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Iolaus freyaallanae sp. nov. (Papilionoidea: Lycaenidae: Theclinae) – a new species from Zambia in the genus *Iolaus* Hübner, [1819], subgenus *Iolaphilus* Stempffer & Bennett, 1958

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Abstract: A new species, *Iolaus freyaallanae* sp. nov. in the subgenus *Iolaphilus* Stempffer & Bennett, 1958 is described from forests in north-western Zambia. Its general appearance suggests, and examination of male and female genitalia confirms, a close relationship with *I. gabunica* Riley, 1928 and *I. liberiana* Sáfián, 2017. For easier navigation between them and other *Iolaus* species with similar facies, the *I. gabunica* species group is proposed.

Key words: taxonomy, *Iolaus gabunica* species group, *Iolaus gabunica gabunica* Riley, 1928, *I. gabunica mbami* (Libert, 1993), *I. liberiana* Sáfián, 2017, genitalia morphology
Citation: *Iolaus freyaallanae* sp. nov. (Papilionoidea: Lycaenidae: Theclinae) – a new species from Zambia in the genus *Iolaus* Hübner, [1819], subgenus *Iolaphilus* Stempffer & Bennett, 1958. *Metamorphosis* **33**: 72–78.
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INTRODUCTION

Iolaus gabunica (Riley, 1928) was described on the basis of a single male collected in Gabon (as Gaboon in Riley 1928). The species has since been recorded from Cameroon, Central African Republic, Uganda, Kenya and mentioned from Zambia (Stempffer & Bennett 1958, Larsen 1991, Heath *et al.* 2002, Williams 2022, https://abdb-africa.org/species/iolaus_gabunica). More recently, a subspecies from the Cameroon Highlands was recognised and described as *Iolaphilus gabunica mbami* Libert, 1993 (Libert 1993). Examination of *Iolaus* material in the African Butterfly Research Institute, Nairobi revealed that three specimens bred and collected in north-western Zambia and previously identified as *I. gabunica* differ from the Central African populations in the blue colour of both sexes, and both male and female genitalia also show differences. The special geographic position of the Zambian populations in the outlier rainforest stretches in peat-bedded gullies and dry *Cryptosepalum* forest in the forest-woodland transition zone (Heath *et al.* 2002), these differences indicate that the taxon is distinct from *I. gabunica* and is described below. The similarities in male and female genitalia structure between the new taxon, *I. gabunica* and *I. liberiana* Sáfián, 2017 allow for the establishment of the *Iolaus gabunica* species group.

METHODS AND MATERIALS

Acronyms and abbreviations

ABRI – African Butterfly Research Institute, Nairobi, Kenya

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ANHRT – African Natural History Research Trust, Leominster, UK
CAR – Central African Republic
CEP-MZUJ – Nature Education Centre, Jagiellonian University, Kraków, Poland
DRC – Democratic Republic of the Congo
ENNR – East Nimba Nature Reserve, Liberia

Genitalia dissection, wing venation and digital processing of images

Genitalia of all specimens were dissected at CEP-MZUJ using the methodology described in Sáfián *et al.* (2022). References to wing venation follow the simplified "English" or numerical system (Miller 1970), which is also used in other modern works on African butterflies (e.g. Larsen 1991, 2005) The digital images and colour plates were edited in various versions of Adobe Photoshop photo editor and Adobe InDesign layout and page-design software.

Comparative material examined

Iolaus gabunica gabunica Riley, 1928

Holotype (GABON) in the original description (Riley, 1928)
1♂ Non-specified, with genitalia illustration (Stempffer & Bennett, 1958).
1♂ CAR, Yakoli, i.1999. ABRI Leg. Gen. prep.: SAFI00355. Unique number: ABRI-2019-3057
1♀ CAR, Batalimo, i.1997. ABRI Leg. Gen. prep.: SAFI00356. Unique number: ABRI-2019-3058
45♂♂, 24♀♀ CAR, Bangui (Yakoli). 1977. Leg.: S.C. Collins.
3♂♂ CONGO, Ouesso 1/84. Leg.: S.C. Collins. Deposited in the ABRI collection.

Iolaus gabunica mbami (Libert, 1993)

Holotype and female allotype (CAMEROON, Mbam) in the original description (Libert, 1993).
6♂♂, 3♀♀ CAMEROON, Tabenkem (Mount Tabenken). ABRI coll. Deposited in the ABRI collection.

Iolaus liberiana Sáfián, 2017

Holotype (LIBERIA, Nimba Mountains), illustrated also in Figs 2C,F; 3C; 4C; 5C, also illustrated in Sáfián (2017), in Figs 3A,D; 4A,D: 1♂ LIBERIA, Nimba Mountains, Camp, ENNR, Nimba County, 03-13.xii.2017, Leg. Aristophanous, M., Sáfián, Sz., Simonics, G., Smith, L. (gen. det.). Gen. prep.: SAFI00395; Unique number: ANHRTUK00037755. Deposited in the ANHRT collection.

Iolaus alexanderi Warren-Gash, 2000

♂ Holotype, IVORY COAST (COTE D'IVOIRE), Tai Forest, 13.v.2000 Leg.: H. Warren-Gash. ILI 00/3, ABRI-2019-3056.

RESULTS

DESCRIPTION OF NEW SPECIES GROUP

Genus *Iolaus* Hübner, [1819]
Verzeichniss bekannter Schmetterlinge: 81.
Type-species: *Papilio eurisus* Cramer, by subsequent designation.

