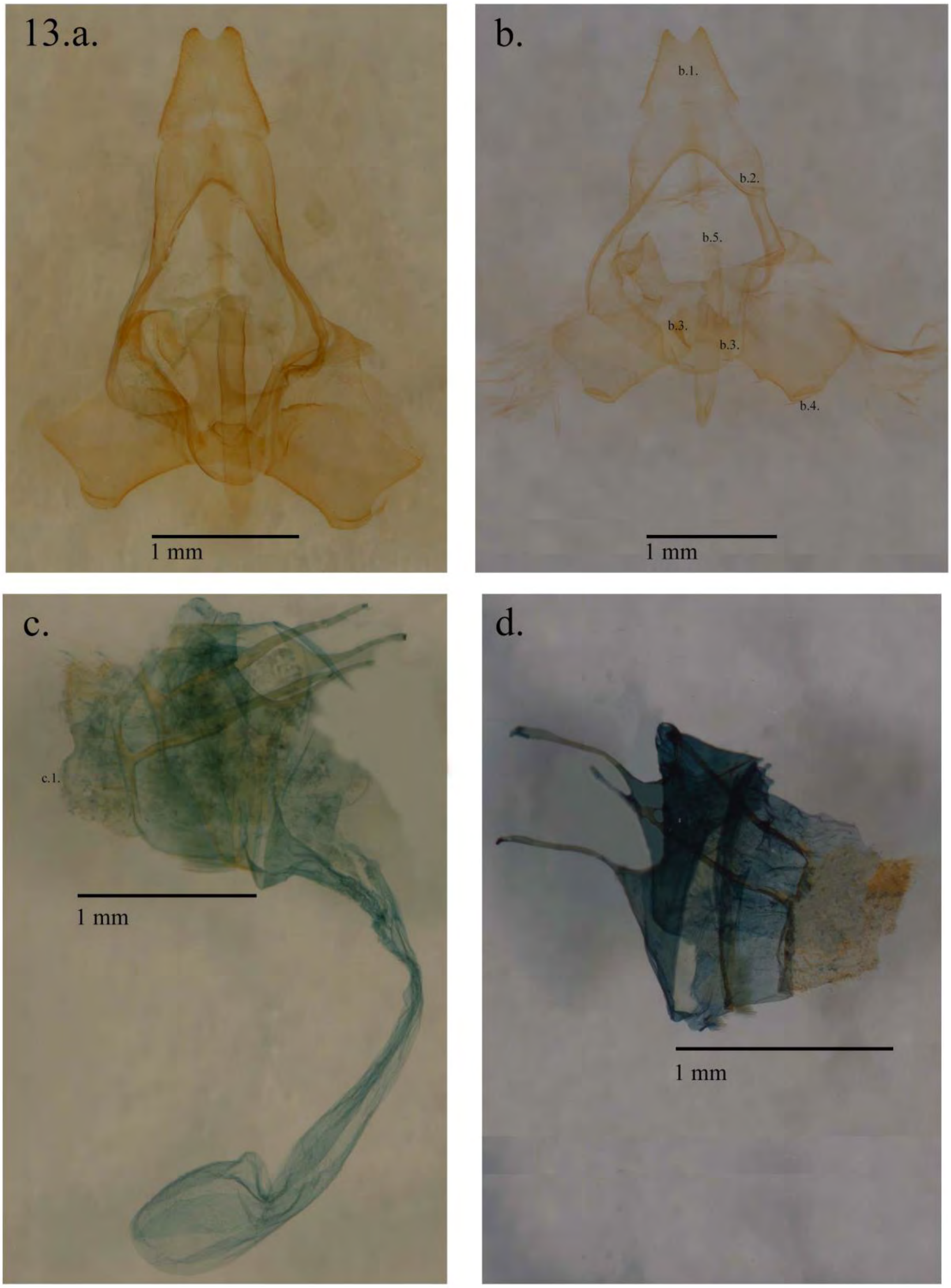
The valvae have a band ventrally that connects both valva. This band-like structure is thinly sclerotized and medium broad, namely only slightly broader than basal part of aedeagus (Fig 13.b., b.3. and b.5.; *cf.* Fig 23.a., a.1. with Fig 23.a., a.2.).

The small lunule-like appendice is visible on the valvae ventral distally (Fig 13.b., b.4.). The distal edge of valva is only slightly C-shaped. The upper part of uncus has a small emargination between mucronate uncus tips; the latter character is not visible in Fig 13.b. since this genitalia is more pressed than in Fig 13.a. The shapes of valvae, saccus and aedeagus are the same in both figures.

13.c. *K. haberlandorum*, female, Kenya, North Coast, Kilifi County, Rabai, collecting Site almost certainly in one of the Rabai Kayas named "Mbwadu" (*cf.* Willis 1996: 94) or "Mkwadu", the latter in handwriting on a piece of newspaper of the year 1933 and written possibly by van Someren, *cf.* "Note" by I.L. presented below the label data of the species *K.haberlandorum*. The papillae anales is pressed below glass, nevertheless its ventral part is still slightly bent outwards similar to the belly of a pregnant woman (Fig 13.c., c.1.). The genitalia has a long ductus bursae that is as long as one posterior apophysis and a large pear-shaped corpus bursae that is 2.0× as large as segment 8 in lateral view (not visible in pressed condition).

13.d. *K. neemambeyuae*, holotype, female, Somali Republic, Jubaland federal state, "Lake [misprint of Lag?] Baddana", collecting Site unknown — most probably collected in the Lag Badana-Bushbush National Park or along the Baddana River near or south of Buulo Xaaji.

The long ductus bursae (not visible in the picture) that is as long as one posterior apophysis is shared with *K. haberlandorum*. Visible in the picture are long anterior apophyses that are 40% longer than the dorsal width of segment 8 (*cf.* Fig 14.a.).


13.a.
1 mm
b.
b.1.
b.2.
b.5.
b.3.
b.3.
b.4.
1 mm
c.
c.1.
1 mm
d.
1 mm

Figures 14.

14.a. *Kayamuhakaia kismayuensis*, holotype, female, Somali Republic, Jubaland federal state, Kismayu town area, collecting Site unknown but almost certainly behind the coastal dunes in an area that belongs to the Z-I region.

Segment 8 is broadly rectangular. Visible is a ring-like band which occurs posteriorly on or adjacent to segment 8. This band is more sclerotized on its lower half (Fig 14.a., a.1.). The anterior apophyses are only 10% longer than the dorsal width of segment 8 (*cf. K. neemambeyuae*).

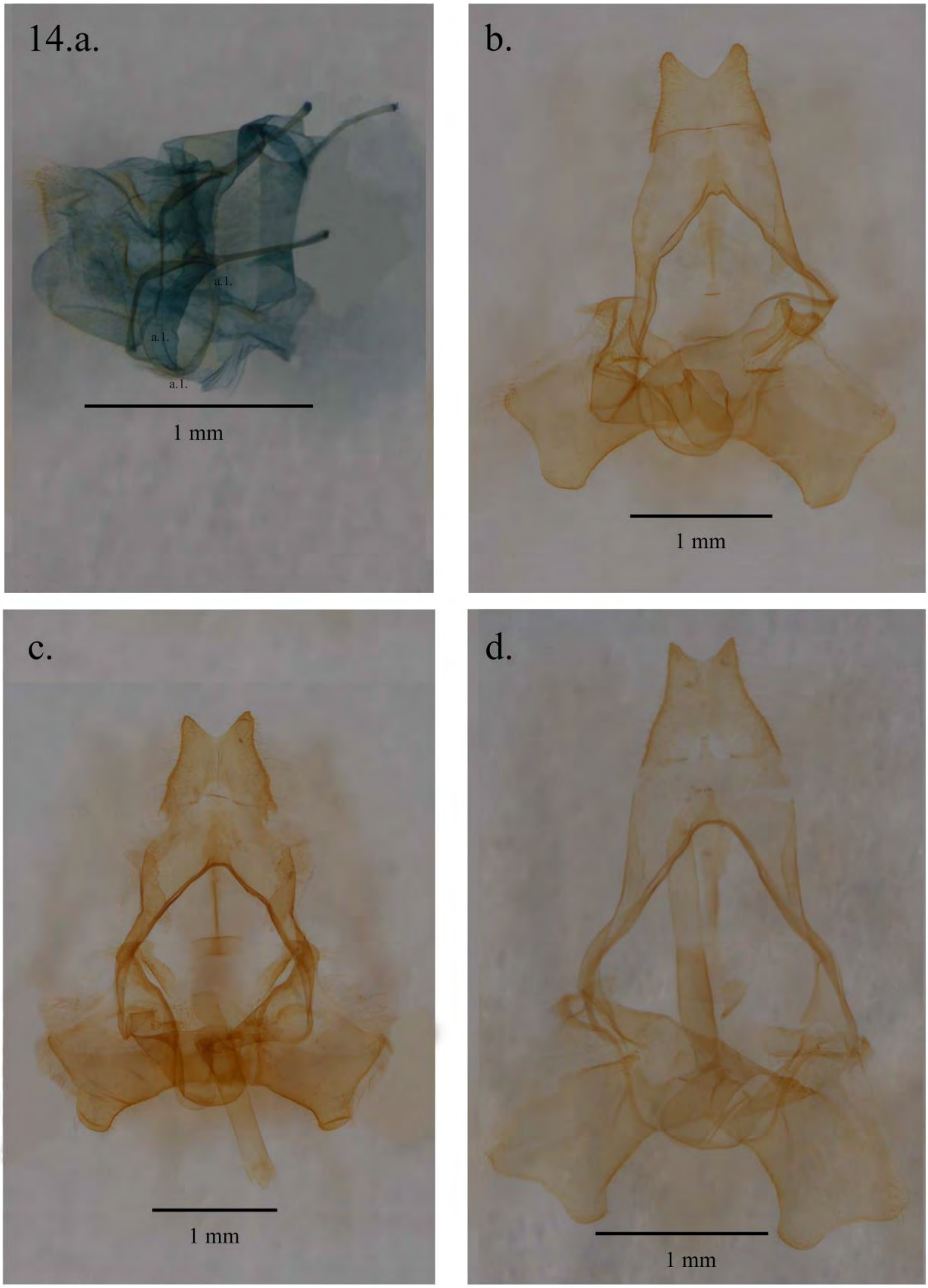
14.b. *K. ngwenoae*, holotype, male, Kenya, North Coast, Kilifi County, Arabuko-Sokoke Forest, collecting Site in *"Cynometra-Manilkara forest" sensu* Britton & Zimmerman (1979: 3).

14.c. *K. ngwenoae*, paratype, male, Kenya, North Coast, Kilifi County, near Arabuko-Sokoke Forest, collecting Site *ca.* 3 km north of Matsangoni and *ca.*4 km south of a large "*Afzelia* forest" *sensu* Britton & Zimmerman (1979: 3).

In the genitalia pictures (14.b., 14.c.) the broad uncus is visible. It is broad in its lower as well as upper part, the latter has a large lunule-like emargination that is as deep as 40% if compared to the whole uncus length and occurs between rectangular uncus tips.

14.d. *K. kasikamwiuae*, holotype, male, Kenya, North Coast, Kilifi County, Arabuko-Sokoke Forest, collecting Site in *"mixed wetter semi-deciduous forest" sensu* Githitho (2021: Fig 1) or *"lowland rain forest" sensu* Britton & Zimmerman (1979: 3).

The distal margin of valva is C-shaped. Visible in the picture is also that the lunule-like emargination between both uncus tips is as deep as 20% or less if compared to the whole uncus length.


14.a.
a.l.
a.l.
a.l.
1 mm
b.
1 mm
c.
1 mm
d.
1 mm

Figures 15.

15.a. *Kayamuhakaia petermuriithii*, holotype, male, Kenya, *"northern Eastern Arc Mountains" sensu* Lovett (1998: 62), Taita Hills, Yale Forest, Taita-Taveta County, collecting Site in the forest interior of an *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

Visible in the picture are the S-shaped distal margin of valva that is 10% longer than the ventral margin (*cf.* diagnosis of *K. triangularis*) as well as the almost rectangular-shaped semi-transtilla (*cf.* right valva).

15.b. *K. nubifera* (Bethune-Baker, 1909), male, Kenya, Nairobi, Nairobi City County, collecting Site unknown.

Although the genitalia is pressed below glass, the mucronate uncus tips, the strongly C-shaped distal margin of valva as well as the extended almost rectangular appendice ventral distally are visible in the picture.

15.c. *K. nubifera* (Bethune-Baker, 1909), "type", female, Kenya, Nairobi, Nairobi City County, collecting Site unknown.

Photo by Martin Honey (BMNH, London), 05th December 2006.

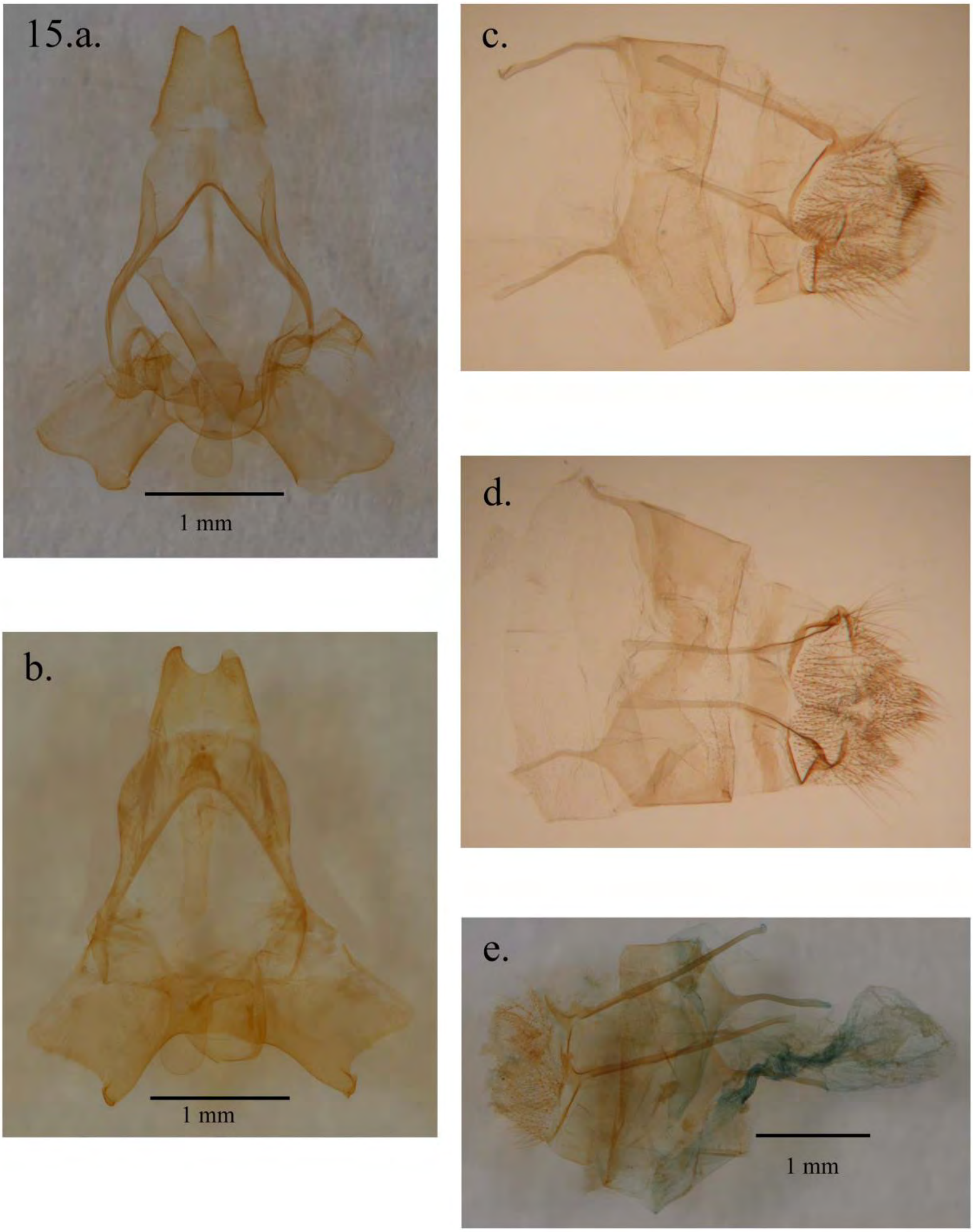
15.d. *K. latifasciata* (Gaede, 1929), "type", female, Kenya, Nairobi, Nairobi City County, collecting Site unknown — this species is considered herein as synonym of *K.nubifera*.

Notes to type genitalia of Figs 15.c.; 15.d.: The anterior apophyses have a straight cut at their end anteriorly (*cf.* Fig 15.d.) which is better visible in the genitalia slide. Hence, they do not represent their intact length which is 40% longer than the dorsal width of segment 8 and with the posterior apophyses 2.3× — 2.5× as long as anterior apophyses, *cf.* Figs 15.c., 15.e.

The lower posterior apophysis in the picture of the type of *nubifera* has also a straight cut anteriorly and hence, its length is different to the upper one — possibly both genitalia preparations (15.c. + 15.d.) were done by the same person.

Photo by Martin Honey (BMNH, London), 05th December 2006.

15.e. Pressed and complete genitalia of *K.nubifera* (Bethune-Baker, 1909), female, Kenya, Nairobi, Nairobi City County, Loresho Ridge, collecting Site was in a cultivated home garden adjacent to a patch of *"Dry transitional montane forest" sensu* White (1983: 166) with old trees of *Croton megalocarpus* Hutch. (Euphorbiaceae).


15.a.
1 mm
b.
1 mm
c.
d.
e.
1 mm

Figures 16.

16.a. *Kayamuhakaia nanyukiensis*, paratype, female, Kenya, Laikipia County, Nanyuki, collecting Site unknown.

The papillae anales have short and long setae and very small lobes (Fig 16.a., a.1.), one lobe 30% or 40% length of narrow dorsal width of segment 8 and with one lobe as large as only 6% or 9% of the papillae anales (viewed ventrally, *cf. K. hermannstaudei* Fig 17.b.).

Well visible in the picture is the very long ductus bursae that is at least as long as one posterior apophysis but in other specimens its length can be up to 30% longer than the latter. The corpus bursae is rounded in shape if not pressed below glass.

16.b. *K. wellsi*, holotype, male, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house, collecting Site in *"East African evergreen and semi-evergreen bushland and thicket"*.

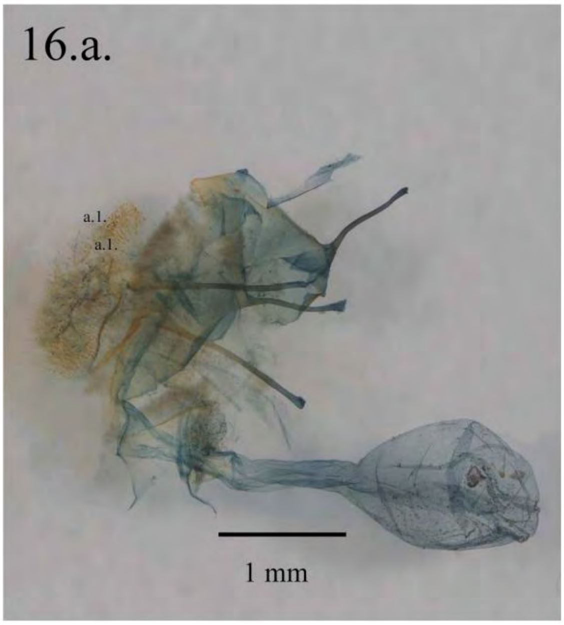
Visible in the picture are the narrow elongated uncus and the C-shaped distal margin of the valva that is 20% shorter than the ventral edge (*cf.* the genitalia of the much larger species *K. haberlandorum* in Fig 13.a.).

16.c. *K. wellsi*, paratype, female, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house, collecting Site in *"East African evergreen and semi-evergreen bushland and thicket"*.

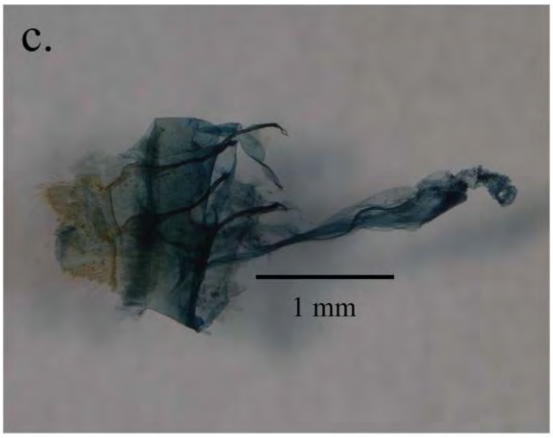
Although pressed below glass, the short ductus bursae is still visible in the picture with a length that is 30% shorter than the length of the posterior apophysis.

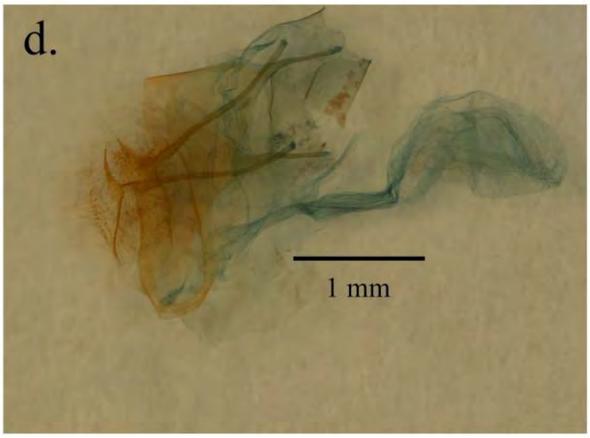
16.d. *K. mountkenyaensis*, holotype, female, Kenya, Mount Kenya, Mount Kenya Forest Reserve, Castle Forest Lodge area, Kirinyaga County, collecting Site in *"Ocotetalia usambarensis" sensu* Bussmann & Beck (1995: 488).

Visible in the picture are an almost triangular shaped segment 8 with a very narrow ventral base as well as the very long ductus bursae that is 30% longer than the very long posterior apophysis that are 2.4× as long as the anterior apophyses. The latter are short and as long as the dorsal width of segment 8.


16.a.
a.l.
a.l.
1 mm


b.
1 mm


c.
1 mm


d.
1 mm

Figures 17.

17.a. *Kayamuhakaia nancycammae*, holotype, female, Kenya, Mount Kenya, Mount Kenya Forest Reserve, "Kazita River" [= Kathita River], near Lake Rutundu, Meru County, collecting Site most probably in *"Hagenietalia abyssinicae" sensu* Bussmann & Beck (1995: 524).

Well visible are the triangular shape of segment 8 and the long posterior apophyses with 2.5× as long as anterior apophyses.

17.b. *K. hermannstaudei*, paratype, female, Kenya, Mount Kenya, Mount Kenya Forest Reserve, *ca.* 4 km east of Rutundu road, Meru County, collecting Site in *"Hagenio abyssinicae – Juniperion procerae" sensu* Bussmann & Beck (1995: 526).

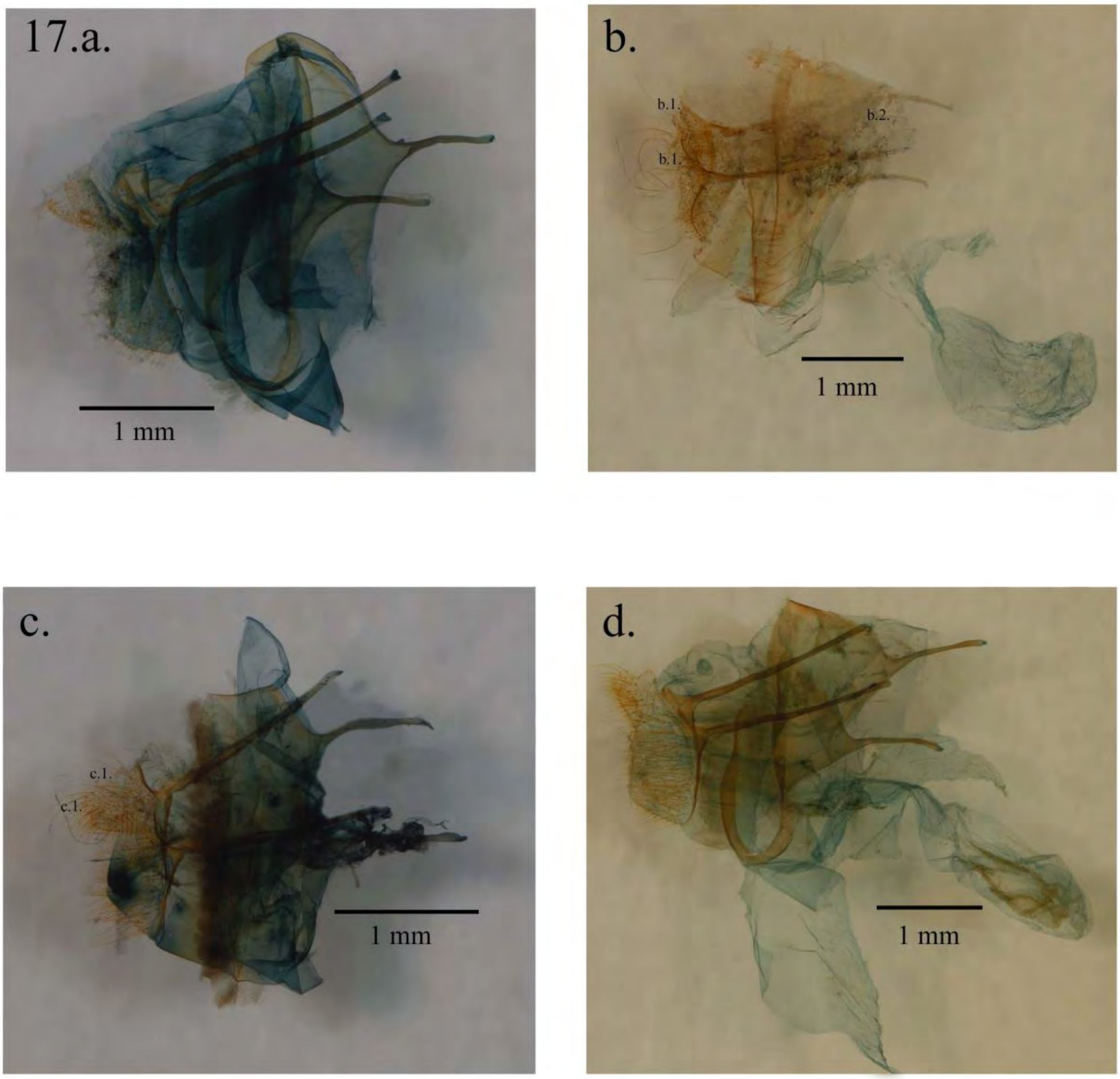
Although pressed, the largest lobes (*cf.* 17. b., b.1.) of the papillae anales among species of *Kayamuhakaia* are visible. They are 20% longer than the dorsal width of segment 8 in a not pressed condition (not visible in the picture) as well as 20% larger than one base of the anterior apophysis (*cf.* 17.b., b.2.) viewed posteriorly.

17.c. *K. aberdarensis*, holotype, female, Kenya, Aberdare Range, Aberdare National Park, Lower Salient, Nyeri County, collecting Site in closed forest of the "*Cassipourea malosana - Setaria plicatilis* agg. community" *sensu* Schmitt (1991: 83).

The large lobes (Fig 17.c., c.1.) are 30% the size of the papillae anales and separate this species, *e.g.* from *K. bokatolaensis* (*cf.* Fig 21.a.).

17.d. *K. karenae*, paratype, female, Kenya, Aberdare Range, Kikuyu Escarpment Forest, Gatamaiyu Forest Nature Reserve, Kiambu County, collecting Site most probably in *"Moist Montane forest" sensu* Lambrechts *et al.* (2003: 9).

Visible in the picture are the narrowly triangular shape of segment 8 as well as the thinly sclerotized ring-like band that represents the ventral edge. The dorsal part of this ring-like band is only slightly narrower than segment 8 dorsally. The dorsal part of segment 8 has a large "gap" which is well visible in the picture.


17.a.
1 mm
b.
b.1.
b.2.
b.1.
1 mm
c.
c.1.
c.1.
1 mm
d.
1 mm

Figures 18.

18.a. *Kayamuhakaia barrychappelli*, holotype, female, Kenya, Maralal Plateau, Karisia Hills, northwestern and lower Loroghi Forest, Samburu County, collecting Site in secondary bushland that replaced largely a drier type of *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

Below the ductus bursae occurs a broadly triangular membranous plate-like structure that is fixed to a narrow sclerotized band-like structure ventrally. In particular the latter is well visible just above the scale in the picture.

18.b. *K. finchhattoni*, holotype, female, Kenya, Lolgorien, Narok County, collecting Site in *"Evergreen clump-grassland"* with patches of semi-deciduous *"Diospyros-Olea forest"* or in a *"Broad-leaved savanna type with Combretum mixtures of probable forest origin" sensu* Kenya Government & Ministry of Overseas Development UK (1969) including riverine forest and woodland patches that occur along numerous drainage lines.

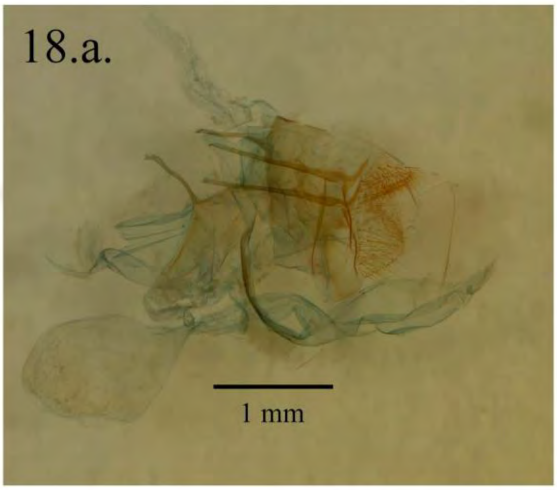
Although pressed below glass, the pear-shaped corpus bursae is visible. The anterior apophyses are short and only 20% longer than the dorsal width of segment 8.