Subgenus *Iolaphilus* Stempffer & Bennett, 1958
Bulletin de l'Institut Français d'Afrique Noire (A) **20**: 1298. Type-species: *Iolaus menas* Druce, by original designation.

The *Iolaus gabunica* species group

A group of medium-sized *Iolaus*, tentatively placed in the subgenus *Iolaphilus*, with unique genitalia, having narrow valvae with a lanceolate tip, characteristic Y-shaped fultura inferior and a small protrusion dorsally at approximately halfway on the straight and lanceolate aedeagus (Fig. 1). Males of all species have a uniformly black, circular androconial patch on the hindwing upperside, some with a larger black or dark grey outer ring. The androconial hair-tuft on the forewing underside is also black. All species recognised in the group are known to occur in forests, including lowland rainforest, submontane and riverine forests. It is proposed here that they collectively belong to the *Iolaus gabunica* species group, with the following members:

Iolaus gabunica gabunica (Riley, 1928)
Iolaus gabunica mbami (Libert, 1993)
Iolaus freyaallanae sp. nov.
Iolaus liberiana Sáfián, 2017

Note: *Iolaus alexanderi* and *I. liberiana* are very similar in appearance and could be conspecific. However, the fultura inferior of the holotype of *I. alexanderi* illustrated in Larsen (2005) carries features, namely the lobes on both sides of the stem of the fultura laterally that are missing from the two dissected *I. liberiana* males. Unfortunately, the genitalia of the holotype of *I. alexanderi* were not found in the ABRI collection, and their status will therefore remain uncertain until further material becomes available.

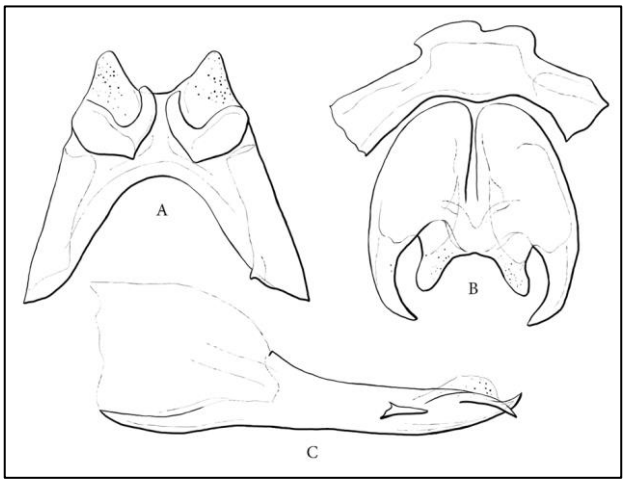

Figure 1 – Male genitalia of *Iolaus gabunica*, re-drawn from Stempffer & Bennett's original (1958): uncus, subunci and tegumen – A; valvae and fultura inferior – B (note that from the ventral view the valvae and fultura – misleadingly – look fused, on Fig. 4B the separate valvae and fultura – fused only at the base – are clearly visible); aedeagus – C.

The *I. gabunica* species group might have affinities with *I. menas* Druce, 1890 and related species, but members of this latter, as yet undefined group, have rather different genitalia.

DESCRIPTION OF NEW SPECIES

***Iolaus freyaallanae* sp. nov.** (Figs: 2A,D; 3A,D; 4A; 5A; 6A, D; 7A,C; 8)
urn:lsid:zoobank.org:act:A1D4907D-F5A8-4908-B47C-5EB6077DD19E

Type material: Holotype ♂: ZAMBIA, Chiwoma (Chiwomo) Forest, 31.v.1999. Leg.: T.C.E. Congdon. Deposited in ABRI.
Paratypes 1♀ ZAMBIA, Chiwoma (Chiwomo) Forest, V.1999. Leg.: T.C.E. Congdon; 1♀ ZAMBIA, Zambezi B(ridge) R(apids), Ikelenge (bred). 24.xi.1981. ABRI Leg. ABRI-2019-3060. Deposited in ABRI.

Note: the holotype appears also in Heath *et al.* (2002). The digital image on the supplementary compact disc for the book was mirrored horizontally and thus the characteristic linear wing damage across the discal cell on the forewing upperside (Fig. 2A) appears there on the right wing.

Male facies (Figs 2A, D): Forewing length: 17 mm. Wingspan: 31 mm. General appearance as males of other species in the sub-genera *Philiolaus* and *Iolaphilus* with black ground colour overlaid by extensive iridescent blue on upperside, and dirty white underside with black and orange sub-marginal lines and two tails at the tip of veins 1 and 2 and a vestigial one at the tip of vein 3 on the hindwing. Blue colour of azure light blue, with no greenish or silverish tinge. Approximately half of forewing covered with blue, also along black costa, which gradually turns grey and silvery basally. Black outer margin narrows down to 1 mm in space 1b, broadening slightly towards tornus. The outer edge of blue area prominently lobed in space 1b, slightly in spaces 2, 3. Majority of hindwing covered with blue, except whitish-grey space 1a, along grey costa and the black margin, which tapers down from approximately 1 mm at apex to a fine black marginal line between veins 1-5. Androconia grey, rather circular, small,