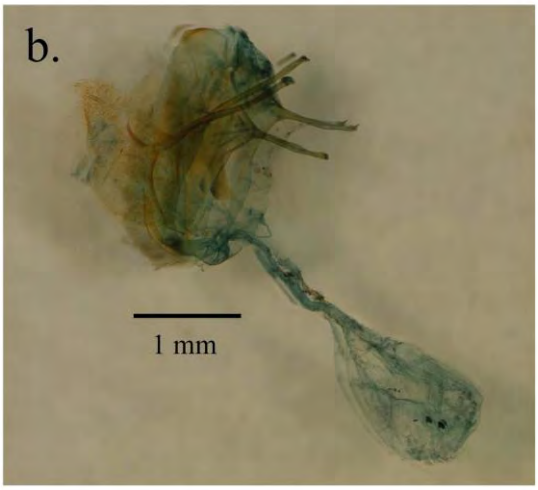
18.c. *K. lolgoriensis*, holotype, female, Kenya, Lolgorien, Narok County, collecting Site in *"Evergreen clump-grassland"* with patches of semi-deciduous *"Diospyros-Olea forest"* or in a *"Broad-leaved savanna type with Combretum mixtures of probable forest origin" sensu* Kenya Government & Ministry of Overseas Development UK (1969) including riverine forest and woodland patches that occur along numerous drainage lines.

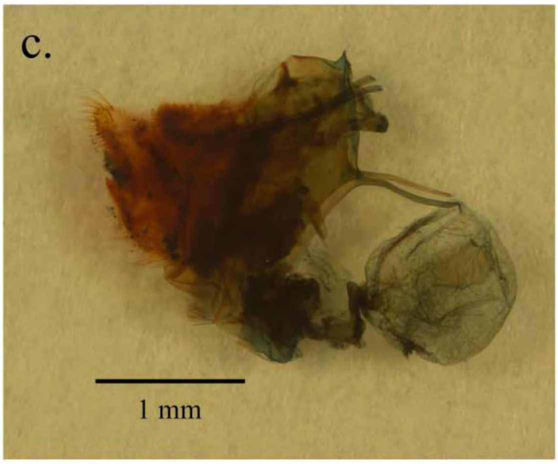
Although pressed below glass, the rounded corpus bursae is visible, and is only 50% as large as segment 8 in lateral view. The anterior apophyses are 50% longer than the dorsal width of segment 8.

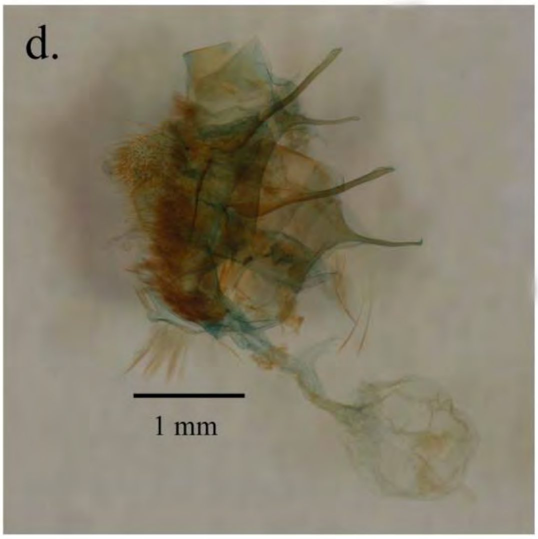
18.d. *K. stephanierobertsae*, holotype, female, Kenya, Elgeyo Hills, Kaptagat, Uasin Gishu County and at the border with Elgeyo Marakwet County, collecting Site unknown, most probably in or close to the Kaptagat Forest Reserve in *"Undifferentiated Afromontane forest" sensu* White (1983: 165).

Well visible is the broadly rectangular segment 8 with the anterior apophyses that are as long as its dorsal width.


18.a.
1 mm


b.
1 mm


c.
1 mm


d.
1 mm

Figures 19.

19.a. *Kayamuhakaia juliusmathiui*, holotype, female, Kenya, Kakamega Forest, Isecheno Nature Reserve, Kakamega County, collecting Site in *"middle-age secondary forest"* of the "*Strombosia scheffleri* – plant community" *sensu* Althof (2005: 90).

Visible is the very long ductus bursae that is 40% longer than the posterior apophysis and is among the longest in species of *Kayamuhakaia*.

19.b. *K. yiruchengae*, holotype, female, Kenya, Mount Elgon, Mount Elgon National Park, Kimothon River, Trans Nzoia County, collecting Site in subalpine forest patches of the *"Ericaceous Belt" sensu* Hedberg (1951: 182) including relict patches of the *"Hagenia-Hypericum Zone" sensu* Hedberg (1951: 174).

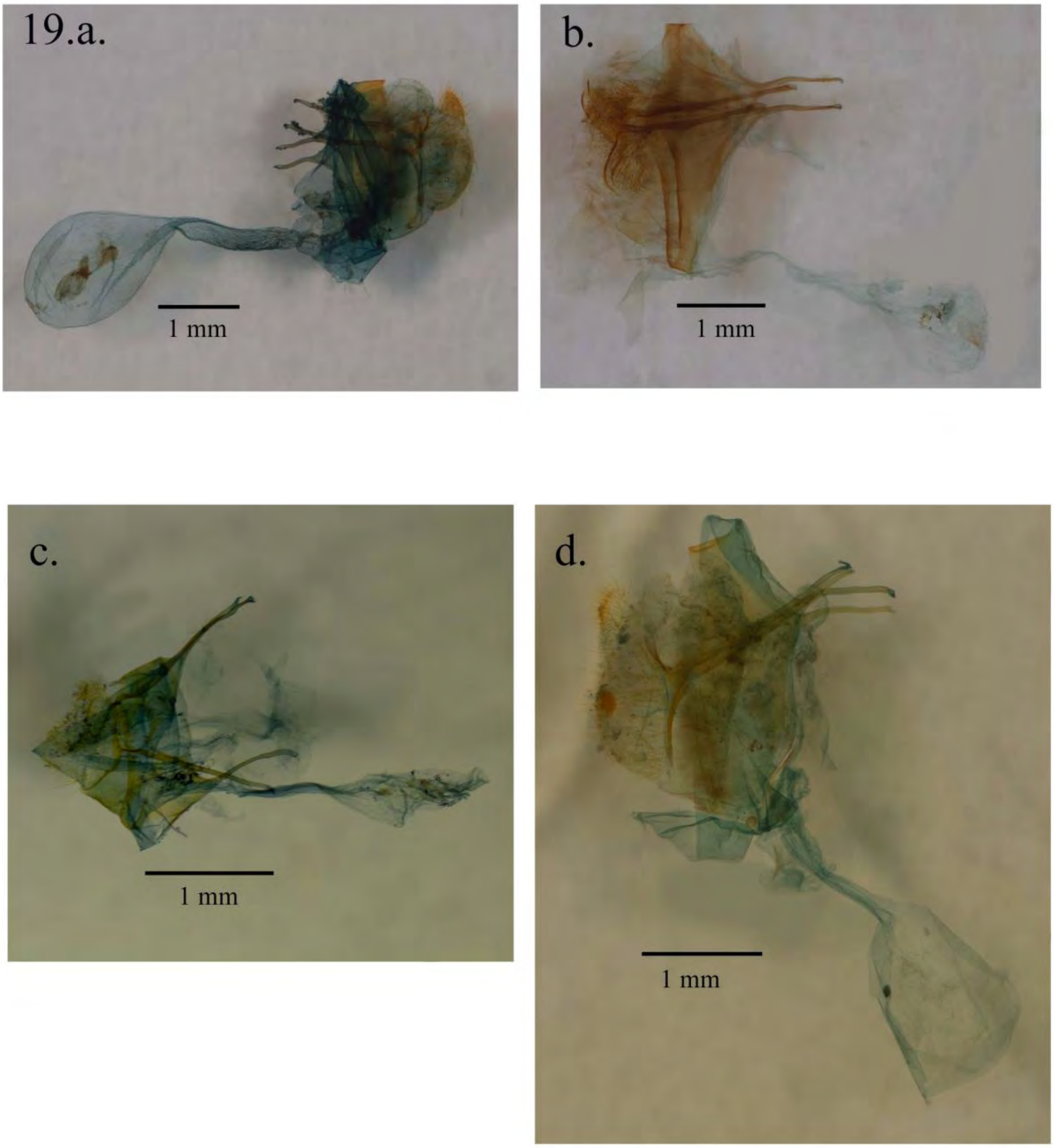
Visible is the narrow rectangular shape of segment 8 that has a narrow dorsal as well as narrow ventral base with anterior apophyses that are straight and not bent.

19.c. *K. maasi*, holotype, female, Uganda, Western Region, Kabarole District, Lake Nkuruba Nature Reserve, collecting Site in a transitional forest type comprising Guineo-Congolian linking tree sprecies and Afromontane linking tree species near the southern shore of Lake Nkuruba.

The broken corpus bursae is visible (the thinly membranous structure to the right in the picture), but if intact is among the largest in *Kayamuhakaia* with 2.5× the size of segment 8 in lateral view.

19.d. *K. gitegaensis*, holotype, female, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest" sensu* White (1983: 181).

Although pressed, the shape of the corpus bursae, that is almost rectangular with its nearly straight distal margin, is still visible.


19.a.
1 mm
b.
1 mm
c.
1 mm
d.
1 mm

Figures 20.

20.a. *Kayamuhakaia fontainei*, holotype, male, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest"*.

The small broadly rectangular-like appendice at the ventral edge of valva distally is well visible in the right valva as well as its rectangular shape with the S-shaped distal margin.

20.b. *K. fontainei*, paratype, female, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area, collecting Site most probably at Gitega School for Nursing adjacent to former patches of *"Transitional rain forest"*.

The character "very long ductus bursae that is 30% longer than the posterior apophyses" is not visible in the pressed genitalia in the picture (*cf.* diagnosis). Still visible is the almost rounded shape of the corpus bursae.

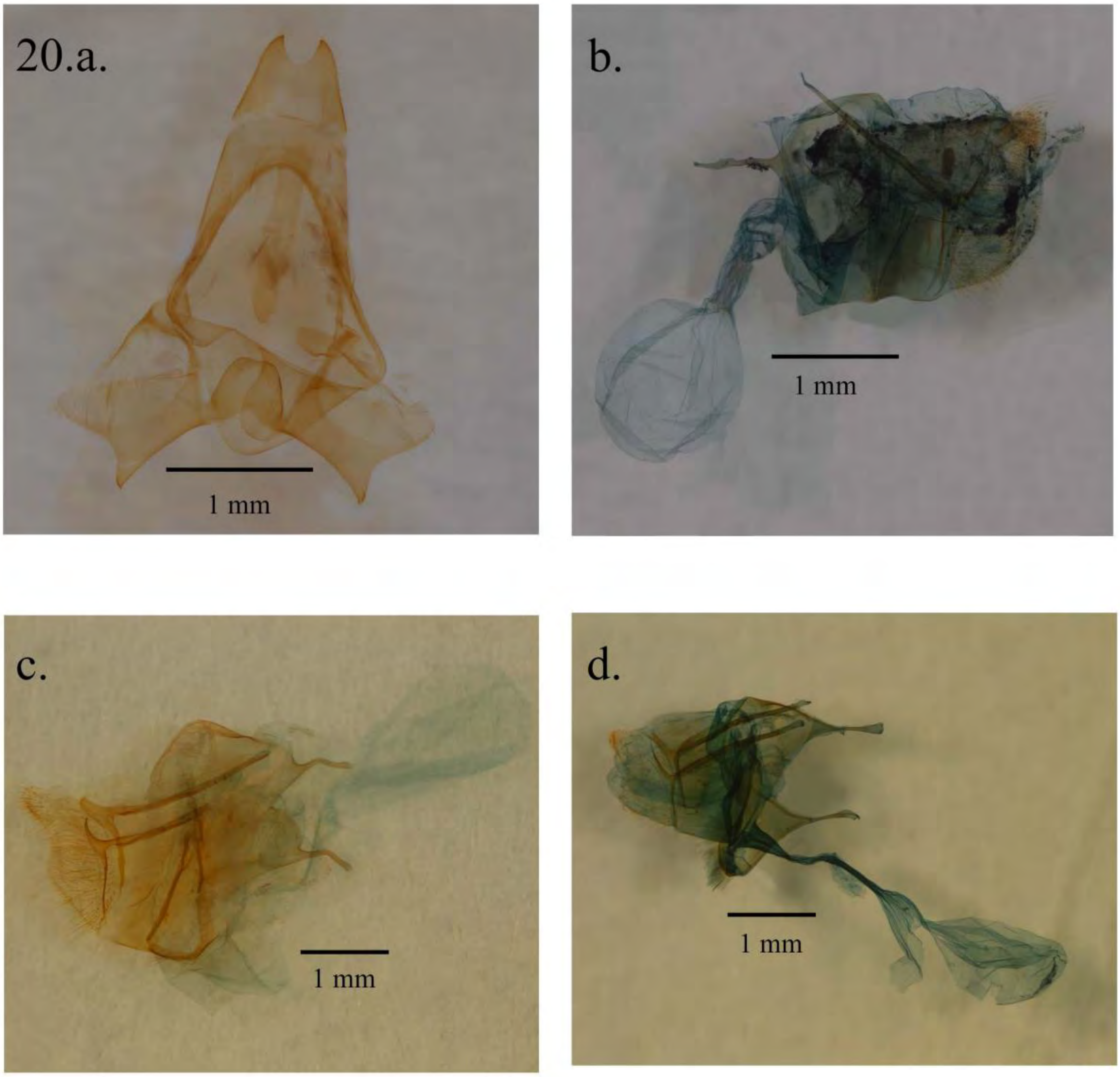
20.c. *K. killmannae*, holotype, female, Rwanda, Nyungwe National Park, Nyungwe Forest, the exact locality in the forest as well as the collecting Site are unknown (*cf.* additional notes by I.L. regarding the label data).

Two unique characters are visible and comprise the short, S-shaped anterior apophyses in combination with very long posterior apophyses that are 3.0× as long as the anterior apophyses.

The corpus bursae is thinly membranous and pear-shaped (top right in the picture).

20. d. *K. philipokwaroi*, holotype, female, Rwanda, Southern Region, Nyamagabe District, Pindura, Nyungwe National Park, Nyungwe Forest, collecting Site in *"montane forest at middle altitudes (2.100 — 2.600 m)" sensu* Fischer & Killmann (2008: 15).

A broken corpus bursae is visible. Its original shape is broadly oval and large with a size of 1.7× as large as segment 8.


20.a.
1 mm
b.
1 mm
c.
1 mm
d.
1 mm

Figures 21.

21.a. *Kayamuhakaia bokatolaensis*, holotype, female, Democratic Republic of the Congo, Équateur Province, Bokatola, collecting Site in *"Mixed moist semi-evergreen Guineo-Congolian rain forest" sensu* White (1983: 77) located at least in a *"small scale* [fluvial lowland forest] *refuge area" sensu* Leal (2001: 1073, 1077) and adjacent to *"Guineo-Congolian swamp forest and riparian forest" sensu* White (1983: 82).

The small lobes (*cf.* Fig 21.a., a.1.) of the papillae anales with one lobe as broad as the dorsal width of segment 8 (*cf.* Fig 21.a., a.2.) is only 10% as large as the papillae anales (*cf.* Fig 17.c.).

The corpus bursae (*cf.* Fig 21.a., a.3.) is thinly membranous, rounded and large with 1.4× the size of segment 8, a character that is similar in *K. aberdarensis* **sp. nov.**

Well visible are the anterior apophysis that are 75% longer than the dorsal width of segment 8 (*cf.* Fig 21.a., a.2.).

21.b. *K. tombutynskii*, paratype, female, Tanzania, Kilimanjaro Region, Mount Kilimanjaro, Kibonoto, Siha District, collecting Site most probably in the cultural zone that is dominated by Chagga home gardens with relicts of *"Dry transitional montane forest" sensu* White (1983: 166, 167).

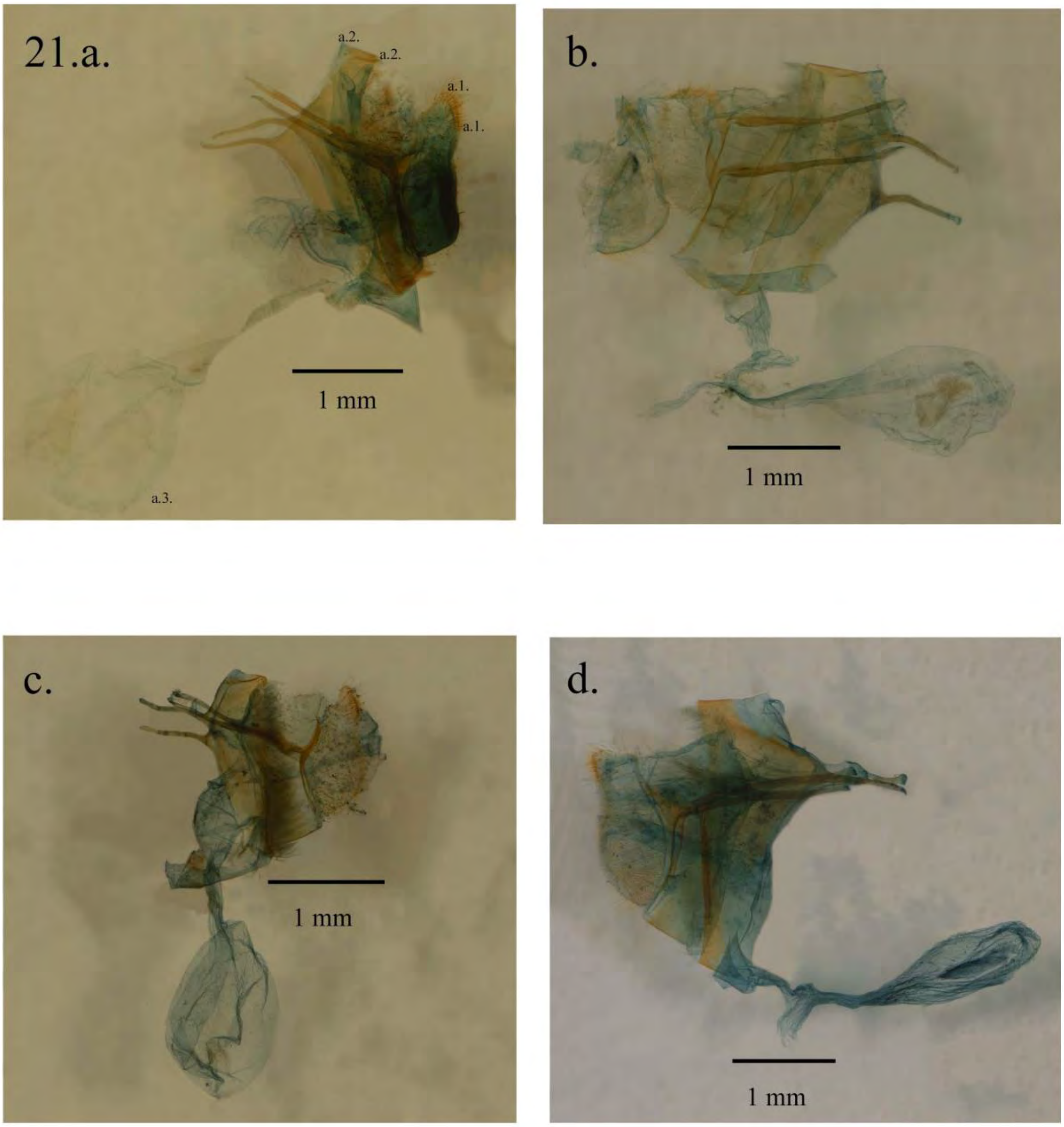
Well visible is the small, oval-shaped corpus bursae that has only 70% the size of the rectangular segment 8 in lateral view. Both characters are shared with *K. kismayuensis* **sp. nov.** with the corpus bursae not figured, *cf.* Figs 14.a.; 21.a., a.3.

21.c. *K. kilimanjaroensis*, holotype, female, Tanzania, Kilimanjaro Region, Mount Kilimanjaro, forest east of Kimambo Gardens, Siha District, collecting Site in the cultural zone that is dominated by Chagga home gardens with relicts of *"Dry transitional montane forest" sensu* White (1983: 166, 167).

If not pressed, the very large corpus bursae is round and 2.5× as large as segment 8 which is shaped narrowly rectangular, *cf.* Fig 21.b.

21.d. *K. rupimangatae*, holotype, female, Tanzania, Arusha Region, Mount Meru, Miriakamba Hut, Arusha National Park, Meru District, collecting Site in *"Undifferentiated Afromontane Forest" sensu* White (1983: 165).

The intact corpus bursae is, if not pressed, elongated oval-shaped and small with 90% the size of the narrowly rectangular segment 8 in lateral view, *cf.* Fig.21.c.


21.a.
a.2.
a.2.
a.1.
a.1.
1 mm
a.3.
b.
1 mm
c.
1 mm
d.
1 mm

Figures 22.

22.a. *Kayamuhakaia kimbozensis*, lateral view, paratype, male, Tanzania, Morogoro Region, Kimboza Catchment Forest Reserve, Morogoro District, collecting Site along the banks of the Ruvu River in *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186).

Well visible are the broad saccus that is 15% longer than the ventral width of valva as well as the acuminate uncus tips.

22.b. *K. aarviki*, ventral view with not spread valvae, paratype, male, Tanzania, Morogoro Region, Morogoro town area, Morogoro District, collecting Site in a cultivated garden with relicts of a drier type of *"Zambezian miombo woodland" sensu* White (1983: 92).

The mucronate uncus tips are well visible as well as the smaller size and different shape of the saccus if compared to the previous species.

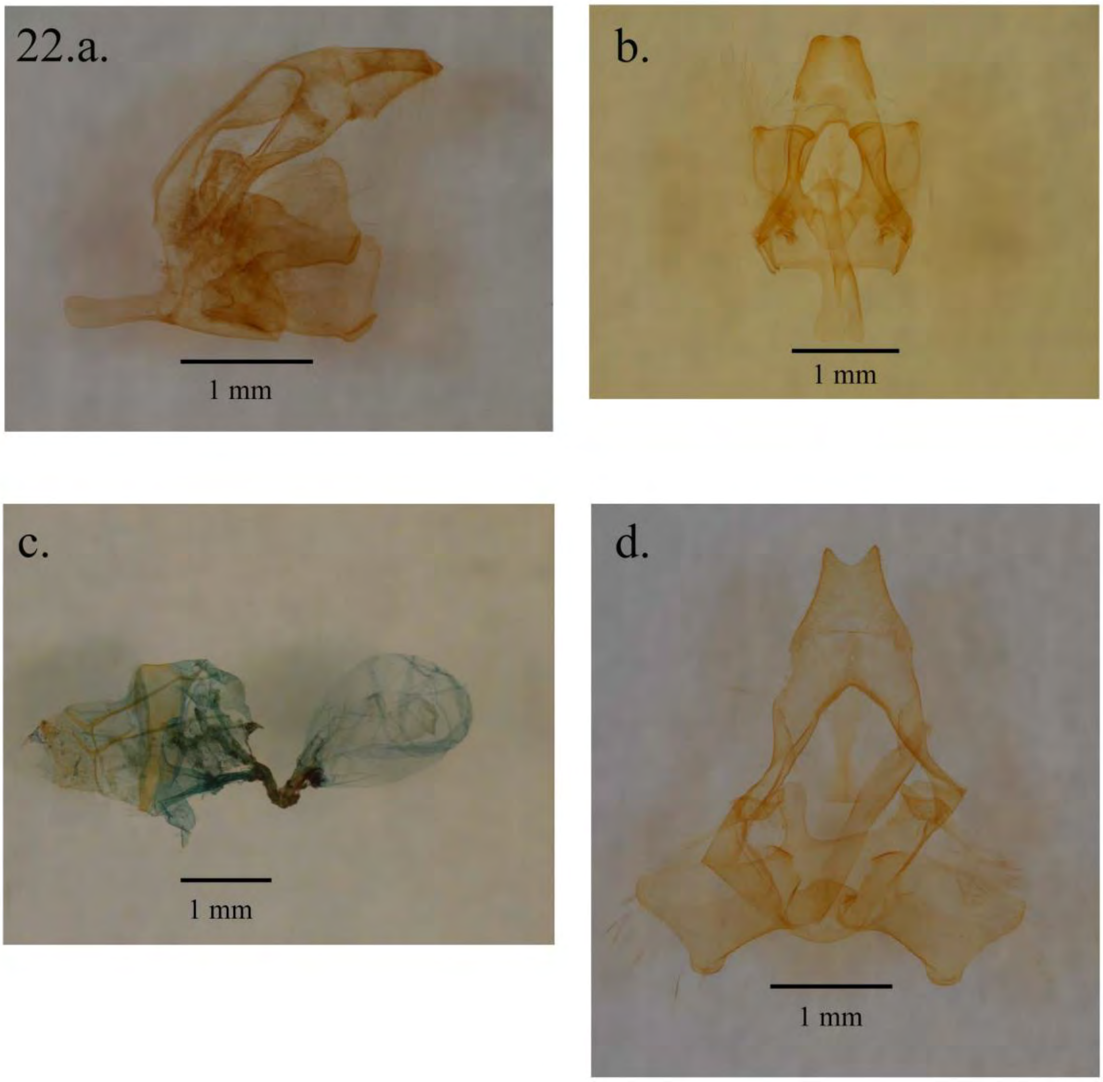
22.c. *K. mbalensis*, lateral view, holotype, female, Zambia, Northern Province, Mbala, Mbala District, collecting Site is unknown — most probably in *"northern wet miombo woodland" sensu* Chidumayo (1997: 8).

Well visible is the large triangular-shaped and thickly membranous plate-like structure below the base of the ductus bursae that is 70% as large as the papillae anales.

The largest corpus bursae among species of *Kayamuhakaia* is shown with a size of 3.5× as large as segment 8 in lateral view, but is smaller in the picture due to the fact that the genitalia is pressed below glass.

22.d. *K. mkuwadziensis*, ventral view with spread valvae, holotype, male, Malawi, Northern Region, Mkuwadzi Hill, Nkhata Bay District, collecting Site in *"Zambezian transition woodland" sensu* White (1983: 91). This Site was formerly most probably covered by *"Zanzibar-Inhambane lowland rain forest" sensu* White (1983: 186) — a forest type that was completey destroyed in the Nkhata Bay area (*cf.* Chapman & White 1970: 178; White *et al.* 2001: 60, 61).

Well visible are the broad, not elongated uncus as well as the ventral edge of valva that is as long as the distal edge with the latter less C-shaped if compared to Fig 14.d.


22.a.
1 mm
b.
1 mm
c.
1 mm
d.
1 mm

Figures 23.

23.a. *Kayamuhakaia huchtemanni*, holotype, male, Malawi, Northern Region, Mzuzu, Nkhorongo, Mzimba District, collecting Site in *"Zambezian transition woodland"* or *"Zambezian miombo woodland" sensu* White (1983: 91, 92).

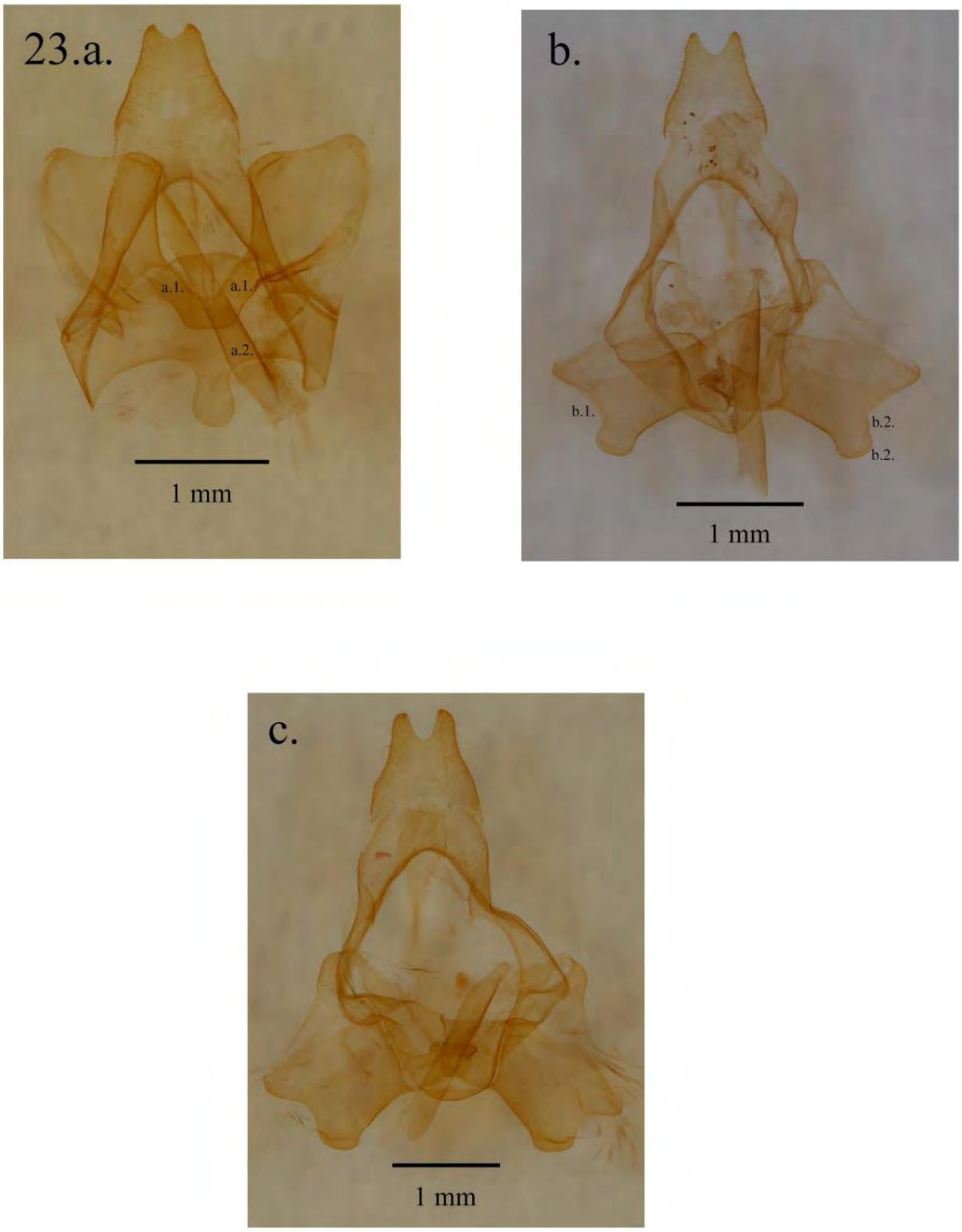
Well visible is the "potential parsimony-informative character" described as "thinly sclerotized, medium broad band that connects both valva ventrally" (Fig 23.a., a.1.) in comparison with the base of the aedeagus (Fig 23.a., a.2.). This character represents the closest approach with the parsimony-informative character "70" *sensu* Lehmann (2019b: 33, 41, 386).