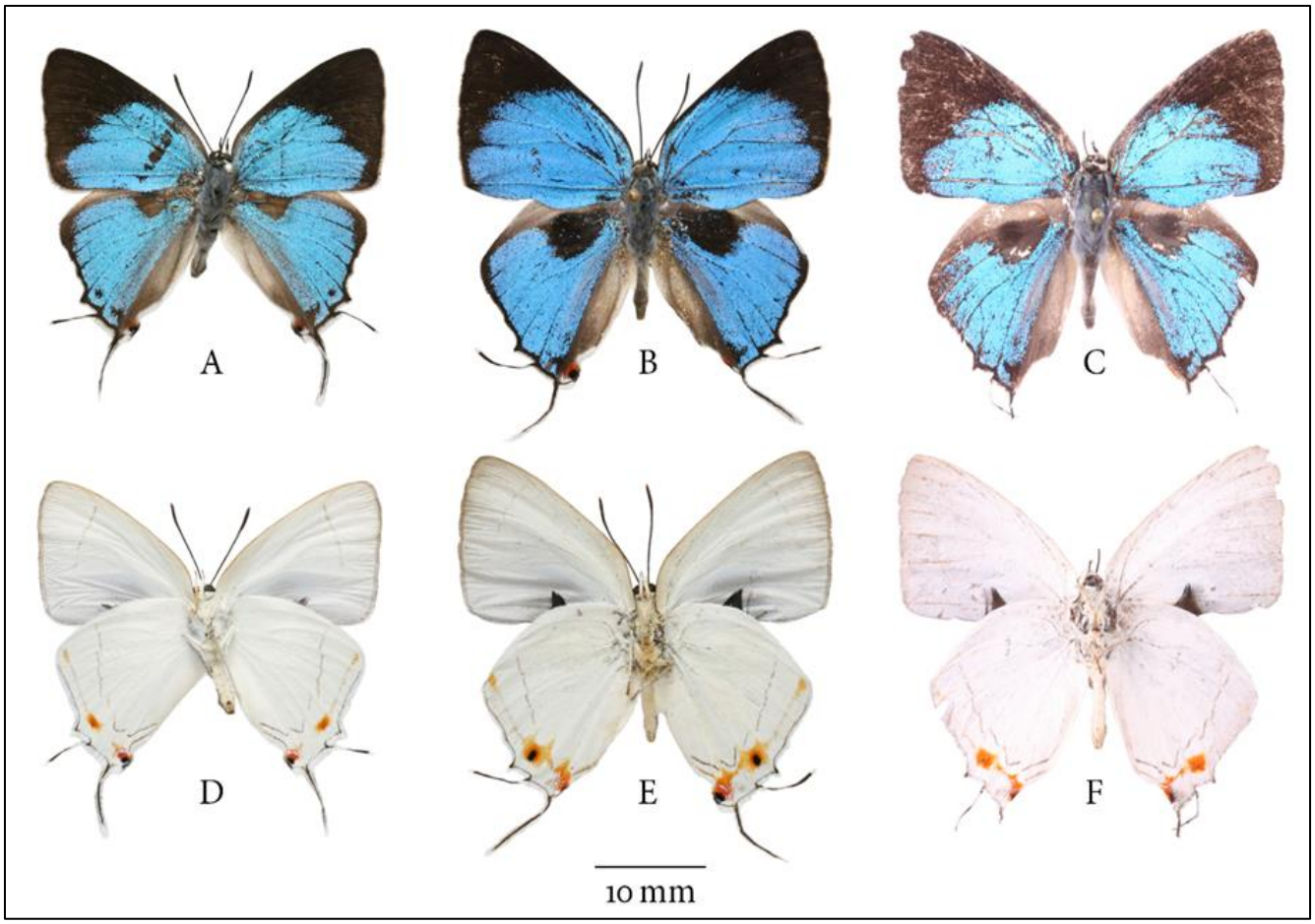

Figure 2 – Males: *Iolaus freyaallanae* (holotype) upperside – A, underside – D; *I. gabunica gabunica* (CAR) upperside – B, underside – E; *I. liberiana* (holotype) upperside – C, underside – F.