23.b. *K. yvonnedejongae*, holotype, male, Malawi, Southern Region, Shire Highlands, Mount Zomba, on the banks of the Lower Mlunguzi River, Zomba township, Forestry Research Institute of Malawi, Zomba District, collecting Site in a relict patch of *"Zambezian swamp forest and riparian forest" sensu* White (1983: 91).

Visible are the strongly C-shaped distal margin of valva (Fig 23.b., b.1.) and one of the longest extensions along the distal edge of valva ventrally (Fig 23.b., b.2.).

23.c. *K. hilarysommerlatteae*, holotype, male, Malawi, Southern Region, Mount Mulanje, Ruo River Valley, Mulanje Mountain Reserve, Mulanje District, collecting Site along the steep banks of the Ruo River in a relict of *"Zanzibar-Inhambane lowland rain forest"* and *"Transitional rain forest" sensu* White (1983: 186, 187).

This species has the largest mucronate uncus tips — although pressed they are well visible in the picture — if compared to all other males herein.


23.a.
a.1.
a.1.
a.2.
1 mm
b.
b.1.
b.2.
b.2.
1 mm
c.
1 mm

Figures 24.

24.a. *Finsterwaldeia danduensis*, holotype, male, Kenya, collected at Dandu village or on the “inselberg” Dandu Hill, Mandera County, collecting Site unknown, possibly at the foot or on the slopes of the “inselberg”.

Visible is a simple genitalia with a ventral edge of valva that is shorter than the basal width of valva as well as with the sclerotized sword-like appendice that represents in regard to its position on the valva an autapomorphy for the Metarbelidae (Fig 24.a., a.1.).

The uncus is as long as the basal width of valva in contrast to species of *Kayamuhakaia* where the uncus is always shorter as the basal width of valva, *e.g.* Fig 23.b..

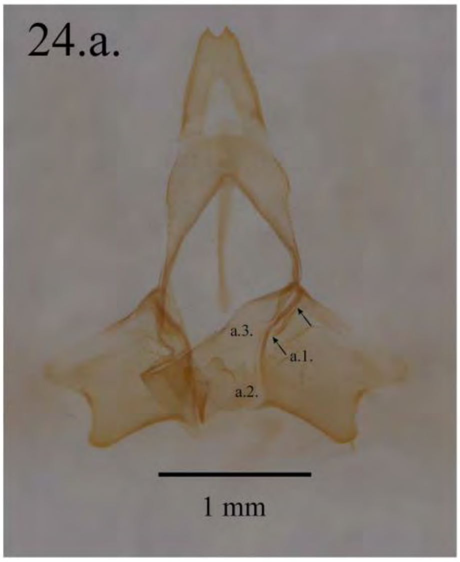
Difficult to see is the “potential parsimony-informative character” described as “thinly sclerotized, medium broad band that connects both valva ventrally” (Fig 24.a., a.2. — below the juxta; *cf.* Fig 23.a., a.1.). A similar but different apomorphy as well as “parsimony-informative character” number “70” was found by Lehmann (2019b: 33, Fig 6c) and describes a narrow strongly sclerotized band-like structure that is in regard to its position as well as width the closest approach to the band-like structure in *F. danduensis* **sp. nov.** The reconstructed and predicted ancestral area for species with character “70” *sensu* Lehmann (2019b: 33) are the Eastern Arc Mountains as well as the *“Zanzibar-Inhambane regional mosaic”* and the *“Tongaland-Pondoland regional mosaic” sensu* White (1983: 184, 197).

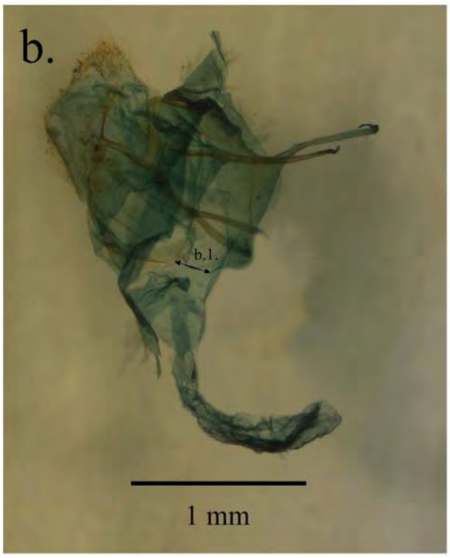
The broad vinculum is well visible (Fig 24.a., a.3.).

24.b. *Lichterfeldia olarinyiroensis*, holotype, female, Kenya, Ol Ari Nyiro Ranch, Kuti, Laikipia County, collecting Site in *“East African evergreen and semi-evergreen bushland and thicket” sensu* White (1983: 115).

Note that a ring-like band posteriorly on or adjacent to segment 8 is absent. This represents a diagnostic character for species of this new genus (*cf.* Fig 14.a., a.1.).

The ventral base of segment 8 is well visible but did break during preparation (Fig 24.b., b.1.).


24.a.
a.3.
a.1.
a.2.
1 mm


b.
b.1.
1 mm

Figures 25. — 27. Examples of male and female genitalia in the original shape during a <u>not</u> pressed condition of species of the genera *Kayamuhakaia*, *Finsterwaldeia* and *Lichterfeldia* (drawings by I.L.)

Figures 25.

25.a. *Finsterwaldeia danduensis*, holotype, male, Kenya, Dandu village or Dandu Hill, Mandera County.

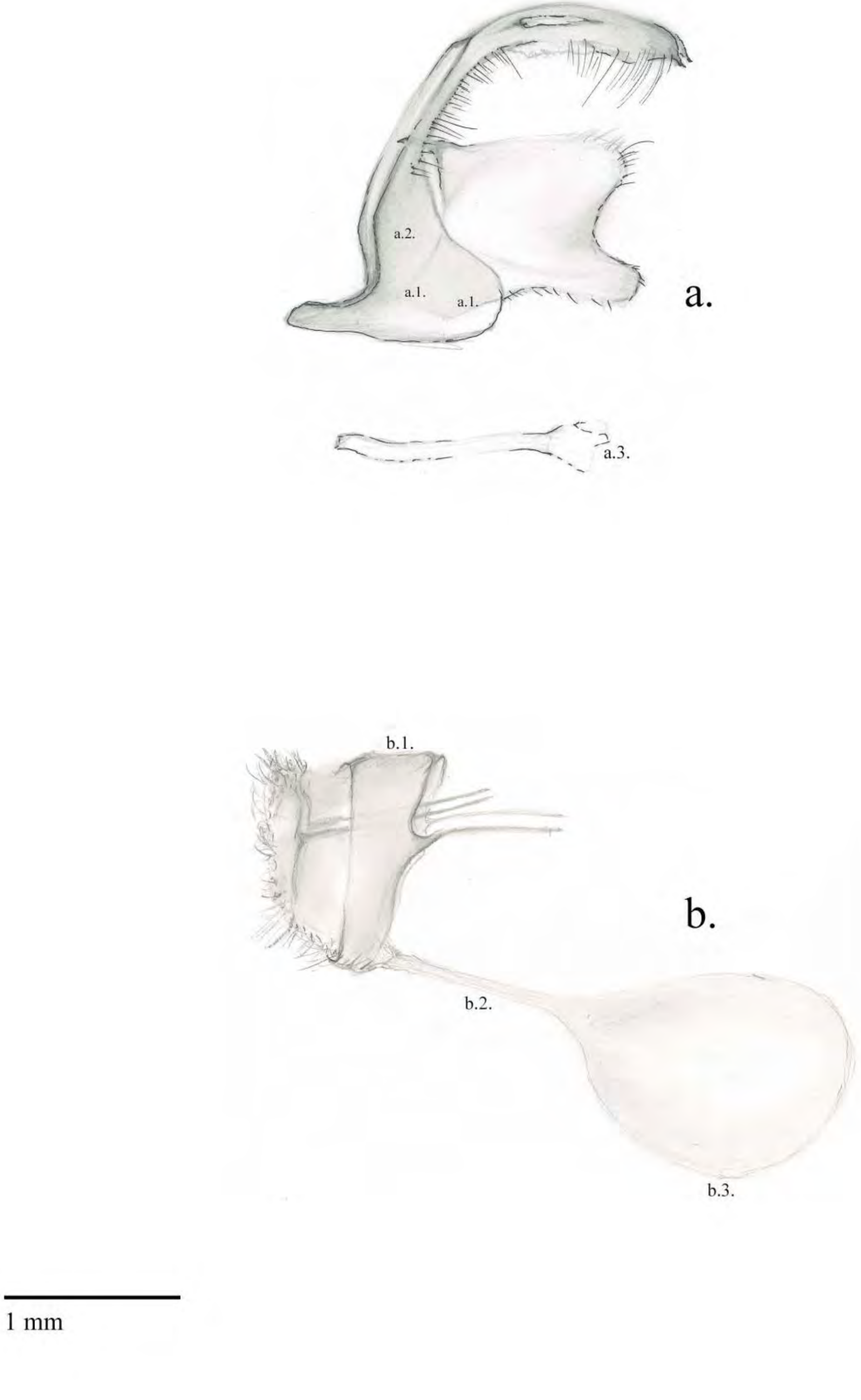
The “potential parsimony-informative character” described as “thinly sclerotized, medium broad band that connects both valva ventrally” is well visible in lateral view (Fig 25.a., a.1.; *cf.* Fig 24.a., a.2.). The broad vinculum is more sclerotized than the latter character (Fig 25.a., a.2.; *cf.* Fig 24.a., a.3.).

Phallus thinly sclerotized, long, 1.5× longer than basal width of valva, narrow, simple tube-like, broadest at base, not bent, with a flat and rectangular tip distally and without any appendice (Fig 25.a., a.3.).

25.b. *Lichterfeldia olarinyiroensis*, holotype, female, Kenya, Ol Ari Nyiro Ranch, Kuti, Laikipia County.

The ductus bursae (Fig 25.b., b.2.) is narrow, long with 1.2 mm in length, thinly membranous, without any structures; below the base of the ductus bursae occurs <u>no</u> sclerotized plate-like or bottleneck-shaped structure; corpus bursae (Fig 25.b., b.3.) is thinly membranous, without any structures, broadly oval and is, if not broken or not pressed below glas, 2.5× as large as segment 8 (Fig 25.b., b.1.) in lateral view.

25.



Figures 26.

26.a. *Kayamuhakaia triangularis*, "Type", male, collected at the originally "Dar Salam", *cf.* Shaykh Al-Amin (1995: 20), today Tanzania, Dar es-Salaam Region, Dar es-Salaam.

The valva is large rectangular and elongated, *ca.* 6.0× larger than saccus (in ventral view), costal margin is slightly lunule-like (Fig 26.a., a.1.) and pointed distally, distal margin slightly S-shaped (Fig 26.a., a.2.) and as long as ventral edge, the latter with a dominant lunule-like appendice distally (Fig 26.a., a.3.).

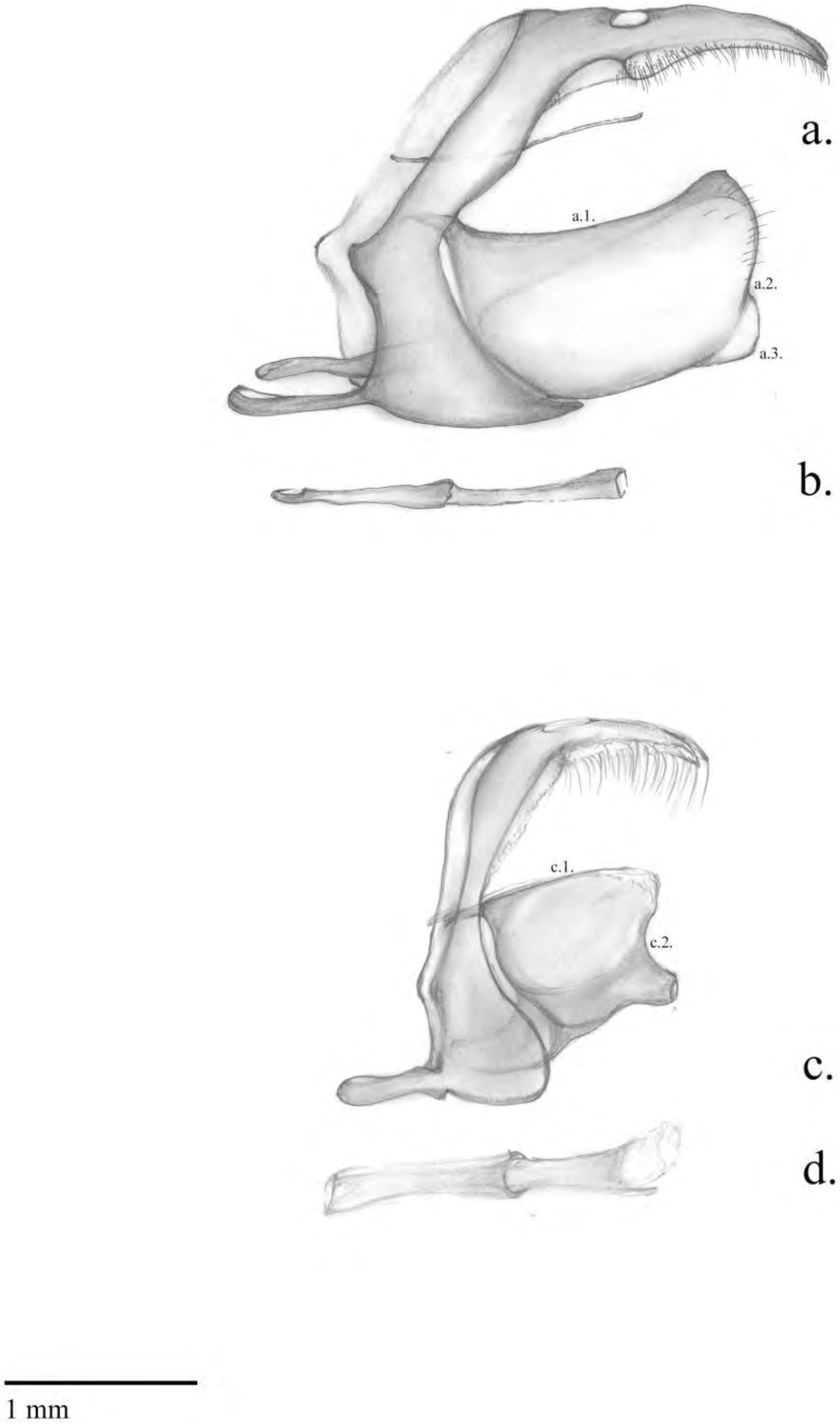
26.b. Aedeagus (phallus) of *K. triangularis*, "Type", is long and narrow.

26.c. *K. wellsi*, holotype, male, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house.

The valva is large, *ca.* 6.5× larger than saccus (in ventral view), rectangular-shaped, horizontal costal margin is straight (Fig 26.c., c.1.) and rounded distally. The distal margin of valva is C-shaped (Fig 26.c., c.2.) and 20% shorter than the ventral edge of valva.

26.d. Aedeagus of *K. wellsi*, holotype, is long and broad with *ca.* 5.0× length of saccus.