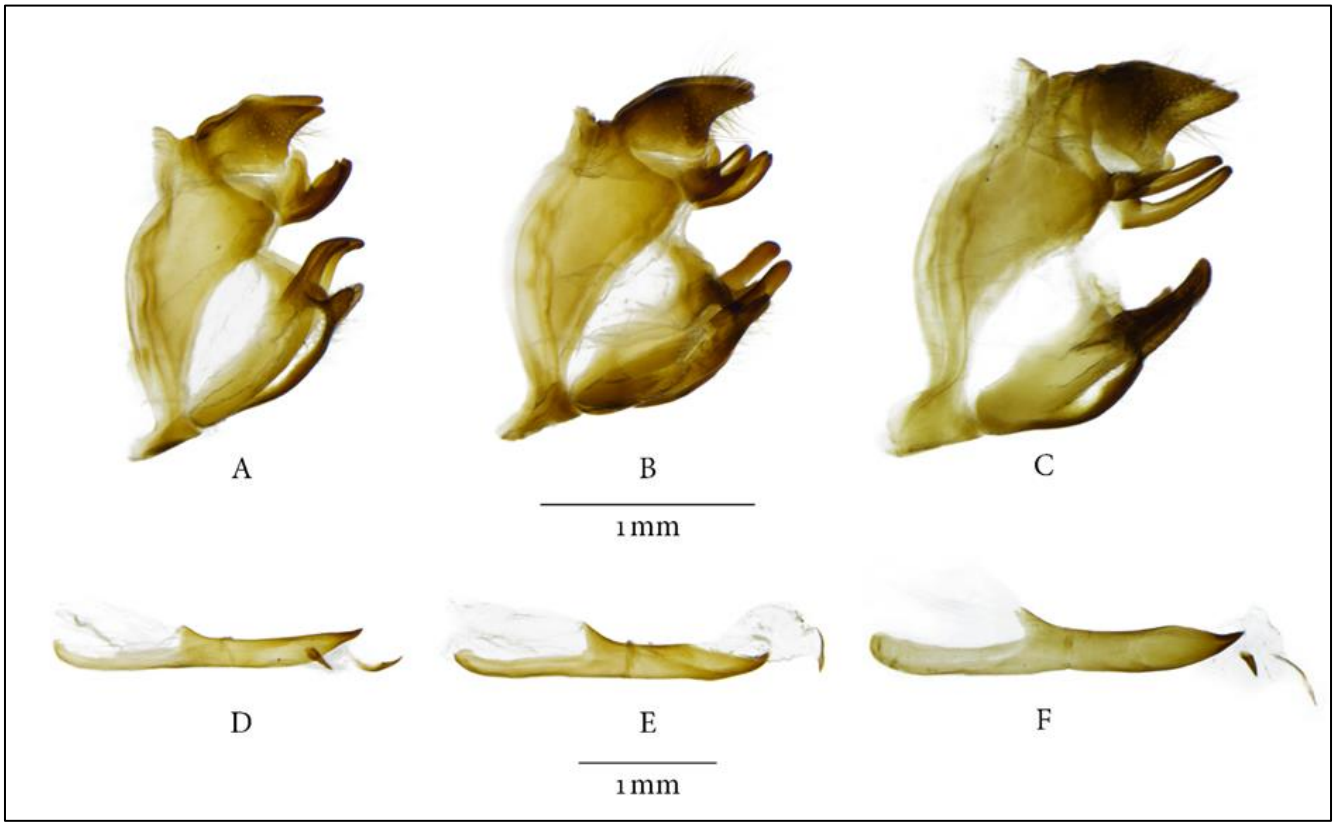

Figure 3 – Male genitalia and aedeagi (lateral view): *Iolaus freyaallanae* (holotype) – A, D; *I. gabunica gabunica* (CAR) – B, E; *I. liberiana* (holotype) – C, F.

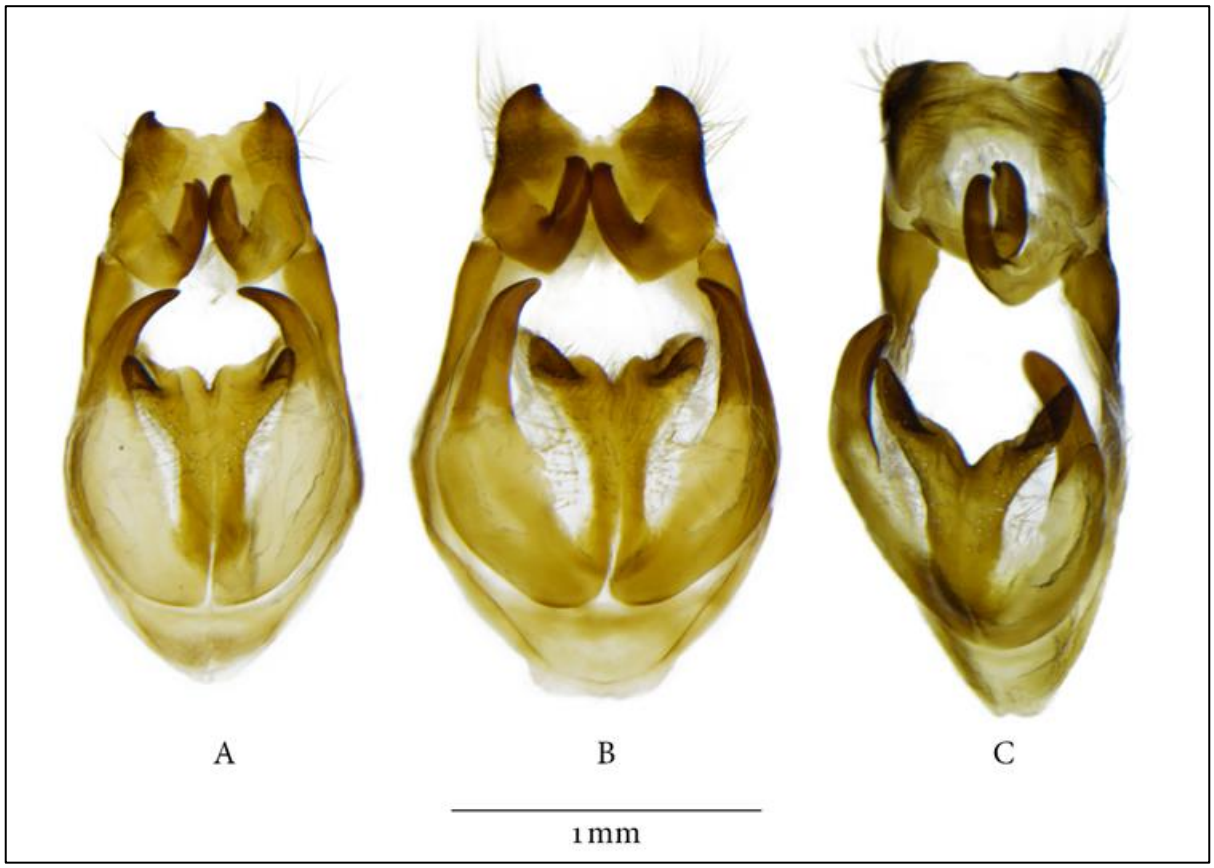

Figure 4 – Male genitalia (posterior view): *Iolaus freyaallanae* (holotype) – A; *I. gabunica* (CAR) – B; *I. liberiana* (holotype) – C.