26.

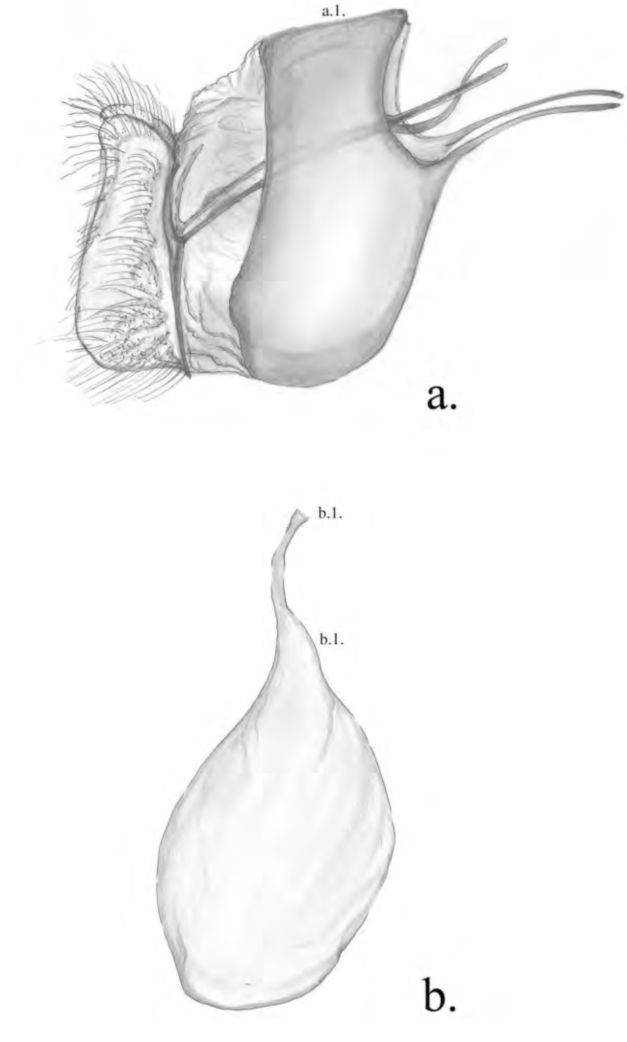


Figures 27.

27.a. Segment 8 is broad rectangular (Fig 27.a., a.1.), thinly sclerotized in *K. wellsi*, paratype, female.

27.b. Thinly membranous, pear-shaped and slightly elongated corpus bursae in *K. wellsi*, paratype, female. The ductus bursae (Fig 27.b., b.1.) is thinly membranous and *ca.* 30% shorter than the posterior apophyses.

27.



Figures 28. — 30. Examples of male and female wing venation of species of the genera *Kayamuhakaia*, *Finsterwaldeia* and *Lichterfeldia*

Figures 28.

28.a. *Kayamuhakaia haberlandorum*, male, Kenya, North Coast, Kilifi County, Rabai; the collecting Site was almost certainly the same as of the female below.

28.b. *K. haberlandorum*, female, Kenya, North Coast, Kilifi County, Rabai; the collecting Site was almost certainly in one of the Rabai Kayas named "Mbwadu", *cf.* Willis (1996: 94) or "Mkwadu" — a word that was presented in handwriting in a sentence on a piece of newspaper of the year 1933 and possibly written by van Someren, *cf.* "Note" by I.L. below the label data of the species *K. haberlandorum*.

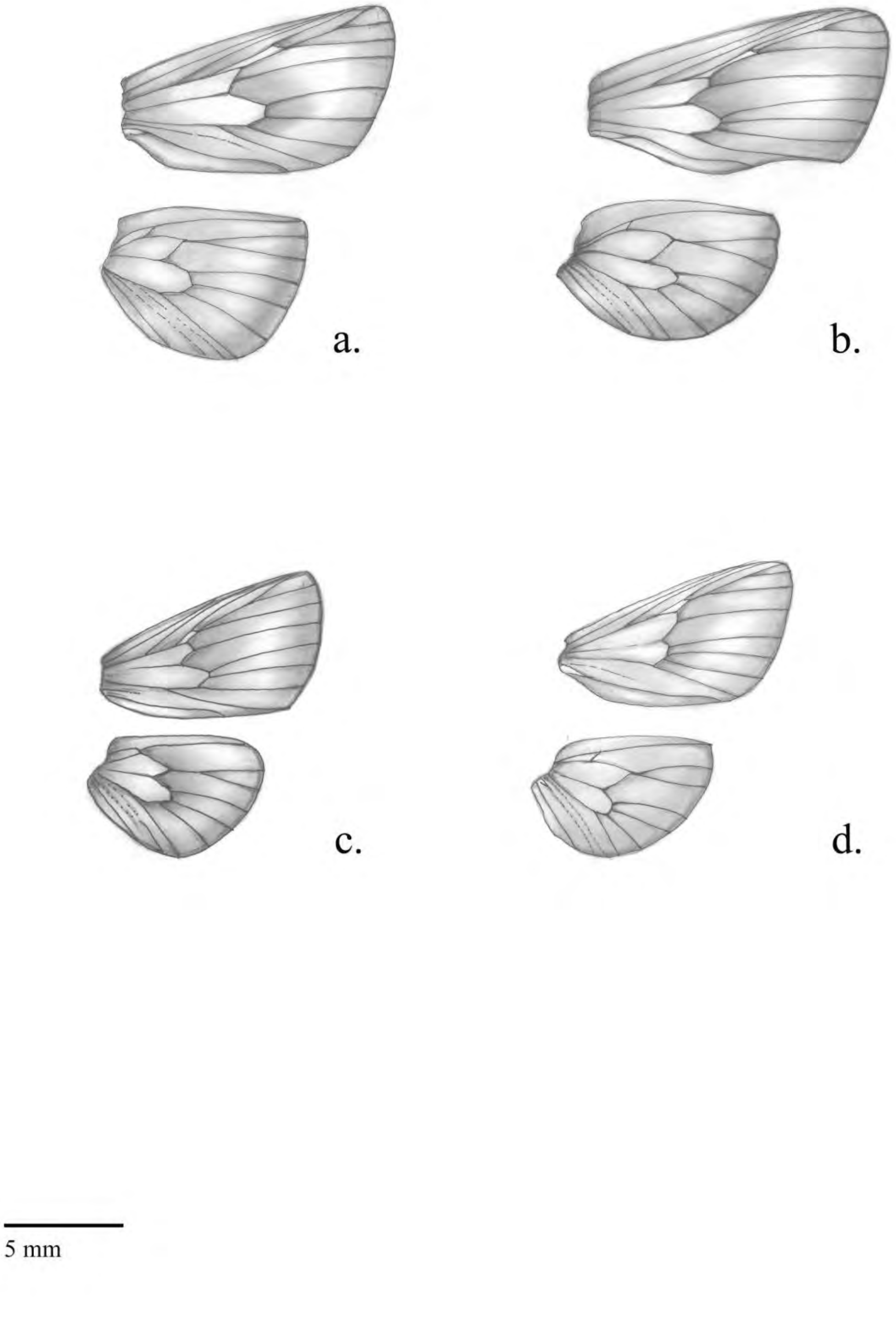
The long areole in the forewing is present in both sexes and has *ca.* 45% of the length of upper discal cell in the female.

28.c. *K. wellsi*, holotype, male, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house.

28.d. *K. wellsi*, paratype, female, Kenya, Laikipia County, Lolldaiga Hills, Lolldaiga Hills Ranch and Wildlife Conservancy, near General Manager's house.

The areole in the forewing of both sexes is much shorter if compared to the length of the areole in both sexes of *K. haberlandorum*.

28.



Figures 29.

29.a. *Kayamuhakaia gitegaensis*, holotype, female, Burundi, Central Plateau, Gitega Province, Gitega District, Gitega town area.

In the hindwing venation are M_1 and Rs separated but originate from the same basal point in the paratype.

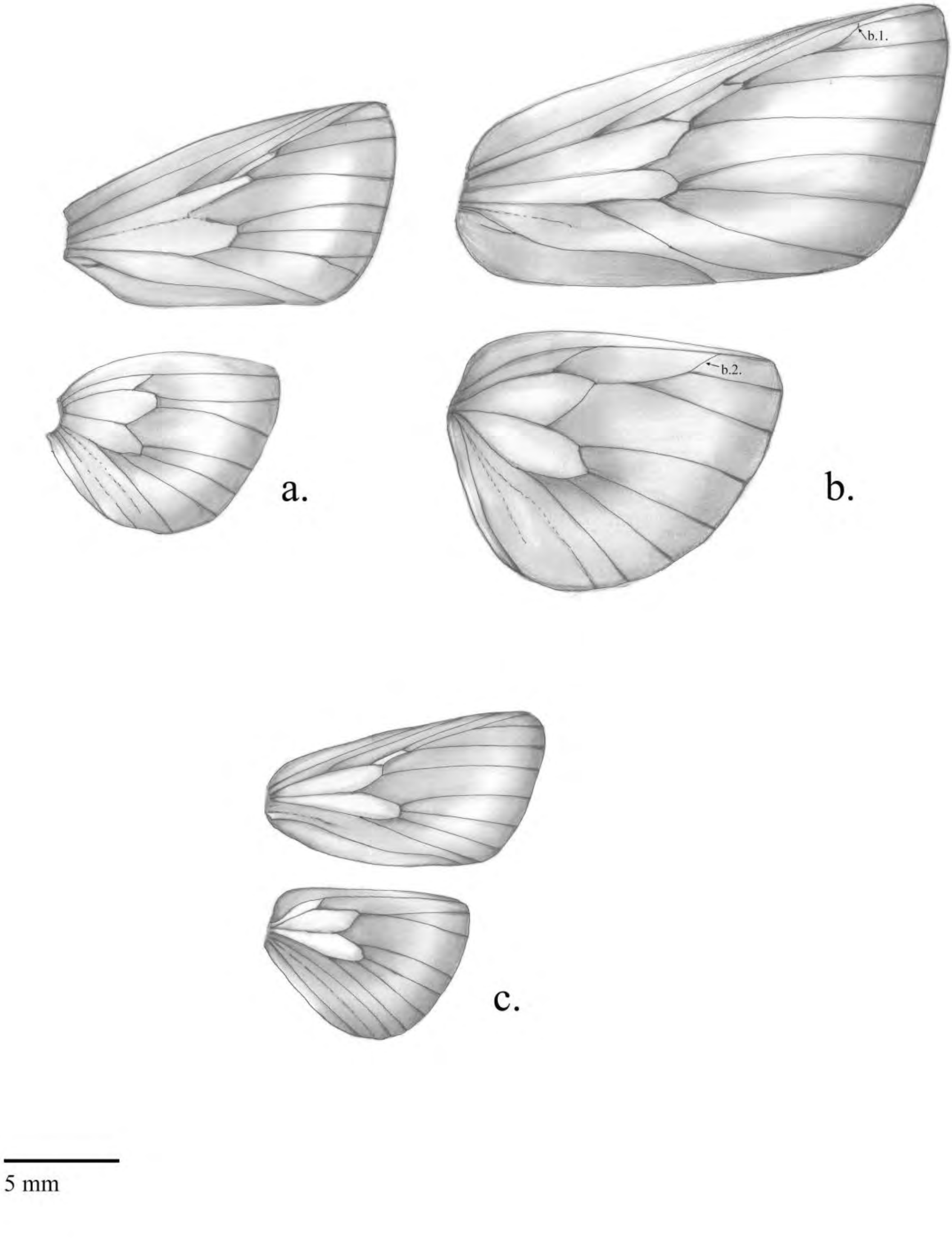
Of interest is the forewing venation that has a unique anomaly if compared to more than 1000 studied species of Metarbelidae, namely a very long stalked CuA_1 on both forewings — a character state that is absent in the paratype.

29.b. *K. killmannae*, holotype, female, Rwanda, Nyungwe National Park, Nyungwe Forest.

Two unusual cross-bars occur only on the left forewing (Fig 29.b., b.1.+ arrow) and only on the left hindwing (Fig 29.b., b.2.+ arrow), namely between R_2 and R_3 near the apex (left forewing) as well as between $Sc+R_1$ and Rs near the apex (left hindwing). Such cross-bars — in regard to the same position on the wing — are not known from other species of Metarbelidae.

29.c. *K. triangularis*, "Type", male, collected at Dar Salam, *cf.* Shaykh Al-Amin (1995: 20), today Tanzania, Dar es-Salaam Region, Dar es-Salaam.

29.



Figures 30.a. — 30.b.

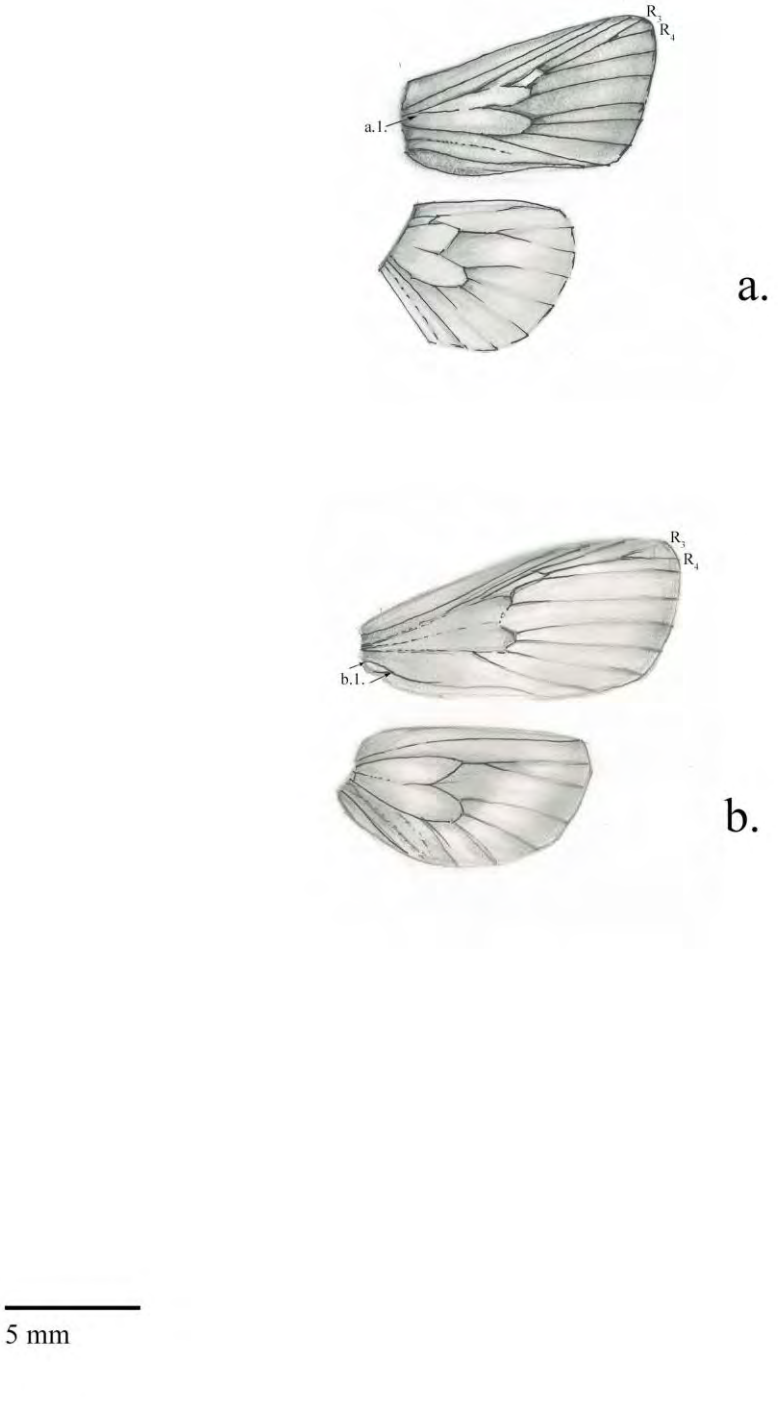
30.a. *Finsterwaldeia danduensis*, holotype, male, Kenya, Dandu village or Dandu Hill, Mandera County.