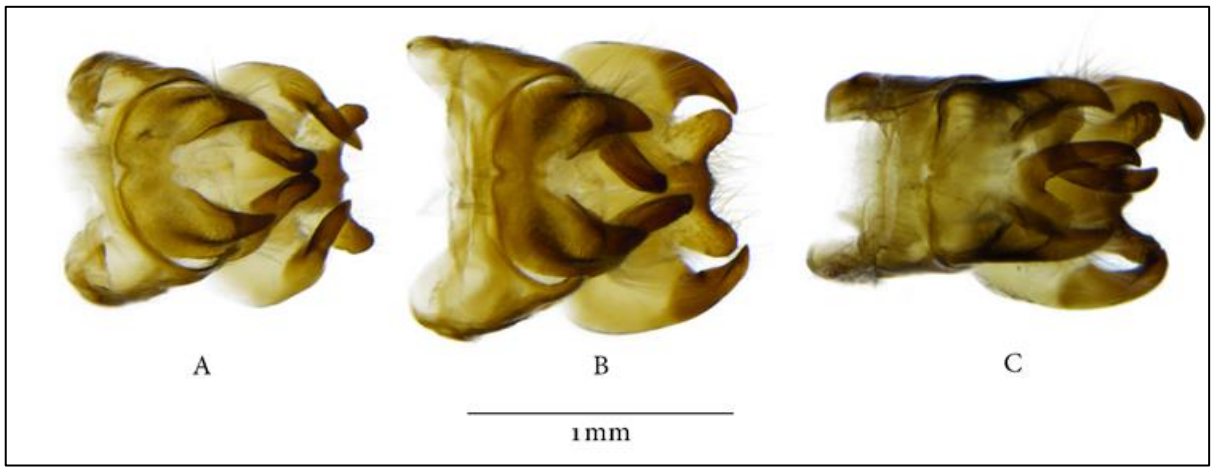

Figure 5 – Male genitalia (dorsal view): *Iolaus freyaallanae* (holotype) – A; *I. gabunica* (CAR) – B; *I. liberiana* (holotype) – C.

with diameter approximately 3 mm. Tornal lobe half black, half claret-red, with white edges basally and along margin. Brown tornal spot in space 1b and small subtornal circular black spot in space 2 present. Underside white, with slightly darker orangish tinge along forewing costa, costal line faint, light orangish-tan. Forewing with faint, almost straight greyish postmedian line between veins 2 and 7 that remains away from margin. Forewing androconial hairtuft dark grey. On hindwing, a weak, grey inner submarginal line strongly remains away from outer margin, reaching costa 4 mm from apex. Outer sub-marginal line broad but rather pale, orangish-grey, orange at apex. Tornal spot at the end of space 1a largely red, black near margin with light incomplete silvery blue edge. That in space 2 bright orange, very loosely connected to apex through sub-marginal line. Tails black with white edge. Fringes (cilia) short along outer margin of forewing, on upperside grey, longer, grey along inner edge. Fringes grey on hindwing outer margin, replaced by longer whitish hairs along inner margin. Fringes grey on forewing underside, white on hindwing. Head, thorax and abdomen black with long, silvery-grey hairs on upperside, covered by white hairs on thorax underneath, abdomen with slight yellowish overlay. Palpi black on top, white below, longer than twice the diameter of eyes. Eyes glabrous, black. Antennae black, speckled with tiny white dots underneath, only slightly thickened towards chocolate brown apex; their length shorter than half of forewing.

Male genitalia (Figs 3A, D; 4A, 5A): Uncus bi-lobed with sphenoid tips, triangular in lateral view, with slightly angled dorsally. Subunci short and broad, sharply bent