Note that on the forewing R_3+R_4 are marked and occur on a very long stalk; the base of 1A+2A is not forked (Fig 30.a.). Both characters can also occur in species of *Kayamuhakaia* although the stalk is slightly shorter. The vein in the discocellular cell on the forewing is weak and ends well before the forewing base (Fig 30.a., a.1.).

30.b. *Lichterfeldia olarinyiroensis*, holotype, female, Kenya, Ol Ari Nyiro Ranch, Kuti, Laikipia County.

Note that on the forewing R_3+R_4 are marked and occur on a very long stalk; the base of 1A+2A is long forked (Fig 30.b., b.1.+ two arrows). The latter character is in regard to a long fork usually absent in species of *Kayamuhakaia*. The vein in discocellular cell on forewing is weak and absent near the apical angle of the discocellular cell.

30.



Figures 31. — 39. Examples of habitats for species of *Kayamuhakaia* and *Finsterwaldeia*

Figures 31.a. — 31.b.

31.a. Collecting Site and habitat of the holotype of *K. haberlandorum* in *"Zanzibar-Inhambane secondary grassland and wooded grassland"* of the *"Zanzibar-Inhambane regional mosaic" sensu* White (1983: 189) adjacent to the northwestern forest edge of Kaya Muhaka (Kenya, South Coast). The figured area was undisturbed during 1994 to 2007 and almost certainly until the 1930s (*cf.* Dale 1939: 17).

Dominant tree species comprise *Dalbergia melanoxylon* Guill. & Perr. (Papilionoideae/ right) and *Dichrostachys cinerea* Wight & Arn. (Mimosoideae/ in the centre) growing *ca.*10 m away from *ca.* 150 years old and large trees of *Julbernardia magnistipulata* Troupin (Caesalpinioideae – visible in the background of the picture). Common species in the shrub layer include *Lantana camara* L. (Verbenaceae), *Grewia plagiophylla* K. Schum. (Malvaceae), *Hyphaene coriacea* Gaertn. (Arecaceae) and *Combretum littoreum* Engl.(synonym: *Quisqualis littorea* Exell/ Combretaceae).

Photo by Ingo Lehmann, February 1996.

31.b. Undisturbed habitat of *K. haberlandorum* in*"Zanzibar-Inhambane undifferentiated forest" sensu* White (1983: 187) and *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) in the northern forest interior of Kaya Muhaka — one of Kenya's 121 *Key Biodiversity Areas* (*KBAs*) and located in the *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61, 62). Kaya Muhaka is considered herein as microrefugium.

Dominant tree species at the visible Site comprise *Cynometra suaheliensis* Baker f. (Caesalpinioideae/ centre of picture with a measured tree height of 25 m) and *Lannea welwitschii* Engl. (Anacardiaceae) with *Craibia brevicaudata* Dunn (Papilionoideae) in the understorey. The visible trees grow on Kilindini sands with complex, very deep soils (>120 cm), *e.g.* Rhodic Ferrasols.

Photo by Ingo Lehmann, January 2006.

31.a.

b.

Figures 31.c. — 31.e.

31.c. Undisturbed habitat of *K. haberlandorum* in the central forest interior of Kaya Muhaka.

Dominant tree species comprise *Hymenaea verrucosa* Gaertn. (right, measured height was 33 m) and *Cynometra suaheliensis* Baker f. (Caesalpinioideae, visible in the centre, height 29 m) with *Pseudobersama mossambicensis* Verdc. (Meliaceae) in the understorey, *cf.* Lehmann & Kioko (2000: 14, Fig 3 + profile diagram).

Photo by Ingo Lehmann, January 2006.

31.d. Habitat of *K. haberlandorum* in *"Wetter mixed semi-deciduous forest" sensu* Lehmann & Kioko (2005: 126) as viewed from the roof of our Land Rover in the central Gogoni Forest Reserve (Kenya, South Coast) — one of Kenya's *KBAs* located in the *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61, 62) and considered as microrefugium herein.

Dominant tree species comprise *Julbernardia magnistipulata* Troupin (the large tree in the centre), the rare *Gigasiphon macrosiphon* Brenan (Caesalpinioideae) and *Craibia brevicaudata* Dunn (Papilionoideae). In the understorey occur *Dorstenia kameruniana* Engl. and *Ficus exasperata* Vahl (Moraceae). The Kenyan endemic liana *Ancistrocladus robertsoniorum* J. Léonard (Ancistrocladaceae) is common on this Sample Site. Adjacent to this Site occurred selective logging *ca.* 20 years ago.

Photo by Ingo Lehmann, February 2007.

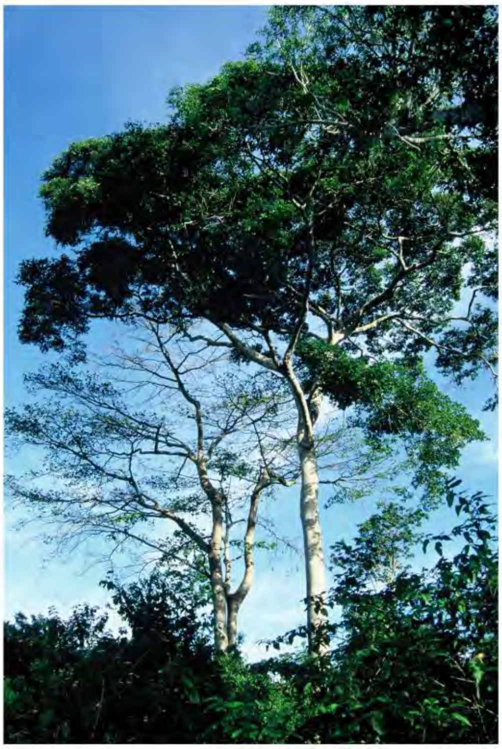
31.e. Close to the habitat of *K. haberlandorum* in Gogoni Forest occurs a young specimen, 0.9 m tall, of the rare *Ancistrocladus robertsoniorum* J. Léonard (Ancistrocladaceae, visible in the foreground) growing on reddish-yellow to white, loose, sand to loamy sand of Albic Arenosols and Orthic Ferrasols (Kenya Soil Survey 1982).

Adjacent to this specimen (to the right) is a path that was once used as logging trail until *ca.*1991. We used this path with our Land Rover to undertake more than 50 light-trappings in the forest interior at various places in the Sample Area but without any further record of *K. haberlandorum.*

Photo by Ingo Lehmann, January 2006.

31.

c.



d.

e.

Figures 32.a. — 32.b.

32.a. Habitat of one paratype of *K. ngwenoae* **sp. nov.** in *"Brachystegia forest"* representing a *"Mixed forest type" sensu* Githitho (2021: Fig 1) in Arabuko-Sokoke Forest (Kenya, North Coast) — one of Kenya's *KBAs* and located in the *"Swahilian regional centre of endemism" sensu* Clarke (1998: 61, 62). The open forest structure in the picture has a transitional nature to woodland of the *"Zanzibar-Inhambane regional mosaic"* (*cf.* White 1983: 188) and is dominated by *Brachystegia spiciformis* Benth. (centre) and *Julbernardia magnistipulata* Troupin (Caesalpinioideae) growing on reddish-yellow to white, loose, sand to loamy sand of Albic Arenosols and Orthic Ferrasols (Kenya Soil Survey 1982) in the central and southern areas of Arabuko-Sokoke Forest.

Photo by Jonathan Mwachongo (**Nature***Kenya*), October 2024.

Note: The same soil units occur in Gogoni Forest (Kenya, South Coast) with *B. spiciformis* Benth. present but absent on ten Sample Sites and the Transect Site of I.L.

32.b. Habitat of the holotype of *K. petermuriithii* **sp. nov.** in Yale Forest (Kenya) representing an *"Undifferentiated Afromontane forest" sensu* White (1983: 165) and located in the *"northern Eastern Arc Mountains" sensu* Lovett (1998: 62). The forest patch belongs to the Taita Hills Forests — one of Kenya's *KBAs*. The collecting Site was in the forest interior on an elevation of 1.804 m and below but adjacent to the right Rock Outcrop in the picture. The hill is culminating at 2.104 m.

As part of the Mozambique Belt, various Taita Hills fault blocks initiated around 500 Ma (Pohl & Horkel 1980: 140) or 290 — 180 Ma with a major block uplift 30 — 25 Ma, possibly related to the evolution of the EARS, *cf.* Pohl & Horkel (1980: 144), with a local reactivation of the faults 7 Ma (Griffiths 1993: 9, 15; Burgess *et al.* 2007: 211).

The visible Rock Outcrop in the picture is between 7 — 30 million years old. It was subjected to high-grade metamorphism with a complicated pattern and might represent metamorphosed slices of oceanic crust comprising mainly amphibolites and quartz-feldspar of the *"Central Kurase Group" sensu* Pohl & Horkel (1980: 140, 141). The visible forest patch is dominated by *Xymalos monospora* Baill. (Monimiaceae), *Albizia gummifera* C.A.Sm. (Mimosoideae) and *Phoenix reclinata* Jacq. (Arecaceae), *cf.* Chege & Bytebier (2005: 233) that occur on reddish brown to brown stony sandy clay loam with an acid topsoil of Humic Cambisols and Dystric Regosols and Rock Outcrops (Kenya Soil Survey 1982).

Photo by Rupi Mangat (Nairobi), 2023.

32.

a.

b.

Figures 33.a. — 33.b.

33.a. A cultivated garden area at Gatuamba House (0°13’55.86”S 37°02’43.45”E, elevation 1.982 m, near Naro Moru, Kenya) *ca.* 7 km west from Mount Kenya Forest Reserve. Few natural habitats still occur nearby as patches and belong to the *“East African evergreen and semi-evergreen bushland and thicket” sensu* White (1983: 115) of the *“Somalia-Masai regional centre of endemism” sensu* White that abuts near Naro Moru in various places the “*Afromontane archipelago-like regional centre of endemism” sensu* White (1983: 111, 112, 161).

The large tree represents a fast-growing *Eucalyptus saligna* Smith (Myrtaceae) or a hybrid with this species and was most probably planted *ca.* 1946 (Nancy Camm pers. comm. to I.L. in January 2006). Less than 30 m away from this tree occur several *Acacia xanthophloea* Benth. (Mimosoideae) which are at least 50 years old. The few patches of natural open bushland nearby comprise species such as *Euphorbia murielii* N.E.Br. (synonym: *Euphorbia candelabrum* Trémaux /Euphorbiaceae), *Euclea divinorum* Hiern (Ebenaceae), *Carissa spinarum* L. (synonym: *C. edulis* Vahl / Apocynaceae) and *Aloe lateritia* Engl. var. *graminicola* S. Carter (Asphodelaceae) in the herb layer.

No adult species of Metarbelidae was found in the cultivated garden area or nearby by light-trapping, *e.g.* below *A. xanthophloea* Benth. and near *E. saligna* Smith, nor any larvae on their bark.

Photo by Ingo Lehmann, February 2004.

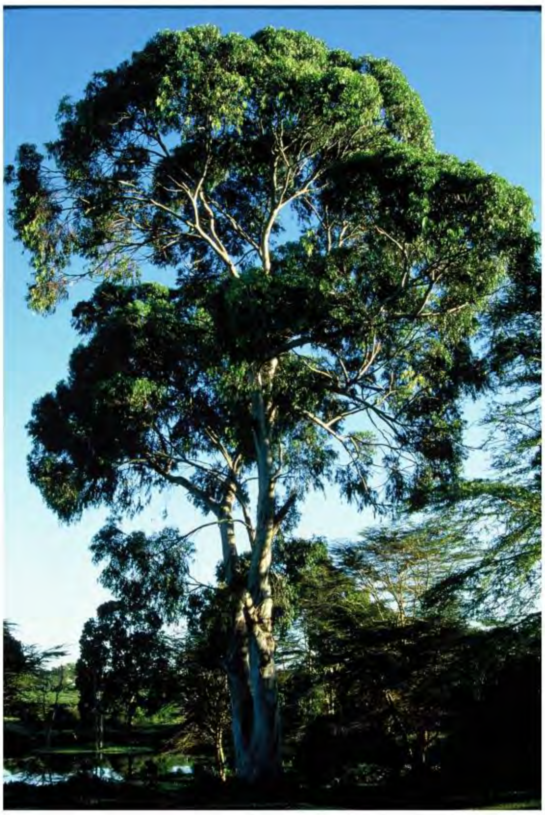
33.b. Treelets of *Olea europaea* L. subsp. *africana* P.S. Green (Oleaceae) in the foreground and planted in 1992 and 1993. Trees — older than 70 years — of *Eucalyptus globulus* Labill., *E. saligna* Smith, *E. sideroxylon* A. Cunn. (Myrtaceae) and *Acacia xanthophloea* Benth. occur in the background representing no habitat for any Metarbelidae near Gatuamba House based on field studies by I.L. during 1992 — 2017.

This indicates that larvae of Metarbelidae of central Kenya almost certainly do not use tree species of the genus *Eucalyptus* L’Hérit. (Myrtaceae) — that is not indigenous to Kenya — as their foodplant.

Photo by Ingo Lehmann, February 2004.

33.

a.



b.

Figures 34.a. — 34.b.

34.a. Habitat of the paratype of *K. nanyukiensis* **sp. nov.** and holotype of *K. wellsi* **sp. nov.** as well as one Sample Site of I.L. in*"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115) on the Lolldaiga Hills Ranch located on the eastern Laikipia Plateau (Kenya). A light morph of an adult of the Reticulated Giraffe, *Giraffa camelopardalis* L. *reticulata* Thomas, is visible in the centre of the picture, *ca.*170 m from the house of the General Manager and viewed from a distance of 40 m from the former "Dik-diks House".

The open vegetation developed during the last 100 years and almost replaced a drier type of *"Undifferentiated Afromontane forest" sensu* White (1983: 165) once dominated by *Juniperus procera* Hochst. (Cupressaceae). Only few scattered trees of *J. procera* remain with up to 32 m height. In the woody understorey (rarely > 7 m height) occur species of *Acacia* Mill. (Mimosoideae), *Ochna holstii* Engl. (Ochnaceae), *Euphorbia murielii* N.E.Br. (Euphorbiaceae), *Euclea divinorum* Hiern (Ebenaceae), *Olea europaea* L. (Oleaceae), *Gymnosporia senegalensis* Loes. (Celastraceae) and *Lippia javanica* Spreng (Verbenaceae).

Photo by Ingo Lehmann, March 2016.