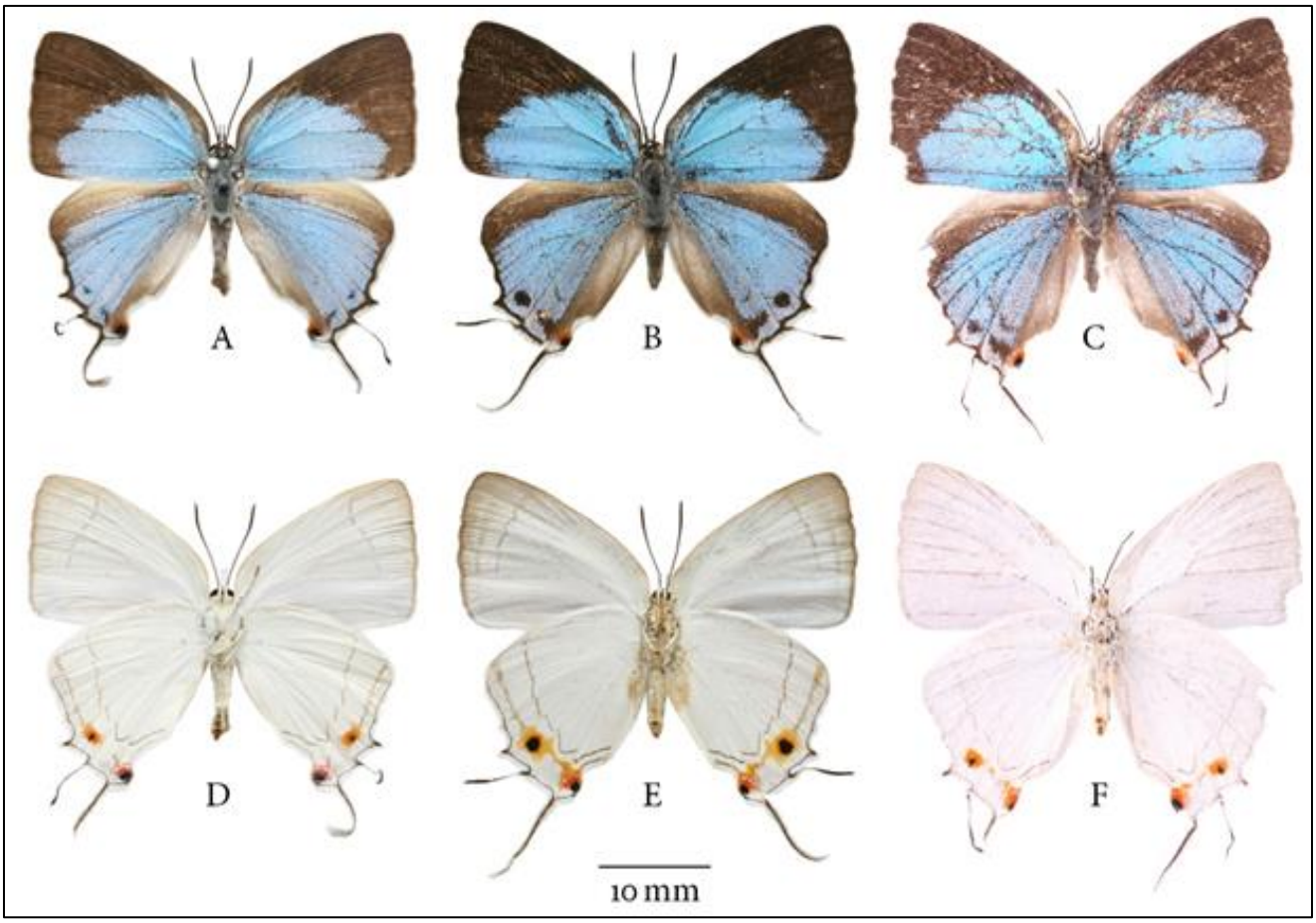

Figure 6 – Females: *Iolaus freyaallanae* (paratype) upperside – A, underside – D; *I. gabunica* (CAR) upperside – B, underside – E; *I. liberiana* (paratype, Liberia, Nimba Mountains) upperside – C, underside – F.

upwards with rather blunt tip. Valvae narrow and lanceolate, slightly curved dorsally, with a more strongly sclerotised down curved lanceolate tip in lateral view, which turn inward as claws in posterior view. Fultura inferior well-developed, Y-shaped with broad stem, two strongly sclerotised tips and a V-shaped incision in the fork, with an unusual protrusion dorsally, which superficially looks like part of the valva on the lateral view.

Female facies (Figs 6A, D): Forewing length: 18.5 mm. Wingspan: 35 mm. General appearance as for males of other species in the sub-genera *Philiolaus* and *Iolaphilus*, with black ground colour overlaid by extensive blue on upperside, and dirty white underside with black sub-marginal lines and two tails at the tip of veins 1 and 2 and a vestigial one at the tip of vein 3 on the hindwing. Blue colour of whitish light blue, with no greenish tinge. Slightly less than basal half of forewing covered with blue. Black outer margin broad, narrows to only 2 mm in space 1b, broadening again towards tornus. The outer edge of blue area visibly lobed in space 1b, otherwise rather even, with diffuse blue scaling along the edge. Majority of hindwing covered with blue between veins 1 and 6 (also with diffuse blue scaling in space 6), except whitish-grey space 1a, along grey costa and black apex and fine black marginal line. Tornal lobe half black, half claret-red, with whitish-blue along margin. Black tornal spot/streak in space 1b and small circular black spot in space 2 present. Underside white, with light brown tinge in forewing apex. Forewing submarginal line faint, light tan, strongly bent inwards in space 4. On hindwing, a weak, serrate, grey inner sub-marginal line close to outer margin, reaching costa 4 mm from apex. Outer sub-marginal line broader but rather pale, orangish-brown, more orange at apex. Tornal spot at the end of space 1a half red, half black with pale, incomplete silvery blue edge. That in space 2 bright orange with black centre, connected to apex through sub-marginal line. Tails black with white edge. Fringes (cilia) short along outer margin of forewing, on upperside dark brown-black, longer, grey along inner edge. Fringes on hindwing outer margin whitish, replaced by longer whitish hairs along inner margin. Fringes light brown on forewing underside, white on hindwing. Head, thorax and abdomen black with long, silvery-grey hairs on upperside, covered by white hairs on thorax underneath, abdomen with slight yellowish overlay. Palpi black on top, white below, longer than twice the diameter of eyes. Eyes glabrous, black. Antennae black, speckled with tiny white dots underneath, only slightly thickened towards chocolate-brown apex. Their length shorter than half of forewing.