34.b. Type locality of *K.hermannstaudei* **sp. nov.** in a patch of an almost certainly more than 200 years old *"Undifferentiated Afromontane forest" sensu* White (1983: 165) located *ca.*4 km east of the Rutundu road at 2.954 m in the Mount Kenya Forest Reserve — one of Kenya's *KBAs*. Annual rainfall is 750 — 1250 mm.

The figured forest type was classified as *"Hagenio abyssinicae – Juniperion procerae"* by Bussmann & Beck (1995: 526) and is located in the transition zone to the drier *"Juniperion procerae"* with a high frequency of *Juniperus procera* Hochst. (Cupressaceae) and *Hagenia abyssinica* J.F.Gmelin (Rosaceae) as a co-dominant canopy tree species. In the lower canopy occur *Nuxia congesta* R.Br. (Stilbaceae), *Myrsine melanophloeos* R.Br. (Primulaceae/ synonym: *Rapanea melanophloeos* Mez.) and *Olea europaea* L. subsp. *cuspidata* Cif. (Oleaceae) with *Daucus incognitus* Spalik, Reduron & Banasiak (Apiaceae) as character species in the shrub and herb layer. The mossy cushions on stems and branches comprise species of the Antitrichiaceae, *e.g. Antitrichia curtipendula* Brid.

Photo by Hermann Staude (Magaliesburg, Republic of South Africa), November 2009.

34.

a.

b.

Figures 35.a. — 35.c.

35.a. Habitat of *K. karenae* **sp. nov.** in *“Moist Montane forest” sensu* Lambrechts *et al.* (2003: 9) at 2.400 m in the Gatamaiyu Forest Nature Reserve — one of Kenya’s *KBAs*.

More or less visible dominant canopy tree species comprise *Cassipourea malosana* Alston (Rhizophoraceae), *Neoboutonia macrocalyx* Pax — indicating forest disturbance — *Macaranga kilimandscharica* Pax (Euphorbiaceae) and *Prunus africana* Kalkman (Rosaceae).

Photo by Peter Muriithi (**Nature***Kenya,* Nairobi), October 2024.

35.b. The Uluguru Mountains fault block — that belongs to the *“central Eastern Arc Mountains” sensu* Lovett (1998: 62) — is viewed from Kigurunyembe — an area in Morogoro town — and from an elevation of 540 — 700 m. The elevation range of the mountains in the background is 1.268 — 1.676 m. They represent the habitats for one of the largest numbers of narrow endemic East African plant species including the location “Morogoro” (Beentje *et al.* 2006). The fault block had started to form a distinctive unit 290 Ma with various vertical movements — the visible shape of the mountain block is at least 7 million years old (Griffiths 1993: 15).

The Eastern Arc forest types are visible in the picture only on elevations above *ca.* 1.200 m. The lower part of these forests includes the field station “Morning side” where old specimens of Metarbelidae might have been collected if only “Morogoro” is written on their labels. Below 1.200 m occurs a drier type of *“Zambezian miombo woodland” sensu* White (1983: 92) if not replaced by cultivation and gardens.

Photo by Leif Aarvik (Oslo), November 1992.

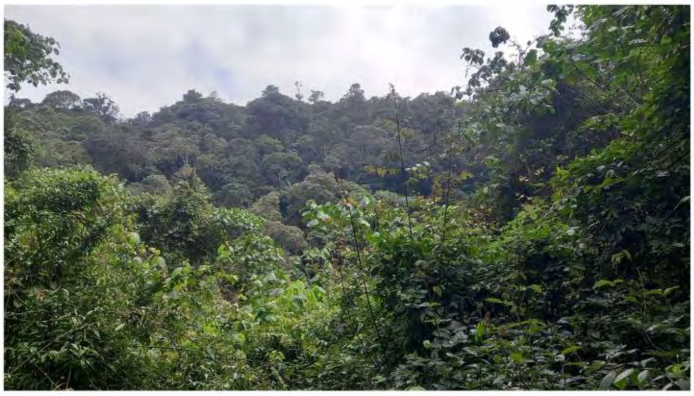
35.c. Type locality of *K. aarviki* **sp. nov.** at an elevation of 526 m and within Morogoro town (Tanzania).

The picture of the habitat was taken among cultivated plants and shows the Uluguru Mountains in the background. The large tree in the centre and adjacent to the car is *Mangifera indica* L. (Anacardiaceae). Scattered trees of *Brachystegia* Benth. are still present (not visible in the picture) and indicate a former drier type of *“Zambezian miombo woodland”* comprising, *e.g. Brachystegia tamarindoides* Welw. subsp. *microphylla* Ckikuni and *Julbernardia globiflora* Troupin (Caesalpinioideae). Relicts of a former *“Riparian woodland” sensu* White (1983: 95) are also still present including, *e.g.* species of *Acacia* Mill. (Mimosoideae).

Photo by Leif Aarvik (Oslo), January 1993.

35.

a.



b.

c.

Figures 36.a. — 36.b.

36.a. The habitat of *K. maasi* **sp. nov.** as described below *ca.* 13 years later with no visible disturbance comprising tree species that indicate its transitional forest character, *e.g.* the Afromontane linking *Albizia grandibracteata* Taub. (Mimosoideae); the Guineo-Congolian linking *Sparrea gomphophylla* Y.G. Fu & T.S. Yi, the African linking *Celtis africana* Burm.f. (Cannabaceae); the African linking species and ecological transgressor *Diospyros abyssinica* F. White (Ebenaceae) and the Afromontane near endemic *Olea welwitschii* Gilg & G. Schellenb. (Oleaceae) growing on white and pale grey coloured pumice — visible in the centre of the picture above the water surface.

Photo by Colin Austin Chapman (Washington DC), June 2000.

36.b. The same habitat of *K. maasi* **sp. nov.** as in Fig 36.a. in forest near the southern shore of Lake Nkuruba (Uganda, Western Region) located in the "*Lake Victoria regional mosaic" sensu* White (1983: 179) and *"Victoria Basin Forest-Savanna Mosaic" sensu* Burgess *et al.* (2004: 20, 21).

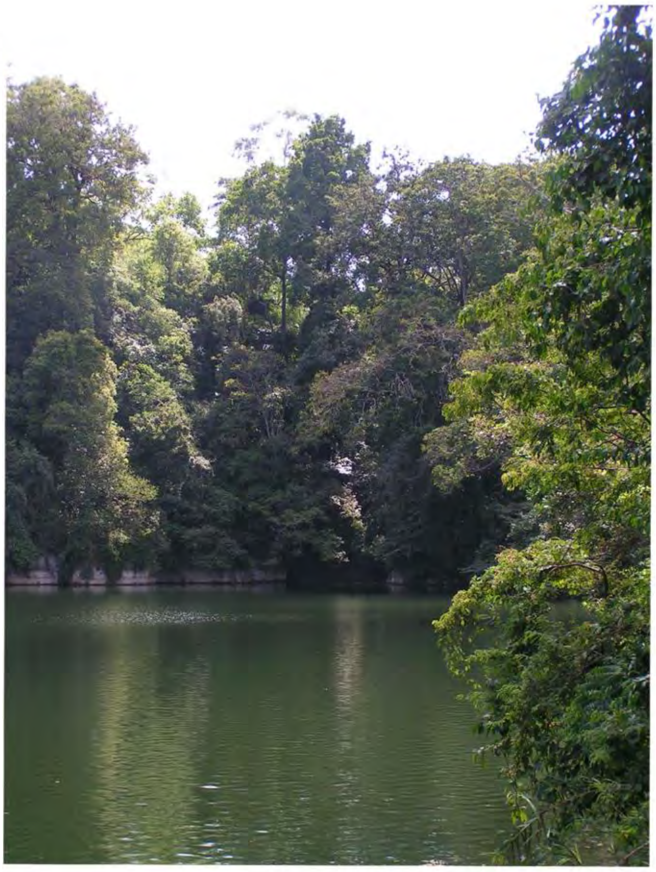
It represents an example of a forest Site that is younger than 12,500 years with trees growing on white and pale grey coloured pumice that is of volcanic origin.

Also due to this relatively young age of the forest Site the forest type is transitional between *"Drier peripheral semi-evergreen Guineo-Congolian rain forest"*, *"Transitional rain forest"* and *"Afromontane rain forest" sensu* White (1983: 164, 181).

Photo by Matti Nummelin (Helsinki), 1983.

36.

a.



b.

Figures 37.a. — 37.b.

37.a. The picture represents an extremely rare vegetation in Malawi on the type locatlity of *K. hilarysommerlatteae* **sp. nov.** The figured *"Zanzibar-Inhambane lowland rain forest"* and *"Transitional rain forest" sensu* White (1983: 187) occurs along the steep banks of the Ruo River on the southern slopes of Mount Mulanje at an elevation of 890 — 962 m and within the *"Swahilian/Maputaland regional transition zone" sensu* Clarke (1998: 61, 62). Both forest types were almost completely destroyed on Mount Mulanje in the past with only 200 ha and 1800 ha remaining (White *et al.* 2001: 62)!

The large liana *Artabotrys monteiroae* Oliv. (Annonaceae) occurs on the type locality and represents a characteristic species for both forest types.

Dominant tree species comprise, *e.g.* the Sub-Afromontane near-endemic *Newtonia buchananii* G.C.C. Gilbert & Boutique (Mimosoideae); the Guineo-Congolian linking *Albizia adianthifolia* W.F.Wight, *Parkia filicoidea* Welw. (Mimosoideae) and *Erythrophleum suaveolens* Brenan (Caesalpinioideae), the Afromontane endemic *Gambeya gorungosana* Liben (Sapotaceae) and the Afromontane near-endemic *Syzygium afromontanum* Byng (Myrtaceae).

Photo by Raymond James Murphy (Nkhorongo, Mzuzu), October 2011.

37.b. The picture represents potential habitats for species of the new genus *Finsterwaldeia* in *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket"* of the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 113) located in remote areas of northeastern Kenya. It is very likely that species of *Finsterwaldeia* occur regularly on and near "inselbergs" of northeastern Kenya as well as on "inselbergs" in the adjacent parts of Somalia and Ethiopia. The picture was taken southeast of the "inselberg" Korondil (elevation range of this hill is 548 — 1.134 m) which is visible in the distance and is viewed from near Buna.

The habitat in the picture is located *ca.* 10 km southeast of Korondil and *ca.* 80 km southwest of Dandu on "Quaternary — Recent Sediments" (Survey of Kenya 1969) and on an elevation of 490 m. Small tree species comprise, *e.g. Acacia brevispica* Harms, *A.bussei* Harms (Mimosoideae) and *Commiphora samharensis* Schweinf. (Burseraceae) that grow on slightly saline sandy clay loam (Kenya Soil Survey 1982).

Korondil Hill with its Granite Outcrops (Survey of Kenya 1969) is located on extensive basalts of the "Demo Dera region" formed by Quaternary volcanics with lava flows on an already significantly tilted end-Tertiary surface (Williams 1978: 62, 63).

Photo by Yvonne de Jong (Nanyuki) and Tom Butynski (Soita Nyiro Conservancy, Kenya), September 2024.

37. a.

b.

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Figures 38.a. — 38.c.

38.a. The picture represents potential habitats for species of *Finsterwaldeia* near "inselbergs" located in *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket"* of the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 110, 113). The picture was taken *ca.* 20 km southwest of the "inselberg" Dandu Hill (visible in the distance to the left), located in one of the hottest and in one of the most remote areas of northeastern Kenya.

Photo by Tom Butynski and Yvonne de Jong, February 2025.

38.b. Potential habitats of various species of *Finsterwaldeia* are located in *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113) and are possibly linked to "inselbergs" of northeastern Kenya. The picture was taken in such a potential habitat located *ca.*10 km southwest of Dandu Hill (elevation range of this hill is 789 — 1.219 m) which is visible in the background. The vegetation in the picture grows on well drained, reddish brown Rhodic Ferrasols including mostly sandy clay loam with transported weathering materials derived from a wide variety of rocks (Kenya Soil Survey 1982).

Photo by Tom Butynski and Yvonne de Jong, February 2025.

38.c. This habitat picture is rare because it represents the very remote holotype locality of the local endemic *Finsterwaldeia danduensis* **sp. nov.** The collecting Site was located somewhere near or adjacent to or on Dandu Hill in the *"Somalia-Masai regional centre of endemism" sensu* White (1983: 112). The hill is located on Precambrian Basement and has impressive Granite Outcrops (Survey of Kenya 1969) that are visible in the picture to the right.

The vegetation types on Dandu Hill as well as in its adjacent area occur on Eutric Regosols with stony, coarse-textured sandy clay loam as well as (young) calcic Cambisols in an area with active geologic erosion (Kenya Soil Survey 1982).

Photo by Tom Butynski and Yvonne de Jong, February 2025.

38. a.

b.

c.

Figures 39.a. — 39.b.

39.a. The habitat of the endemic *Finsterwaldeia danduensis* **sp. nov.** is almost certainly represented by a scattered pattern on and near Dandu Hill where wetter tiny Sites occur in *"East African evergreen and semi-evergreen bushland and thicket" sensu* White (1983: 115). Such potential tiny habitat Sites occur at and near the foot of the dry rocky outcrops (well visible in the picture) located on the slopes as well as at the foot of Dandu Hill.

The vegetation includes species such as *Bullockia pseudosetiflora* Razafim., Lantz & B. Bremer (Rubiaceae), small trees of *Vepris eugeniifolia* I. Verdoorn (Rutaceae), *Dodonaea viscosa* Jacq. subsp. *angustifolia* J.G. West (Sapindaceae) and the evergreen *Euclea racemosa* L. (Ebenaceae). In the shrub layer occur *Grewia penicillata* Chiov. (Malvaceae), *Xerophyta spekei* Baker (Velloziaceae), *Cissus aphyllantha* Gilg (Vitaceae), *cf.* Verdcourt (1993: 38) and *Cadaba farinosa* Forssk. (Capparaceae) with climbers of *Cyphostemma digitatum* Desc. (Vitaceae), *cf.* Verdcourt (1993: 122, 124).

This vegetation type forms an ecotone (*cf.* habitat description of the new genus) and has a transitional nature. The scattered dark cress green coloured trees in the left, centre and in the right of the picture might represent *Platycelyphium voense* Wild (Papilionoideae) and *Euclea racemosa* L. (Ebenaceae).

Photo by Tom Butynski and Yvonne de Jong, February 2025.

39.b. A second possibility for the location of the collecting Site, but less likely, is a holotype locality of *Finsterwaldeia danduensis* **sp. nov.** in *"Somalia-Masai Acacia-Commiphora deciduous bushland and thicket" sensu* White (1983: 113) that occurs above all adjacent to Dandu Hill as well as towards Dandu village.

These habitats include, *e.g. Acacia brevispica* Harms, *A.bussei* Harms (Mimosoideae), *Commiphora rostrata* Engl. var. *reflexa* Gillett (Gillett 1991: 15), *C. confusa* Vollesen, *C. samharensis* Schweinf. (included in this species is at present *C. danduensis* Gillett/ Burseraceae) with shrubs of *Croton somalensis* Pax (Euphorbiaceae), *Harmsia sidoides* K. Schum. (Malvaceae) and small trees and shrubs of the rare *Dalbergia eremicola* Polhill (Papilionoideae).

The dominance of the shallow-rooted *Commiphora* trees represent a dense bushland in the left and centre of the picture that indicates an absence of herds of larger mammals since these trees would easily be pushed over.

Photo by Tom Butynski and Yvonne de Jong, February 2025.

39. a.

b.