Female genitalia (Figs 7A, C): Papillae analis slightly hairy, relatively small (<1 mm laterally) and slender, with unique lobed protrusion dorsally. Apophyses posterior straight, 1 mm long. Lamella antevaginalis strongly sclerotized, discoid in ventral view, 1 mm broad laterally with two small, rounded lobes posteriorly, which are edges of two transverse backfolding sub-lamellae longitudinally. Mouth of ductus bursae (antrum) slightly sclerotized, membranous elsewhere. Its length equal to that of oval bursa copulatrix. Two small signa on bursa also present.

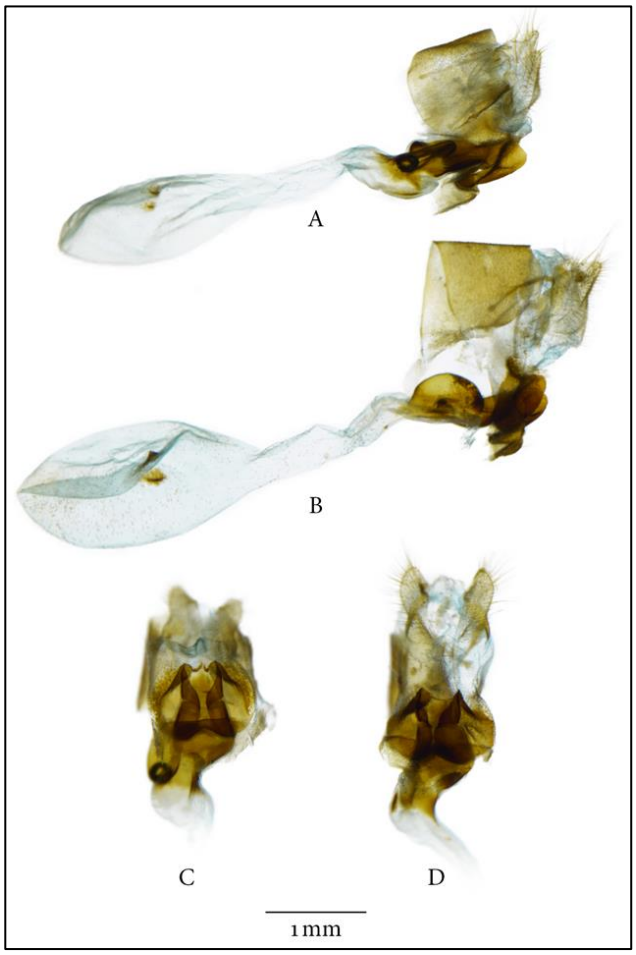

Figure 7 – Female genitalia: *Iolaus freyaallanae* lateral view – A, lamella antevaginalis and papillae analis dorsal view - C; *I. gabunica* lateral view – B; lamella antevaginalis and papillae analis ventral view – D.

Diagnosis

The size of the androconial patch and its outer ring in the male of *I. freyaallanae* sp. nov. is very small (Fig. 2A), similar to those of *I. gabunica mbami* (teste Libert 1993), compared to the very prominent black androconia in *I. gabunica gabunica* (Fig. 2B).

Male genitalia also show differences especially in the shape of valva, which is slightly broader with straight tip in *I. gabunica gabunica*, best viewed in lateral view (Fig. 3B), while the valva is slightly more slender with downcurved and more acute tip in *I. freyaallanae* sp. nov., best viewed in lateral and posterior views (Figs 3A; 4A). They also show differences in the uncus, the dorsal edge of which is evenly curved in *I. gabunica* and is slightly angled in *I. freyaallanae* sp. nov. In the female genitalia, the lamella antevaginalis is broader in *I. gabunica gabunica*, with more serrate edge posteriorly, while the posterior edge of the lamella is more rounded in *I. freyaallanae* sp. nov.

Etymology: The species is named in honour of Miss Freya Allan, the British actress, who stars as Princess Cirilla Fiona Ellen Rianon – 'Ciri' in the internationally successful Netflix series 'The Witcher': also featured in the action comedy 'Gunpowder Milkshake' and HBO Max's 'The Third Day'.

DISCUSSION

This area of north-western Zambia and north-eastern Angola and the adjacent southern area of the DRC is biogeographically very interesting as many Congolian forest butterflies reach their southern limit here. There are also a number of endemic taxa, which inhabit either the narrow stretches of the peat-bedded riverine rainforest in the numerous valleys and deeper gullies, the surrounding closed-canopy miombo woodland or the unique and very restricted *Cryptosepalum* forest habitats. Recently, another *Iolaus* species, *I. ivani* Sáfián & Collins (in review), previously believed to be conspecific with *I. aequatorialis* Stempffer & Bennett, 1958 was recognised from the same area, while other Lycaenidae e.g. *Teratoneura zambiae* Sáfián & Collins, 2008, *Iridana euprepes* (Druce, 1905) (Gardiner 2010, Sáfián & Collins 2014) are also distributed narrowly in this forest-woodland and savannah transition zone, corresponding well with the biogeographic position of *I. freyaallanae* sp. nov.

Biogeography of the *I. gabunica* species group

I. gabunica is a rather widely distributed species in the lowland rainforests of the Congolian forest zone (although it has not been recorded in Equatorial Guinea and the DRC, where it most probably occurs), with outlier populations in Uganda and Kenya (Kakamega Forest), and a distinct subspecies, *I. gabunica mbami* in the Gulf of Guinea Highlands, Cameroon, described and known only from the Mbam Massif and Mount Tabenken. Another outlier population is now described as *I. freyaallanae* sp. nov. from the mid-altitude forest-woodland transition zone in north-western Zambia, and an Upper Guinean taxon *I. liberiana* is recognized from Liberia and Guinea (which could be conspecific with *I. alexanderi*) (Fig. 8). The taxonomic status of the Ugandan and western Kenyan populations and ssp. *mbami* has not yet been assessed.

ACKNOWLEDGEMENTS

Without the help of Steve C. Collins, director of ABRI and many ABRI collaborators, who were involved in the collecting and rearing of numerous *Iolaus* taxa, namely Colin Congdon, Ivan Bampton†, Peter Walwanda and Martin Hassan, this revision of the *Iolaus gabunica* species group would not have been possible. The author is grateful to Jadwiga Lorenc-Brudecka and Klaudia Florczyk (CEP-MZUJ) who dissected and photographed several genitalia used in the paper. Renátó Molnár (Biatorbágy, Hungary) kindly helped with editing the plates and the map. Mark Williams (Pretoria, South Africa) kindly proofread the manuscript.

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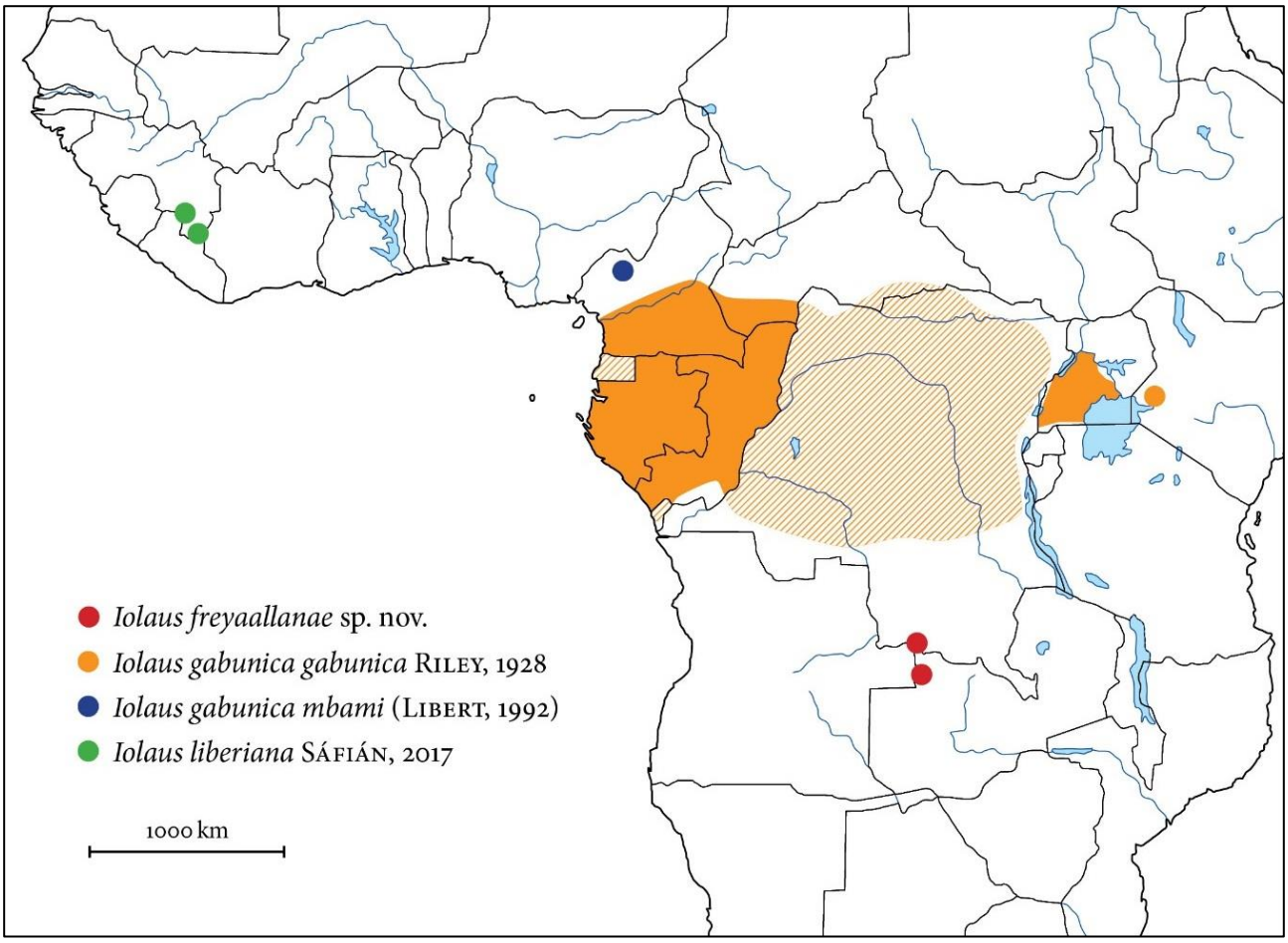

Figure 8 – Projected distribution of *I. gabunica gabunica* (there are no records from the striped areas in Equatorial Guinea and in the DRC) and confirmed occurrences of other members of the *I. gabunica* species group.

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